

Business Model Transformation for the International Division of a Fortune 100 High Technology Company

by

Reza Mokhtari-Dizaji

Submitted to the System Design and Management Program
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Management

at the

Massachusetts Institute of Technology

January 2008


[February 2008]

© 2008 Reza Mokhtari-Dizaji


All rights reserved

The author hereby grants to MIT permission to reproduce and to
distribute publicly paper and electronic copies of this thesis document in whole or in part.

Signature of Author _____


Reza Mokhtari-Dizaji
System Design and Management Program
January, 2008

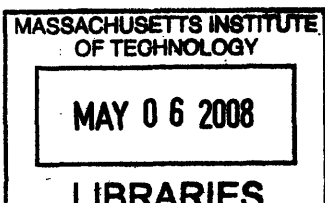
Certified by _____

 Deborah Nightingale
Thesis Supervisor
Professor, Dept. of Aeronautics & Astronautics and Engineering Systems Division

Accepted by _____

 Patrick Hale
Director

Systems Design & Management Program, Massachusetts Institute of Technology



ARCHIVES

Business Model Transformation for the International Division of a Fortune 100 Company

By
Reza Mokhtari-Dizaji

Submitted to the System Design and Management Program
on January 2008 in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Management

Abstract

Raytheon Canada in Waterloo, Ontario offers a very interesting but challenging research case. As one of the international divisions of Raytheon Corporation, the company has a business model similar to its parent company. The company however is facing new trends in its business environment which have characteristics different than those of its parent company. The main focus of this thesis is to identify the key missing elements in the company's current business model and propose solutions in order to assist the company to adopt the best strategy to successfully operate in this evolving market.

The company's interactions with the rest of Raytheon are limited due to the recent tightening of ITAR regulations. Although the company's organization structure is still tightly integrated to the rest of Raytheon, Raytheon US restricts the company's access to the best practice from the rest of the corporation in US. Another interesting observation relates to the company's two major product lines. ATM, Raytheon Canada's legacy product line is being disrupted by the recent arrival of ADS-B technology. This new technology has the potential of providing a major threat to company's sustainability. At the same time Raytheon Canada is introducing HFSWR, which is a disruptive technology, to maritime surveillance market. The company is facing the challenges of commercializing this breakthrough technology to a highly regulated and fragmented market. Raytheon Canada needs to operate in this complex business environment. This makes the company a remarkable research case for analyzing its current business model and ways to improve it through integrating the latest business knowledge from both industry and academia.

The goal of the thesis is to assist Raytheon Canada to transform its business model by determining the key characteristics of its future business model through detailed assessment of the company's current business model and study of the enterprise future business environment. This is obtained by studying the market research data, the strategic goals of parent company, trends in the technology and product landscape, and the customer behavior. Solutions are proposed for developing a realistic roadmap to transform the current business model of the company to address the future business environment challenges.

Thesis Supervisor: Deborah Nightingale

Title: Professor of Aeronautics & Astronautics and Engineering Systems Division

Business Model Transformation for the International Division of a Fortune 100 Company

TABLE OF CONTENTS

| | |
|---|----|
| Abstract----- | 3 |
| List of Tables----- | 8 |
| List of Figures----- | 9 |
| Acknowledgements----- | 11 |
| Biography----- | 11 |
| | |
| Chapter 1 – Introduction----- | 12 |
| Objective----- | 13 |
| Thesis Approach----- | 13 |
| | |
| Chapter 2 – Infrastructure & Value Offerings----- | 19 |
| Introduction----- | 20 |
| Products and Services----- | 21 |
| Air Traffic Management Systems----- | 21 |
| Integrated Maritime Surveillance System----- | 23 |
| Marine Small Target Tracker----- | 24 |
| Diverse Capabilities----- | 25 |
| Manufacturing----- | 25 |
| Organization Structure----- | 25 |
| Company’s Matrix Organization Characteristics----- | 28 |
| Reporting hierarchy----- | 30 |
| Standardized Processes----- | 30 |
| Decision Making Process----- | 32 |
| General Challenges----- | 34 |
| Unique Challenges to Raytheon Canada----- | 34 |
| Transformation Management Process----- | 35 |
| The Capability Maturity Model Integration----- | 35 |
| The International Traffic in Arms Regulations and its Impact on the Enterprise----- | 36 |
| How ITAR Affects Canadian Defense Industries? ----- | 36 |
| ITAR and its Impact on Raytheon Canada----- | 38 |
| | |
| Chapter 3 – Financial Data, Customers, and Market----- | 39 |
| Introduction----- | 40 |
| Financial Performance----- | 40 |
| Booking, Sales, and Profit----- | 40 |
| Working Capital----- | 41 |
| Customers & Market----- | 43 |
| Customers Types----- | 43 |
| Customer Need Response----- | 44 |
| Market Characteristics ----- | 45 |
| Market Share----- | 46 |
| Other Stakeholders----- | 49 |
| Employees----- | 49 |
| Community----- | 50 |

| | |
|---|-----|
| Suppliers and subcontractors----- | 50 |
| Chapter 4 – Execution & Risks----- | 51 |
| Introduction----- | 52 |
| Business Model Execution----- | 52 |
| Pull vs. Push based Business Model----- | 54 |
| Risks in the Business Model----- | 56 |
| Chapter 5 –Characteristics of Enterprise Future Business Environment----- | 61 |
| Introduction----- | 62 |
| Future Market Characteristics----- | 63 |
| Booking Type----- | 63 |
| Contract Type----- | 64 |
| Customers----- | 66 |
| Future Product and Technology Landscape----- | 67 |
| Chapter 6 – Transformation to New Business Environment----- | 71 |
| Introduction----- | 72 |
| Transformation to New Market----- | 72 |
| Booking and Contract Types----- | 72 |
| Customers----- | 74 |
| Transformation to New Technology and Product Landscape----- | 76 |
| Culture Transformation in the Enterprise----- | 77 |
| Culture Change and Incentive Plans----- | 80 |
| An Overview of Incentive Plans----- | 81 |
| Incentives based on Accounting Measures----- | 81 |
| The Balanced Scorecard----- | 82 |
| Recommendations for an Effective Incentive Plan for the Enterprise----- | 83 |
| Chapter 7 – Disruptive Technology Management----- | 85 |
| Introduction----- | 86 |
| Disruptive Technology Management----- | 86 |
| Christensen disruptive technology model----- | 87 |
| Product Lifecycle Analysis----- | 89 |
| ADS-B, A Disruptive Technology in ATM Market----- | 93 |
| HFSWR, A Disruptive Technology in Maritime Surveillance Market----- | 95 |
| Chapter 8– Organization for Innovation----- | 101 |
| Introduction----- | 102 |
| Challenges of Making an Enterprise Innovative----- | 102 |
| Overview of Ambidextrous Organization----- | 104 |
| Pseudo Ambidextrous Organization for Raytheon Canada----- | 105 |
| Chapter 9– Pricing Strategy----- | 108 |
| Introduction----- | 109 |
| Overview of Different Pricing Strategies----- | 109 |
| Cost based Pricing----- | 110 |

| | |
|--|-----|
| Customer based Pricing----- | 110 |
| Competition based Pricing----- | 111 |
| Economy Value based Pricing----- | 111 |
| Dynamic of Pricing in Different Product Life Cycle Stages----- | 114 |
| A Pricing Strategy for Raytheon Canada----- | 116 |
| | |
| Chapter 10 – Conclusion----- | 118 |
| | |
| References----- | 123 |

LIST OF TABLES

Table 3.1 Market shares of major suppliers of ATC surveillance equipment

Table 7.1 Characteristics of the product environment along its life cycle

LIST OF FIGURES

- Fig. 2.1 Global sales of radar system by Raytheon Canada
- Fig. 2.2 Raytheon's ASR-10SS Radar System
- Fig. 2.3 Raytheon's High Frequency Surface Wave Radar System
- Fig. 2.4 Raytheon's Marine small Target Tracker System
- Fig. 2.5 High level organizational structure
- Fig. 2.6 Raytheon's Integrated Product Development System
- Fig. 3.1 Raytheon Canada products and systems sales
- Fig. 3.2 Enterprise profit and WC
- Fig. 3.3 Customer listening and action in Raytheon Canada
- Fig. 3.4 Raytheon Waterloo headcounts in last 8 years
- Fig. 4.1 Exchange rate for last five years
- Fig. 5.1 Trend of booking type
- Fig. 5.2 Trend in contract type
- Fig. 5.3 Trend of customer combination
- Fig. 5.4 International sales based on the targeting countries
- Fig. 5.5 Trend of product portfolio combination
- Fig. 7.1 Christensen curves for customer and technology needs
- Fig. 7.2 S-curve shape evolution of products
- Fig. 7.3 Customer segmentation methodology introduced by Moore showing a chasm between early stage market and main stream market
- Fig. 7.4 a surge in new product/service demand among tech enthusiasts and visionaries
- Fig. 7.5 ADS-B Schematic
- Fig. 7.6 ADS-B technology development stage
- Fig. 7.7 US deep water schematic
- Fig. 7.8 a comparison of HFSWR coverage and typical marine microwave radar
- Fig. 7.9 Comparison of cost saving benefits by using HFSWR
- Fig. 7.10 HFSWR technology development stage
- Fig. 9.1 Cost based pricing strategy
- Fig. 9.2 Customer based pricing strategy
- Fig. 9.3 Competition based pricing strategy

Fig. 9.4 EVC based price determination

Fig. 9.5 Dynamic of pricing in terms of sales volume, cost, and the price of a product

ACKNOWLEDGEMENTS

I would like to express my gratitude to all those who gave me the possibility to complete this thesis. I want to thank Raytheon Canada for giving me permission to commence this thesis in the first instance, to do the necessary research work and to have access to non confidential company data. I have furthermore to thank those in senior management of Raytheon Canada, especially Mr. John Alsop and Mr. Tom Pidgeon who spent several hours with me answering my questions.

I am deeply thankful to my supervisor Professor Nightingale from the Massachusetts Institute of Technology whose help, stimulating, and suggestions helped me in writing of this thesis.

Especially, I would like to give my special thanks to my wife Nasim whose relentless encouragement, support and patient love enabled me to complete this work. Lastly, to my daughter Parmis, it was your beautiful smile that brightened my days.

BIOGRAPHY

Reza Dizaji received his M.Sc. in the Systems Design and Management Program from Massachusetts Institute of Technology in 2007. He was also a cross registered at Harvard Business School in 2006-2007 academic year. Along with his study at MIT, he was also working at Harvard Business School with another appointment with Advanced Institute of Management Research in UK as a research associate where his work focused on the product development strategy and industry evolution.

Reza has a PhD in Electrical Engineering from Canada (a nominee for the best thesis award in Canada, 2000). Before enrolling in MIT, he was with the New Venture Group of Raytheon as a team leader for innovative product development. With five US/international patents, he received several awards from Raytheon for engineering excellence and leadership.

Chapter One

Introduction

1. Objective

Raytheon Canada in Waterloo, Ontario is a subsidiary of Airspace Management and Homeland Security (AMHS) division of Raytheon. This facility is the centre of excellence in the fields of solid-state Air Traffic Control primary surveillance radars and High Frequency Surface Wave Radar (HFSWR) technology.

The company is known for its global market leadership position in manufacturing superior technologies and products in the air traffic management systems. The company however is expecting to face some serious challenges in keeping its market leadership position due to the changes in the characteristics of its future business environment. Raytheon Canada is seeking ways to keep its market leadership position through identifying the key missing elements of its current business model in order to successfully pass through this changing business environment.

The goal of this thesis is to provide Raytheon Canada with the key strategic suggestions for inclusion in its current business model. These suggestions are made based on the detailed assessment of company's current business model and the study of the enterprise future business environment obtained by integrating the market research data, the strategic goals of parent company, the trends in the technology and product landscapes, and the customer behavior.

2. Thesis Approach

The business model as defined by Ostewalder et al. [1] consists of a large set of inter-related elements that allows expressing the business logic of the company. To assess the current business model of Raytheon Canada and identify its key missing parts we need to analyze and study these inter-related elements and find their strengths and weaknesses in a changing business environment.

These elements include the infrastructure needed to execute the business model, the enterprise offerings including products and services, customers and other stakeholders, and enterprise cost structure and revenue. Through these elements the business model becomes a description of the value it offers to one or several segments of customers and a description of the architecture of the company and its network of partners for creating, marketing, and delivering this value to generate profitable and sustainable revenue.

The first four chapters of this thesis are designed to look at the different elements of company's business model. The infrastructure and value offerings of the company are discussed in chapter two. In this chapter the company's products and services, organization structure, standardized processes, and the regulations surrounding and affecting the business environment of the company are discussed. In each of these areas the company's challenges and also limiting factors are discussed. Specifically we look at the enterprise organization structure, the complex relationship with its parent company and their effects on the enterprise's ability to change its business model. For standardized processes, some evidence about the company's challenges in receiving the best practice from its parent company due to the ITAR (The International Traffic in Arms Regulations) [2] are provided. The impact of evolving new technologies on the main product lines of the enterprise is also discussed.

The financial data, customer types, stakeholder analysis, market share and company's competitors are discussed in the chapter three. For the financial data, the company's historical sales data, bookings, and profits are given in the context of financial goals set by the enterprise parent company. The working capital needed for its product lines is compared against to those of product lines from other subsidiaries of Raytheon. It is shown that the high working capital needed for Raytheon Canada's air traffic control systems has placed the company in a competitive disadvantage position compared to other subsidiaries of Raytheon that offer products which need less working capital but give the same return on the investment.

The current major enterprise customers are US Department of Defense (DoD) and US Federal Aviation Administration (FAA). The company's international customers are those countries with a procurement process similar to that of DoD and FAA. The characteristics of this market are different from those specific to a truly international commercial market place. The enterprise market share and driving and limiting factors of the market are also discussed in this chapter. The chapter also provides an overview of company's ability to address the needs of its other stakeholders including employees, the suppliers, and the parent company.

Chapter four deals with the execution of the enterprise current business model and the risks involved. It will be shown that the current execution system is a pull system. In this system, Raytheon Canada addresses the customer needs only if approached by the customers in the form of requests for the proposal (RFP). The production is driven by the demand and the company ideally should not have any inventory unless they are preordered. The pros and cons of the current pull based system are compared to those of the push based systems where the enterprise actively goes after the potential customers. The combined push pull business model is proposed later in this chapter as a more flexible way of adapting to the dynamics of the changing market. At the end, the risks involved with the current business model of the enterprise are discussed. Some of these risks are the enterprise growing reliance on the US government contracts, the new pattern of competition, the steep rise in the complexity of the products and the solutions, and the exposure to the exchange rate.

By this point, a clear picture of company's current business model is portrayed and the challenges that the company has in executing its business model in a changing market environment are described. Chapters 5 to 9 deal with the specifications of company's future business environment and key characteristics of the company's future business model.

In chapter five the future business environment of the company is portrayed through analyzing the company's future market and technology landscapes using both internal

and external market research data. It is argued that the trend in the booking type from the sole source to competitive environment in the absence of new comers, which indicates the company's air traffic management systems are becoming commoditized. Another trend analyzed in this chapter is the trend in Raytheon's product portfolio management. It is shown that the AMHS is moving toward investing in products which need less working capital. Therefore Raytheon Canada as a subsidiary of AMHS is going to face challenges to receive investments for its high working capital product lines. It is discussed how this trend pushes Raytheon Canada to expand its product portfolios with adding new products which need less working capital. Another trend that is described is the trend in the combination of international-domestic sales. The trend shows a growing number of international customers. This will place Raytheon Canada in a new business environment with new risks such as exchange rates, working cultures, etc. The trend in contract type from cost based contracts to fixed price contract is also assessed and it is argued that this is another sign of a changing market which requires change in the standardized processes, the pricing, and an organization which can conduct the projects in much cost effective ways. Later in this chapter the major trends in the new technology adoption in the air traffic management market are shown. Specifically the traditional radar based ATM systems are being replaced by GPS based ATM systems. This trend is expected to speed up during the next five years. Raytheon Canada has not adopted a disruptive technology management practice in its business model yet.

In chapter six, based on the results obtained from assessing the current business model of the company (chapters 2-5) and analyzing the future enterprise business environment (chapter five), important elements which enterprise has to include in its current business model in order to successfully operate in its emerging business environment are discussed. In selecting these elements, attempt is made to minimize the impact on the overall business model of the parent company as Raytheon Canada has very limited power to dictate the suggested changes to its parent company.

Three most critical elements missing in the current business model are identified as disruptive technology management, the organization for innovation, and the pricing

strategy. These topics are discussed in chapters 7-9 in more detail respectfully. In chapter six, we also discuss the culture transformation and the incentive plan needed to effectively introduce these changes to the company.

Chapter seven deals with the managing of disruptive technology. Raytheon Canada's ATM product lines are being disrupted by the ADS-B technology. At the same time, the company's latest product line in the maritime surveillance and homeland security market, HFSWR, is disrupting other technologies currently used in the market. Currently, the company does not follow a rigorous disruptive technology management practice needed to guarantee its long term sustainability.

In chapter eight a critical assessment of the current organizational structure of Raytheon Canada for innovation is presented. It is argued that the company needs to introduce innovative products and solutions in order to reverse the commoditization process that is happening to its legacy product lines. The company currently has very large overhead which prevents it from efficiently introducing new products. Moreover, the company's current organization lacks the entrepreneurship atmosphere needed to introduce new products. In chapter eight a new organization structure for conducting cost effective research and development projects is proposed. This proposed organization structure is based on the ambidextrous organization proposed by O'Reilly and Tushman [3].

Finally in chapter nine the current enterprise pricing strategy is discussed and suggestions for incorporating effective pricing strategy are made. Raytheon Canada traditionally has always used cost based system as its pricing strategy. This offers a non effective way of capturing the value when introducing a new product to the market. This missing element is of specific importance as currently the company is trying to launch its new maritime surveillance product lines after close to 10 years of investing in its research and development. Successful launching of these product lines is crucial for the future growth and sustainability of the company. In chapter nine, first different pricing strategies are discussed with their pros and cons. The dynamics of pricing strategy and its relationship

to the product life cycle stages is discussed next. Suggestions for an effective pricing strategy for Raytheon Canada are discussed later in the chapter.

Through incorporating the suggestions made in this thesis, it is believed that Raytheon Canada would be better positioned to succeed in removing barriers and in adopting a new business model matched to the evolving business environment and to continue introducing innovative products and solutions to the market as it has been doing for over 50 years.

Chapter Two

Assessing the Enterprise Current Business Model:
Infrastructure & Value Offerings

1. Introduction

Established in 1956, Raytheon Canada in Waterloo is a subsidiary of Air Traffic Management and Homeland Security (AMHS) division of Raytheon's Network Centric Systems (NCS). This facility has become the centre of excellence in the fields of solid-state Air Traffic Control (ATC) primary surveillance radars and High Frequency Surface Wave Radar (HFSWR) technology. With sales of \$81M in year 2006, the facility has been a major supplier of these technologies for over 40 years. The company employs over 300 people.

As a subsidiary of Raytheon Corporation, the Waterloo facility follows the vision, strategy, goals, and values of the corporation [4] as described in the following:

Vision: To become the most admired defense and aerospace systems supplier through world-class people and technology.

Strategy:

- 1) Focus on key strategic pursuits, technology and mission assurance to protect and grow the company's business position in four core defense markets:
 - a. *Sensing:* Expand beyond traditional radio frequency (RF)/EO to adjacent markets
 - b. *Effects:* Expand beyond kinetic energy-based weapons
 - c. *C3I (communication, command, control, and intelligent):* Grow market presence through increased footprint and expand knowledge management and knowledge discovery systems.
 - d. *Mission support:* Provide total life-cycle support
- 2) Leverage company domain knowledge in above core defense markets to develop opportunities in adjacent markets and expand company's mission systems integration positions
- 3) Leverage company's expertise to expand and serve international customers.
- 4) Be a customer focused company based on performance, relationship, and solutions.

Goals: Grow revenue faster than the market, retain and attract talent, acknowledge diversity as competitive advantage, improve productivity through improving Return on Invested Capital (ROIC), expand the use of Six Sigma, further engage with customers and partners, apply Integrated Product Development Process (IPDS) [5] methodology, implement Earned Value Management System (EVMS) [6] and adopt Capability Maturity Model Integration (CMMI) [7,8].

2. Products and Services (Value Offerings)

Raytheon Canada offers the following products and services:

Air Traffic Management Systems

Solid-state Primary Surveillance Radar (PSR) systems are the primary products of Waterloo facility. These systems are integrated with the monopulse secondary surveillance radar (MSSR) built and developed by a Raytheon subsidiary in the UK to provide both civil and military airports with the traffic management of approaching airplanes. Raytheon's air traffic control system has been disrupted by a GPS based surveillance technology called ADS-B. The growth of ADS-B technology and its gradual deployment in more airports around the globe are going to impact the global sales of PSR.

Raytheon's PSR systems have been installed and operated in numerous countries around the globe. In fact, the company believes that it has sold more solid-state primary surveillance radars than any of its competitors (see Fig. 2.1). In Canada, the facility has installed Radar Modernization Project (RAMP), the world's largest network of fully solid-state primary radars, monopulse secondary radars and their corresponding automation systems.

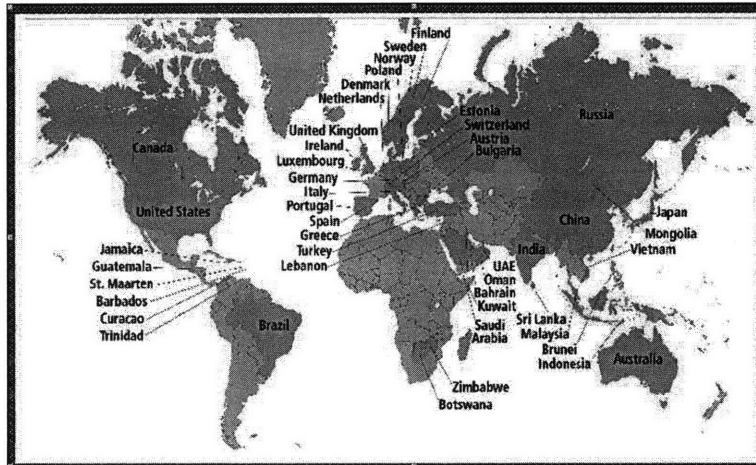


Fig. 2.1 Global sales of radar system by Raytheon Canada [9]

The company makes two types of PSR radar systems. The first product ASR-10SS Mk2 S-Band primary surveillance radar, which is primarily designed for the international market, is a cost-effective radar system which offers easy expandability and can be adjusted to handle high, medium or low traffic volumes for both approach/departure, and extended terminal airspace coverage. The radar is shown in Fig. 2.2. The second product is ASR-23SS L-Band primary surveillance radar which is designed to handle traffic volumes for much extended coverage.

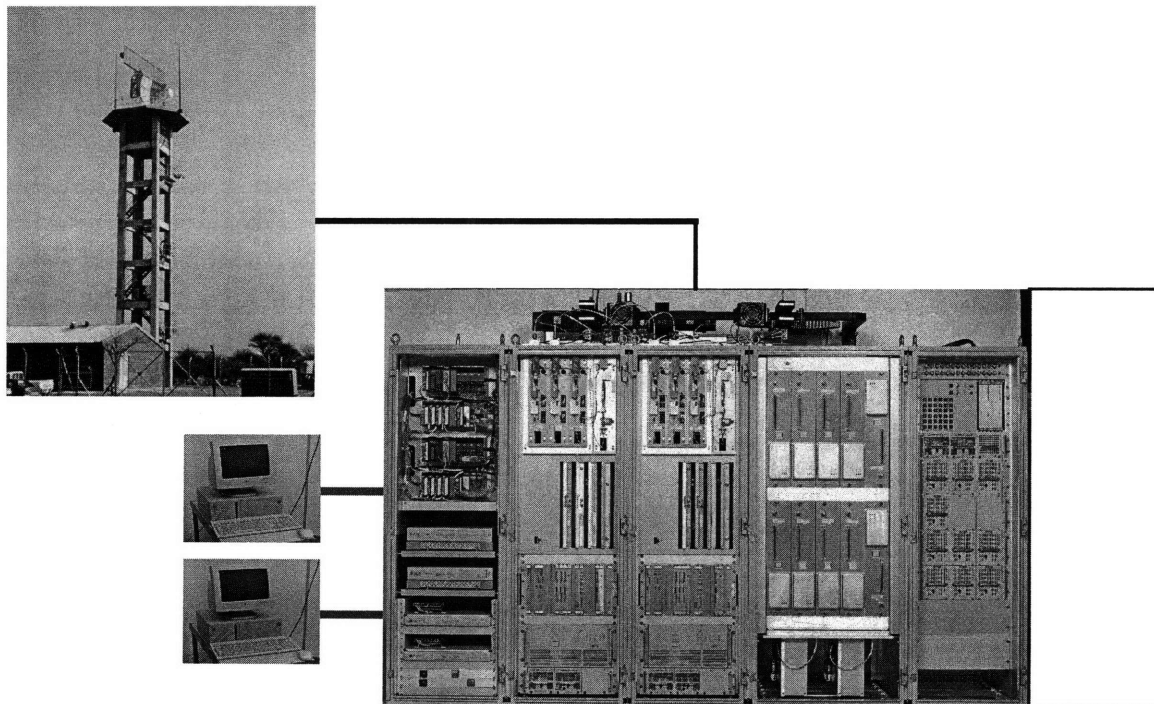


Fig. 2.2 Raytheon's ASR-10SS Radar System [9]

The company also makes custom based radar products. Awarded by the U.S. Department of Defense (DoD) and the Federal Aviation Administration (FAA), Raytheon Canada is building several hundreds of custom based solid-state digital radars valued at US\$700 million, the world's largest air traffic control radar contract.

Integrated Maritime Surveillance Systems

Raytheon Waterloo has developed an Integrated Maritime Surveillance (IMS) system to provide countries with the capability of observing maritime activities over their exclusive economic zone (EEZ). The Surveillance is accomplished through integrating data coming from a network of High Frequency Surface-Wave Radar (HFSWR) systems and combining them with data coming from Automatic Dependent Surveillance (ADS) systems and some other sensors such as short range radars, satellites, reconnaissance aircrafts, etc. The resulting data is used to provide a picture of surface and air activities in the EEZ. Vessel tracks can be run backward and forward in time, enhancing military patrols and coast guard search-and-rescue efforts as well as oil spill control, drug interdiction, and iceberg alerts.

The HFSWR forms the backbone of the IMS system. This radar is a land- based phased array system which transmits high frequency (HF) radio waves that follow the earth's curvature. The system is offered in two configurations. SWR-503 which operates in 3-5MHz band provides the coastal nations the capability of detecting and tracking aircraft, large surface vessels and icebergs up to 200 nm from the shore in a sector of up to 120 degrees. The radar also provides sea current and wind data. The second product line SWR-1018, operates in 10-18MHz band and can detect and track small, medium, and large air and surface targets up to 120nm from the shore. Applications for HFSWR are being developed in various fields such as Theatre Ballistic Missile and Meteor Shower Detection. The radar is shown in Fig. 2.3.

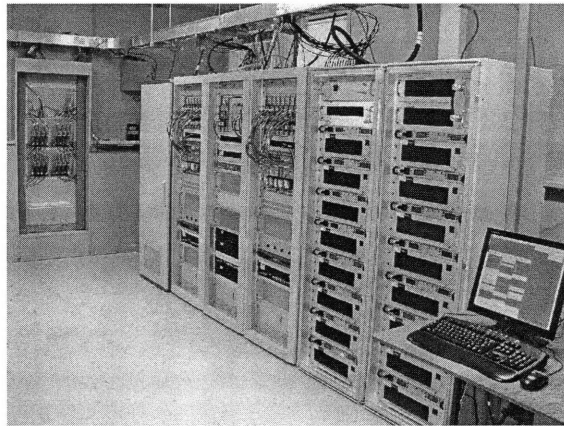
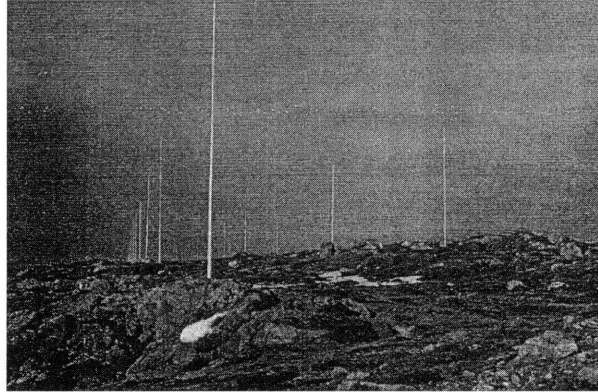


Fig. 2.3 Raytheon's High Frequency Surface Wave Radar System [9]

The author believes that HFSWR is a disruptive technology in the sea surveillance market. Introducing this innovative product to the market requires adopting a delicate process in finding lead users, choosing right markets as the point of entry, and managing resources to address technological challenges.

Marine Small Target Tracker

Raytheon's marine small target tracker is an advanced signal processor developed to upgrade the existing marine radar networks by detecting and tracking very small targets such as swimmers, life rafts, and small go-fast boats at long range in the heavy sea conditions. It extends the current marine radar range by 2-5 times and adds small target tracking capabilities.



Fig. 2.4 Raytheon's Marine small Target Tracker System [9]

Diverse Capabilities

The company has built capabilities in diverse areas, including frequency spectrum management, data fusion, and advanced track and signal-processing for land and maritime, civil and military applications. These capabilities were crucial to winning several recent projects.

Manufacturing

The company has built high quality military standard manufacturing capabilities. Electronic subsystems are produced for vertical-launched Seasparrow missile, Patriot and Hawk missile and AN/SPS-49 radar, amongst others. For the past four years, the company has invested heavily on its manufacturing facility in order to make it lean and cost effective. The goal is to attract as many of Raytheon US's small manufacturing projects as possible

3. Organization Structure

Raytheon Canada has recently adopted a new product line management practice to support each product line of the company. This is a transformation from its traditional

program management organization. A high level organization structure along with a detailed structure of the company's core business units are shown below.

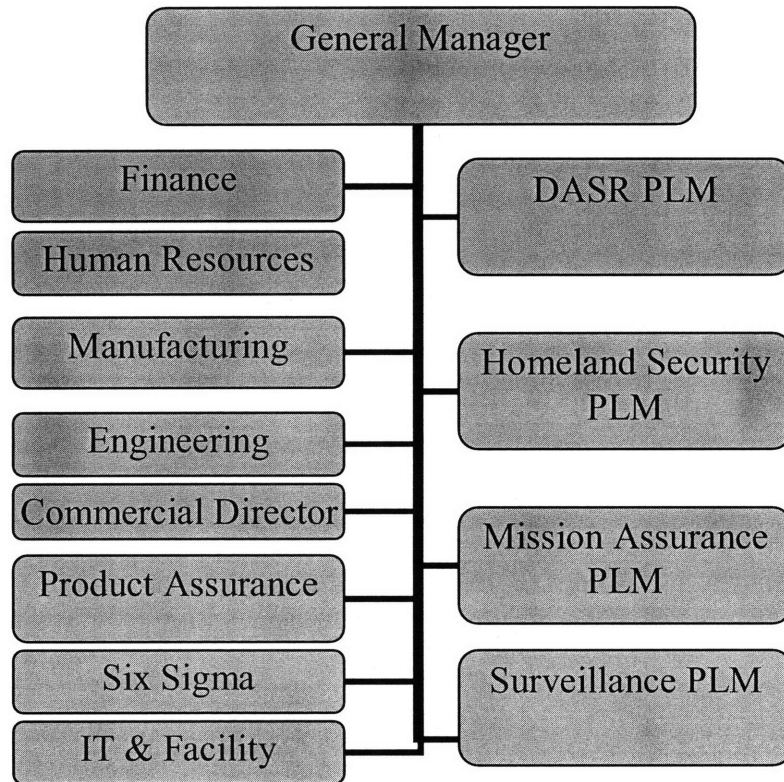


Fig.2.5 High level organizational structure [10]

The reporting hierarchy connects Raytheon Canada's General Manager to the AMHS's air traffic management division. Along with reporting to the facility General Manager, the unit managers also report to their corresponding function managers in Raytheon AMHS. This double reporting hierarchy has slowed the decision making process within the organization [11].

The reason for moving to the product line organization is due to the technological complexity and the wide difference in Raytheon Canada's product lines. An outcome of this new organization structure is that close attention will be paid to the market development of each specific product. Another outcome is that specific responsibility will be assigned for watching the performance and profitability of each product line. In this

organization structure, the possibility of paying less attention and resources to some products because they are not addressing high potential markets or their markets are deemed difficult to penetrate are minimized.

Each of the four product lines shown in Fig. 2.5 represents one of the major capabilities that Raytheon Canada has developed or planned to penetrate based on its new offerings. The surveillance product line management covers the international ATM systems, the bread and butter of Raytheon Canada for nearly 50 years. DASR/IWR covers the major project that Raytheon Canada has with FAA to modernize the ATM systems in the US. The homeland security covers new offerings including IMS systems, HFSWR and MSTT product lines. The mission assurance PLM tries to leverage its relationship with the customers to bring service based contracts to the organization and provides innovative mission support solutions for the upcoming customer needs.

With all the PLM advantages, the author's research has found that the new organization structure has not been fully realized within Raytheon Canada. The major programs in the company are still being performed through a traditional matrix organization with power inclination towards program managers. As soon as programs are identified, they are assigned to some designated program managers who carry general management authority and responsibilities to organize, plan and direct all program activities. In addition to the program manager, a program team is formed from the functional organizations such as contract management, project engineering, quality assurance, configuration management and production management.

Having the PLM combined with the matrix structure can provide the company with the advantages of both structures. There are, however, some problems with this combined organization structure. In the following section, the characteristics of company's organization structure and some of the challenges unique only to Raytheon Canada are discussed.

Company's Matrix Organization Characteristics

The matrix structure is still the backbone of the company's organization. The matrix structure is designed to maximize the company's resource utilization by giving project managers a broader choice of resources and allow functional managers to focus on technical excellence and efficient resource allocation. The advantages of matrix structure are [12-14]:

- 1) *Efficient use of resources*: Individual specialists as well as equipment can be shared across projects.
- 2) *Project integration*: There is a clear authority to coordinate work across functional lines. Thus degree of integration is greatly increased
- 3) *Improved information flow*: Both vertical and lateral communications are enhanced.
- 4) *Flexibility*: Frequent contact between members from different departments expedites decision-making and adaptive responses.
- 5) *Discipline retention*: Functional experts and specialists are kept together even though projects come and go.
- 6) *Improved motivation and commitment*: Involvement of members in decision-making enhances commitment and motivation.

Given all these advantages, there are also several examples showing that the matrix organization has caused the following problems within an organization [14]:

- 1) *Challenge to set a standardized practice*: In the absence of a product manager, by assigning different program managers to deliver the same product to different customers, it is hard to standardize the program management practice for a product and incorporate the best practice.
- 2) *Power struggles*: Conflicts occur because of overlap of responsibilities and authorities.
- 3) *Heightened conflict*: Competition over scarce resources occurs, especially when personnel are being shared across projects.

- 4) *Slow reaction time*: Heavy emphasis on consultation and shared decision-making retards timely decision-making.
- 5) *Difficulty in monitoring and controlling*: Double management by creating project managers.
- 6) *Excessive overhead experience distress*: Dual reporting relations cause ambiguity and role conflict.

Items 1, 3, 4 are more apparent in Raytheon Canada based on the author's study of the enterprise.

The matrix organization is truly an interdependent organization where its success depends on the harmony among units forming the organization. For this reason, good communication is extremely important as performers seek the most desirable work and customers want the most capable performer for their task. Without good communication, it is very difficult to accomplish these goals designed for matrix organization. Communication is formal (such as information about work requirements or available personnel), but it is reported that the most successful work matches come from informal communication. Designing sound interfaces and establishing good communication between functional managers and project managers would ease conflict and clarify goals.

Due to regulatory environment imposed by US ITAR, Raytheon Canada has limited access to the technology, people, and best management practices and tools from the rest of Raytheon in the US. This restriction also limits Raytheon Canada's ability to openly communicate with the rest of Raytheon in order to speed up the decision making process. If this is compared against competitors such as Thales Corp. which is exposed to much less regulatory limitation by the French Government, Raytheon Canada is in competitive disadvantage in performing projects in the international market.

Reporting hierarchy

Raytheon Canada has a double reporting hierarchy which connects the individual units to Raytheon NCS. In this hierarchy, the unit managers report to the general manager of Raytheon Canada and also to their corresponding functional managers in Raytheon NCS. This double reporting hierarchy brings more senior managers into decision making process which is expected to reduce the risk of ending up to non desirable decisions. This however has made the decision making process longer, adding confusion to the organization and negatively impact the performance of employees and managers who are close to the customers and need to be empowered to provide quick reactions to the dynamics of market and customer needs.

4. Standardized Processes

Raytheon is using a collection of common processes, standard tools, reference materials, measures, training, and support infrastructure, designed to help plan and successfully execute programs with repeatability and efficiency. Its goal is to supply the consistent format, content, and terminology necessary to flow down common objectives and metrics, and to roll up the results of implementing and managing through processes. The tool is designed to provide the company with better means to communicate, measure, and improve the products from enterprise perspective. This tool collection is called Integrated Product Development System (IPDS) [5]. This tool along with Raytheon's six sigma [15] and Capability Maturity Model Integration (CMMI) [7, 8] system determines guidelines for Raytheon's major processes. CMMI is a process improvement approach across the entire organization developed by Carnegie Mellon University to execute programs with the assurance of meeting the customer's mission needs.

These processes contain information that is based on experiences and best practices from across the enterprise, and from various national and international standards and models. There is also a development team called IPDS Deployment Experts (DEs) who is

dedicated to help program teams across Raytheon to effectively use IPDS. IPDS constitutes the following sections [5]:

- 1) *Core processes*: Business development, decision making process, program management, supply chain management, risk management, etc.
- 2) *Product development processes*: configuration management and data management, materials and process engineering, mechanical engineering, quality assurance, reliability, maintainability, etc.
- 3) *Supporting processes*: Information technology, finance, etc.
- 4) *Initiatives and tools*: Raytheon Six Sigma, CMMI, ISO, EVMS, etc.

The relationship between these sections is shown in the following figure.

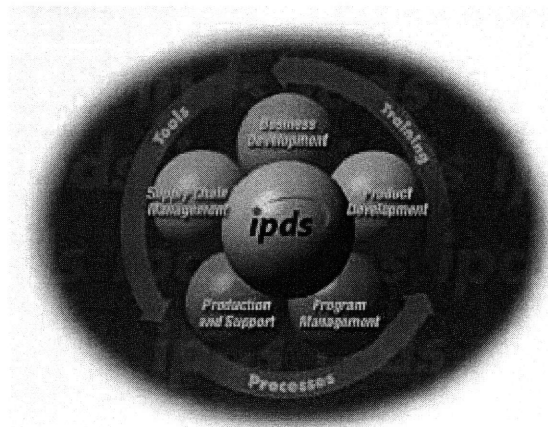


Fig. 2.6 Raytheon's Integrated Product Development System [5]

Raytheon IPDS has been developed to provide standardized processes focusing on customers, concurrent development of products and processes, early and continuous life cycle planning, maximizing flexibility for optimization and use of contractor approaches, robust design and improved process capability, event driven scheduling, multi-disciplinary teamwork, empowerment, and proactive identification of management of risk.

Decision making process

The IPDS constitutes eleven successive processes named as gates to standardize the decision making process throughout the enterprise. The first four gates involve business development practices which deal with customer need evaluation and strategies to win the contracts. These gates are called decision making gates. The second batch of IPDS gates which include gates five to eleven deal with system design and production plan and life cycle support of the product. These gates are called program execution gates. The IPDS gates are [5]:

Gate -1: Customer review: The purpose of this gate is to understand the customer and expected value that can be raised for Raytheon through addressing his needs.

Gate 0: Validation phase: In this gate, the transform of customer needs to valid opportunity is validated.

Gate 1: Reviewing the opportunity: In this gate the new opportunity is reviewed to make sure it aligns with company's strategic plan and core competencies in order to come up with a decision.

Gate 2: Working on win strategy: In this gate, the team draws up a win strategy to capture the opportunity.

Gate 3: Pre-proposal readiness review: In this gate the team works on all elements to determine if the company is ready to write a winning proposal.

Gate 4: Proposal review: In this gate, the final proposed offer is approved ensuring the scope, cost/price, terms and conditions, and key risks are understood and acceptable. The preceding gates provide inputs for executive decision in this gate. The level of review and approval authority is determined by factors such as dollar value, strategic importance and risk to the company, and the profit margin. Business executives are responsible for reviewing the attributes of the proposal under consideration and

recommending the level of review to the business or subsidiary chief executive officer/president.

When the decision is made that an executive office level of review is appropriate, a gate 4 approval review is scheduled with the president & chief executive officer and the appropriate attendees. The purpose of this review is to determine the scope, price, terms and conditions and risk level to be assumed by the company in response to the customer solicitation. This review establishes the direction obtained from the approval authority to allow the completion of the proposal process.

Gate 5: Start-up review: In this gate, the management starts planning the project and approves program implementation.

Gate 6: System functional review: In this gate, the enterprise management confirms the system requirements and makes a decision to proceed with preliminary design.

Gate 7: Preliminary design review: The management confirms the preliminary design and supports a decision to proceed with detailed design.

Gate 8: Critical design review: The enterprise leadership confirms the detailed design and supports a decision to proceed with the build phase.

Gate 9: Test readiness review: The management confirms the test readiness of the system and supports a decision to proceed with the test phase.

Gate 10: Production readiness review: The management confirms the manufacturing maturity and affordability and supports a decision to proceed with low-rate initial production or full-rate production.

Gate 11: Transition and closure review: The enterprise leadership reviews the program for an orderly transition and closure process.

In the above program execution gates, the decision making process involves gathering the stakeholders needed for the decision, conducting formal analyses, select the preferred alternative and identify the associated risks, and based on company's vision, values, missions, and goals come up with the decision for strategies and tactics to tackle the problem.

General Challenges

There are challenges in applying IPDS in practice. Finding right tools among relevant information in IPDS is hard to achieve. Even once something is located it can be difficult to determine what is really relevant as everything in IPDS is presented as of equal importance.

Moreover, due to the variety of Raytheon's projects which includes a wide range of defense and civil applications coming from US DoD and several international customers, proposing a common framework and practice as suggested by the IPDS may not be adequate to address all challenges facing many of these projects. This fact emphasizes the importance of program managers' roles in tailoring IPDS in a way that it addresses their own projects. This would diversify the program management practice in the organization which could negatively impact the product quality assurance and increase the risk of the business.

Unique Challenges to Raytheon Canada

Since most of Raytheon's contracts are DoD based contracts, the IPDS has been shaped to better address the processes needed for these contracts. For Raytheon Canada, the story is different. Most of contracts of Raytheon Canada comes from international markets and involves offering innovative products which involves taking considerable amount of risks. The current IPDS falls short in addressing the very dynamic nature of the international market. Moreover, due to ITAR regulations, Raytheon US cannot share all of its IPDS information with its international divisions including Raytheon Canada. This

has limited the access of Raytheon Canada to IPDS information and also put restriction on the communications between Raytheon international divisions and those within US soil [11].

To address this challenge, Raytheon Canada has initiated a plan to create Canadian IPDS by adding processes and tools needed to successfully perform its own projects. These efforts should be praised for their positive impact they had on the company's business success. However, if the overall outcome is compared against that of competitors such as Thales who is doing business in much less regulatory environment, Raytheon Canada is in competitive disadvantage in terms of accessing the best practices.

Transformation Management Process (Raytheon Six Sigma)

Another process widely used in the company is six sigma. Raytheon Six Sigma is a knowledge-based process designed to transform company's culture to maximize customer value and business growth. It includes a set of tools and methods to achieve its goals. The company has extensively applied this methodology throughout its business divisions and has made it mandatory for all of its employees to learn these tools and apply them under the coaching of six sigma experts..

The Capability Maturity Model Integration (CMMI)

Raytheon has adopted the Capability Maturity Model Integration methodology for its product and process improvement. The primary focus of the methodology is to build tools to support improvement of processes used to develop and sustain systems and products. The output of the CMMI is a suite of products, which provides an integrated approach across the enterprise for improving processes, while reducing the redundancy, complexity and cost resulting from the use of separate and multiple capability maturity models. This is in response to what we discussed earlier regarding the challenges in using IPDS. In a complex environment, such as development where several of these disciplines are employed, the collective use of individual models has resulted in redundancies, additional

complexity, increased costs and at times, discrepancies. To improve the efficiency of the models used and increase the return on investment, the CMMI goal is to provide a single integrated set of models [6, 7].

5. ITAR and its Impact on the Enterprise

Raytheon Canada as a subsidiary of Raytheon is subject to the US International Traffic in Arms Regulations (ITAR) law. This law has added considerable limitations on the company's business in the international market. In order to study the impact of ITAR on the enterprise communication, it is necessary to understand the ITAR regulations and clauses which are directly related to Canadian defense industry

How ITAR Affects Canadian Defense Industry?

ITAR is a set of United States government regulations that control the export and import of defense-related articles and services on the United States munitions list [2]. The State Department interprets and enforces ITAR. Its goal is to advance national strategic objectives and U.S. foreign policy via the trade controls.

ITAR regulations dictate that information and material pertaining to defense and military related technologies may only be shared with US Persons unless approval from the State Department is received or a special exemption is used. United States companies can face heavy fines if the Department of State discovers they have, without approval or the use of an exemption, exposed non-US-Persons to ITAR-protected products or information such as designs, test data, processes, software code, etc.

A US person in ITAR is either a US citizen or a permanent resident who does not work for a foreign company, a foreign government, or a foreign governmental agency/organization or a part of the US government, or a corporation, business, organization, or group that is incorporated in the United States under US law. The list of ITAR-controlled technologies often changes.

When it comes to Canadian defense companies, including Raytheon Canada, the Canadian exemption to ITAR has historically been expansive because of the strong relationship between the United States and Canada. However, following a number of alleged improper re-exports of items and technology subject to the ITAR from Canada, the U.S. government became concerned that the Canadian exemption, coupled with liberal Canadian export controls, did not adequately protect U.S. national security interests. To remedy this situation, in April of 1999, the State Department substantially narrowed the Canadian exemption [17]. This negatively limited the amount of communications, technology sharing, tools and best practices between Raytheon Waterloo and Raytheon divisions in US.

In 2006, talks between US and Canada began with an aim to resolve the issue of security for materials exported under the ITAR and the flow of goods and technology to Canada [18]. The talks have led to an arrangement between Canadian Department of National Defense and US State Department to ease restrictions on only Canadian Defense forces and employees who are Canadian citizens, including dual nationals, who have a need to know and a have minimum secret-level security clearance. This agreement is not covering Canadian private and public defense industries such as Raytheon Canada though. Even this new arrangement is not giving DND employees a wide access to ITAR listed products and services.

Canada is the second in the world after Australia in the number of its population born outside of the country. Over 20% of the total population was born outside of the country and most of them, new immigrants, are residing in major metropolitan areas where most of the Canadian defense companies are located [19]. Canadian defense companies including Raytheon Canada have benefitted from the expertise of highly talented immigrants in developing its new products. However, ITAR restrictions on these individuals, mostly holding dual nationals, have negatively impacted the company's access to US defense business.

The Government of Canada continues discussion with the State Department in order to find comparable long-term solutions for other federal government departments and Canadian industry. At this moment there is no agreement in place for Canadian defense companies including subsidiaries of US defense companies in Canada.

ITAR and its impact on Raytheon Canada

Due to the enforcing of ITAR regulations to Canadian defense industry, Raytheon US divisions cannot share their technical information and best practices with Raytheon Canada. This also has restricted Raytheon Canada to access the best engineering staff and management knowledge developed at Raytheon divisions in US. To better understand the impact size of these restrictions on Raytheon Canada's business, it is important to mention that almost all Raytheon divisions are located in the US. To address this challenge, Raytheon Canada has initiated a plan to create Canadian IPDS by adding processes and tools needed to successfully perform its own projects [11].

Chapter Three

Assessing the Enterprise Current Business Model:
Financial Data, Customers, and Market

1. Introduction

In this chapter first the revenue, profit margin, booking, and other financial performances of Raytheon Canada are discussed. After a brief overview of the customer types and the market characteristics, the company's performance in keeping and growing its market share and addressing the evolving customer needs are discussed. At the end a brief overview of the company's performance in meeting the needs of other stakeholders such as employees, suppliers, etc is provided.

2. Financial Performance

Each year the AMHS division of Raytheon provides its subsidiaries including Raytheon Canada with the expected financial and operational performance goals. The goals are set for the bookings, sales, profit, ROIC, working capital, and market share.

Booking, Sales, and Profit

With regards to bookings, Raytheon Canada has missed its target goals during the last several years. However, the sales and profits are aligned with the AMHS target goals. Raytheon Canada does not carry out market research for reporting its booking forecast. The company typically inflates the number in order to maximize the funding it receives from the parent company since there is a direct relationship between the size of the external investment and the booking forecast. Therefore there is less incentive to provide non inflated values for the booking. Moreover, the company has little budget and small staff to spend on market research. The forecasts are typically based on the historical data and also the experience of program managers closely working with customers [10, 11].

The sales of Waterloo's facility for the last 10 years are given in Fig. 3.1. It shows the sales were maximum in year 2003 when the company secured some major programs such as DASR and increased its radar sales to China. The company's sales starts to decline after 2003 due to the decrease in the size of the air surveillance contracts. In order to meet

the AMHS goals, the company has to increase its sales and booking mostly in the sea surveillance systems for the next five years to compensate the sales decline in the ATM business.

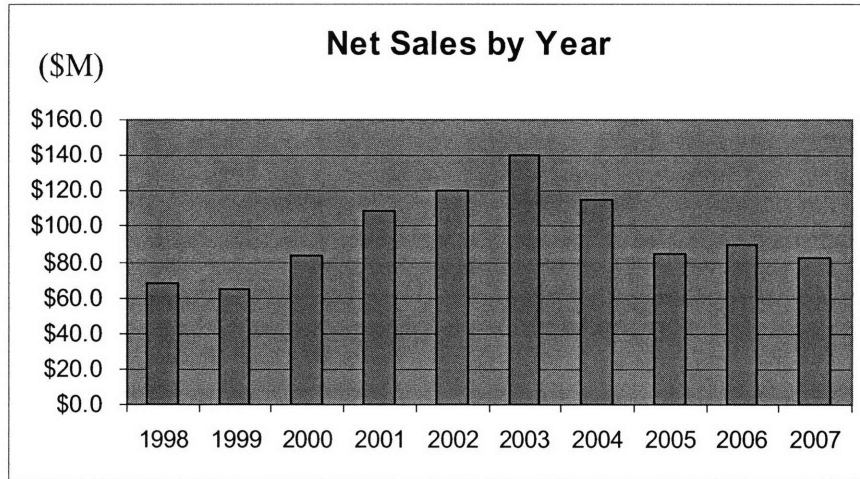


Fig. 3.1 Raytheon Canada sales [10]

It is important to note that Raytheon reports the sales in the same year as the materials are ordered and the company starts to build inventories for goods while the actual sales of the finished goods could happen in the following years. Therefore, the maximum sales around year 2003 is related to having strong backlog and does not necessary mean that Raytheon delivered more radar systems in that year.

Working Capital

Working capital is a financial metric which represents the amount of day-by-day operating liquidity available to a business. It is calculated as current assets minus current liabilities. In many contracts particularly those coming from international markets, Raytheon needs to invest its own financial resources and cash to capture the business and run the program before it receives payment from the customers. Due to limited financial resources of the company and the extent of many international contracts which require Raytheon's initial investment, the company is hesitant in pursuing projects which need large amount of investment from the company. Financing these projects through sources

other than the stock market and financial institutions is not a desirable option for the company. Third party financing is also not desirable due to concerns about sacrificing the company's intellectual property (IP) because of necessities of disclosing the contract and products. Moreover, the lending agencies often require some collateral and guaranteed returns which is again not desirable. The company is comfortable with customer financing the contract though. Some of the very large programs which Raytheon Canada is involved in have been financed by the customers [11].

The following chart gives a comparison of total working capital needed for each product line of AMHS versus the corresponding expected profit margin. The air traffic control systems need substantial amount of working capital compared to other product lines of AMHS with the same profit margins. This has placed Raytheon Canada in a difficult situation for securing investment from the parent company. The company needs to compete against other opportunities within Raytheon which need less working capital.

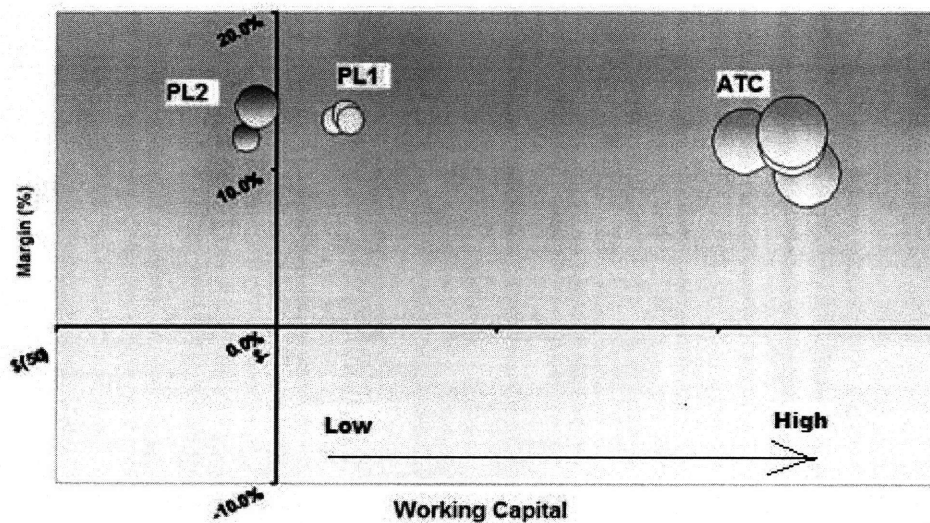


Fig. 3.2 Enterprise profit and WC [20]

3. Customers & Market

Customers Types

The enterprise customers are mainly US Department of Defense (DoD) and US Federal Aviation Administration (FAA). The enterprise's international customers are those who have very similar procurement structure to that of DoD and FAA and are mostly government induced businesses. That is because the enterprise infrastructure and processes are optimized for these types of customers and the company has developed tools and methods to address risks involved with these sorts of projects [10, 11].

For any new opportunity, the company assesses the procurement requirements to see if they are similar to DoD orders before submitting the proposal. The characteristics of this market are different from those specific to a truly international commercial market place. The reason for adopting this business approach is due to the inherent risks and challenges involved in the international commercial market. Raytheon is not prepared and not willing to face these challenges. For example in the air traffic control market, the international procurement agency is typically looking for unlimited liability, standard terms and conditions in the commercial market place. The growth of Raytheon Canada is related to capturing these businesses. As a matter of fact entering in this market can satisfy the company's goal in meeting its ROIC requirements since the company can harvest from its prior investments by increasing its sales in this market. Nevertheless as the contracts in this market are not similar to DoD contracts, Raytheon Canada and its parent company have not adopted strategies to mitigate risks involved with these types of contracts. Therefore, the company is selective in the portions of the international market that it pursues which determines the dichotomy of where the company should position itself in the commercial market.

There are some suggestions to mitigate the risks such as sales through the third party or purchasing insurance to cover the possible loss in these contracts. Raytheon's competitors such as Thales are active in this market. As Raytheon Canada is exploring more

opportunities in the international markets, the company needs to adopt a risk management practice to mitigate risks in this market.

Customer Need Response

Raytheon Canada has been in the air traffic control radar business for over fifty years and has sold radars to many countries. Due to the importance of the radar systems in air traffic safety and because of long life cycle of these systems, the company has been continuously providing its customers with supports, services and upgrades on time and in cost effective manner. The following process depicted in Fig. 3.3 shows the process of company's customer listening and actions:

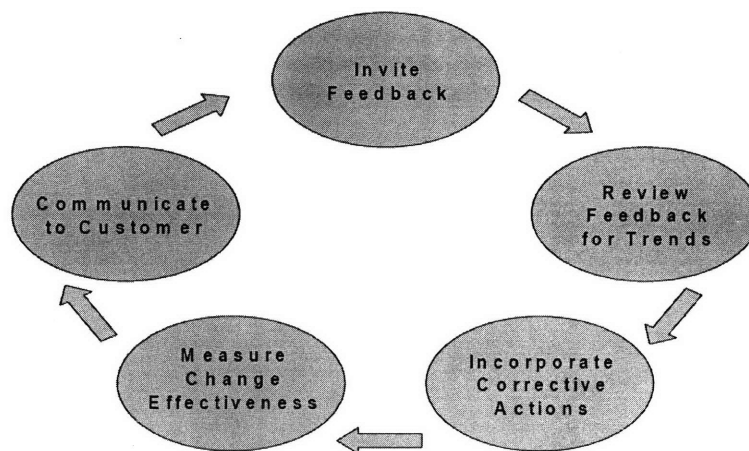


Fig. 3.3 Customer listening and action in Raytheon Canada [10]

The company has developed the above process and committed itself to listen to the customer and implement necessary actions to address their needs. By applying the above process, Raytheon Canada has been able to continuously improve its customer satisfaction by substantially reducing the cycle time for the company's root cause and corrective action process.

Moreover, by reviewing Raytheon's 10K, it can be seen that the goodwill makes the large percentage of company's asset. This in part reflects the company's reputation for

addressing customer needs and services. The company is very serious in responding to customer's request and addressing their needs.

Market Characteristics

The ATM market is a mature market with few players since the entry barrier is high due to the complexity of the products and the sophistication of the customers. The major players in this market are Raytheon, Thales and Northrop Grumman. The drivers of this market are listed below [21]:

1. *Adding New functionality:* A growing international market for radars which also have the capabilities of being used in air defense networks. Several manufacturers have increased market share in different regions such as Latin America on the basis of their ability to serve dual use requirements with a common, cost-effective integrated radar system.
2. *Replacement of aging radar systems:* As new technologies such as ADS-B is still in their introductory phase and have not been popularized in different regions, there are still strong demands from developing countries to upgrade their aging and costly-to-maintain radar systems.
3. *New and secondary airport growth:* Opening of new airports in developing countries and expanding of the secondary smaller airports in developed countries will accelerate the growth of radar systems. Safety implications are the primary factor in most cases. This factor has been a major market driver recently as European countries and US federal aviation agency has limited the air travel to countries which are not equipped by standardized air traffic control radar systems.

The restraints in this market are given below:

1. *Budgets are shrinking:* Decision to replace the aging radar systems or acquire new systems is depended upon the availability of funding from government. In North America the ability of US and Canadian governments to fund their air traffic modernization programs is under question for different reasons. First it is known that FAA will have to manage with lower than expected annual budgets and Nav Canada's financial capability is similarly questioned. For international market, the issue is more volatile. There are many budgetary issues which many governments face to prioritize the needs and allocate enough funding on major acquisition and/or modernization programs.
2. *Large share of market has already been contracted:* US as the largest market of air domain surveillance systems has already contracted the modernization of its legacy radar systems. Therefore, a high market value does not necessarily present market opportunities and this should be taken into consideration when discussing market potential.
3. *Service income:* Due to recent acquisition of new radar systems in US, there will be stable cash flow for companies which are in business of providing services and upgrading to these radar systems. As FAA and other radar operating authorities around the globe are moving toward to outsourcing the service of radar systems in its life cycle period, There will be a great business potential for companies to use economy of scale and take advantage of providing same service to many radars in both North America and international market.

Market Share

It is forecasted that more than half of the estimated revenue in ATM in the next 10 years in North America to be generated from automation systems. That is mainly due to the high investment needed for ATM hardware and this fact that most of hardware has been contracted in the last 7 years. Real market opportunities mostly lie in the segments that follow automation in market share, namely navigation and communications. Surveillance

on the other hand, is the segment with the lowest market revenue, but still presents some opportunities for revenue. As the core capability of Raytheon Canada currently resides in its capability of delivering the hardware side of PSR systems, it is expected that its ATM business would shrink in coming years.

The market has been divided among the major suppliers of ATC equipments and winners and losers are determined based on increase or decrease of their corresponding market shares. An estimate of the market shares of ATC surveillance equipment in year 2000 are shown in Table 3.1.

Table 3.1 Market shares of major suppliers of ATC surveillance equipment [21]

| Market shares of major suppliers in 2000 (%) | |
|---|------|
| Thales | 22.5 |
| Raytheon | 18 |
| Northrop Grumman | 26.5 |
| Frequencies | 5 |
| Others | 28 |
| Total | 100 |

The price of ATM equipment is stable with adjustment for annual inflation. The prices are between \$2M to \$9M, depending on the specific application and added features. In the surveillance segment of North American market where Raytheon Canada’s major offering resides, the company is the undisputed leader with a large install base of sensors in the United States and Canada. During next 5-year time frame, the company is expected to confirm its segment leadership with new deliveries of primary and secondary radars to the region. In the United States, Raytheon will be supplying secondary radars under the ATCBI program, primary terminal radars under the ASR-11 (DASR) program, sensors for the ASDE-x systems as a sub-contractor to Sensis as well as Precision Runway Monitor radars for the country’s most congested runways [21].

In Canada, the company completed the delivery of secondary radars under the Northern Radar Project and no other contractor is expected to replace Raytheon as Nav Canada's preferred supplier of surveillance systems.

There are emerging markets in developing countries mostly in Africa for ATM systems. The driver of this market is the new European regulations which stop airlines to fly to or receive flights from countries with poor or no ATM systems. The market demands less expensive and mostly basic radar systems to address European regulations requirements. Raytheon Canada has not actively explored this market due to the low profit margin characteristics of this market [11].

The second major product line of Raytheon Canada is HFSWR. This radar is a disruptive technology to the maritime surveillance market (please see chapter seven). Today surveillance's equipments and sensors are extremely limited in terms of area of coverage and are very expensive. Available assets are generally deployed in only the most critical areas and are easily bypassed. For example, shore based microwave radars are limited to line of sight (~30 nm), airborne radar provides only a snap shot in time of activity in patrol area, and satellites have neither the spatial or temporal resolution to provide the necessary level of real-time surveillance. HFSWR is designed to provide coastal nations with efficient and very cost effective continuous 24/7 maritime surveillance over wide area of ocean. The radar still has some technological problems and operational limitations which prevent the radar to move to mass market.

After unsuccessfully marketing this radar in developed countries which are more conservative in replacing their current maritime surveillance assets by this radar (as these countries have already invested heavily on alternative technologies), the HFSWR has found its lead users among developing and even undeveloped countries. These countries are in great need of an effective maritime surveillance but they have not been able to acquire one since the traditional systems in the market are very costly.

The HFSWR is still in its market introductory phase. The market share of Raytheon Canada in global maritime surveillance market is therefore negligible.

Other Stakeholders

Employees

Due to the specialized nature of Raytheon’s business, the success of the company is highly related to hiring and retaining key and talented engineering personnel and managers. The company offers its employees competitive salary, medical care, retirement package, travel support to conferences, payment of professional memberships, opportunity to grow, relax work environment, group celebration and trips, student support, online training, etc. It provides a work environment free of injury. The headcounts in the past eight years are given in Fig. 3.4 divided by the work assignments. It shows 25% reduction in the work force in last five years mostly in the manufacturing due to ATM market shrinkage.

The above offerings are competitive in the Waterloo region, however; the study shows that the offerings are not enough to create an effective incentive for both employees and managers to achieve the strategic goals of the corporation in a changing market [10]. The bonus paid to every employee is equal to a percentage of his annual salary. Almost all employees receive the bonus. The bonus system is not considered as an effective incentive tool to drive change within the organization.

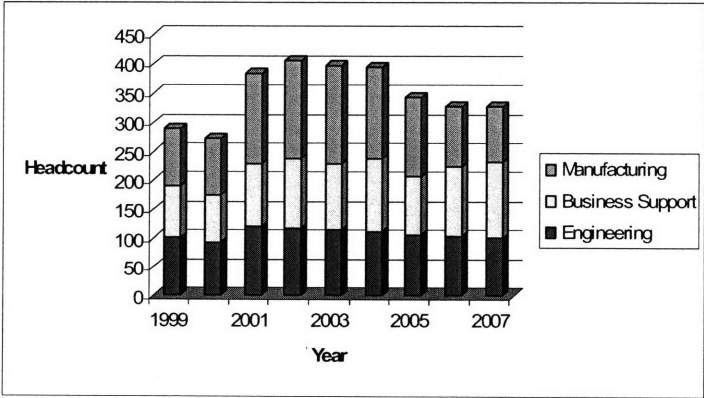


Fig. 3.4 Raytheon Waterloo headcounts in last 8 years [10]

Community

Raytheon Canada has been operating in Waterloo for over 50 years. The company is considered as one of the major high technology companies in Waterloo region. The company is known for being a good member of the community, actively participating in many community services such as donating tools and devices to local schools, participating in fund raising for charity, being a good friend of environment, etc. The company has assigned a member of human resources department to deal with the community [10, 11].

Suppliers and Subcontractors

For the past five years, the company has heavily invested in making its manufacturing and supply chain management divisions lean. The company has been able to reduce its inventory through establishing close relationship with its suppliers.

Chapter Four

Assessing the Enterprise Current Business Model:

Execution & Risks

1. Introduction

The majority of Raytheon's revenue (around 88%) is coming from contracts with US government agencies and other DoD type customers [22]. Given its limited customers, Raytheon uses a pull system to execute its business model. The company has relatively small size new business development, marketing, and sales departments. By investing heavily on its system integration capability, its core technologies, and building project management skills, Raytheon takes a position in the market as a world leader in specific defense systems such as radar and missile systems. This business model matches to program driven acquisitions used by US government. For example FAA usually establishes long-lasting programs and contracts for a large number of production systems and that allows for only a small number of industry participants to establish themselves in the region as core suppliers. This is the core of Raytheon business model which is called "winning the big ones". Raytheon Canada has a business model similar to that of its parent company.

A detailed description of enterprise pull based business model and its challenges are described in section 2. The business model of Raytheon is subject to several risks related to the dynamics of the company's business environment. These risks along with their impacts on the business model of Raytheon Canada are discussed later in this chapter.

2. Business Model Execution

Raytheon Canada's business model execution is very similar to that of its parent company. It is program focused and extensively uses IPDS and other standard processes discussed in previous chapters. The company's business model matches very much to the US Government procurement and acquisition system. It has a relatively small number of people working on new business development, marketing, and sales activities. The company follows a pull system to attract customers.

Since the domestic market of Raytheon Canada is relatively small due to the relatively small defense budget of Canadian government, the company has been actively exploring markets outside of Canada for its products and services. The company has also been leveraging its relationship with its parent company to bid for defense projects in US through a specific clause in ITAR regulation. This clause gives permission to Canadian companies to participate in US defense projects if they meet specific conditions including obtaining clearance for their Canadian employees and adopt a rigorous screening procedure to secure their facilities. This clause helped Raytheon Canada to participate in several large contracts including close to \$700M project to modernize air traffic radar systems for FAA and also another project to refurbish old radar systems used for long range surveillance [10, 11].

Raytheon Canada has also been leveraging the historically large value of the US dollar against the Canadian dollar (see Fig. 4.1) and a special exemption under ITAR regulation to take small defense manufacturing orders from several Raytheon's divisions in US.

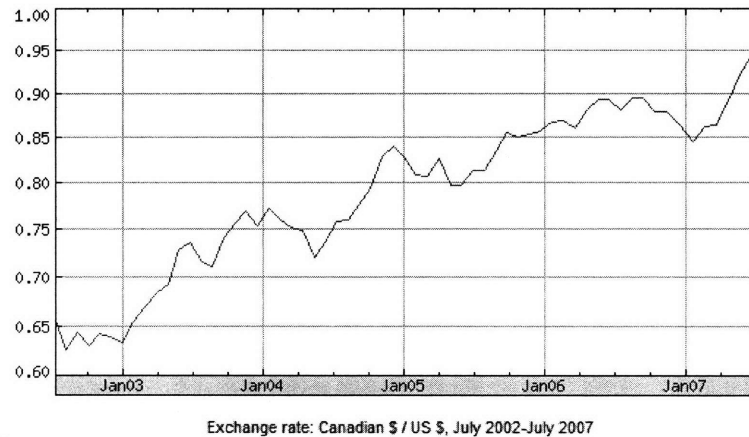


Fig. 4.1 Exchange rate for last five years [23]

For the past four years, Raytheon Canada has invested substantially on modernizing its manufacturing facility, applying lean manufacturing systems, building a certified manufacturing facility under ITAR regulations, employing Canadian citizens only, rigorously training employees, and applying six sigma to make its manufacturing facility a cost efficient destination for Raytheon's manufacturing works. This has provided Raytheon Canada with a secured income for the past several years.

The business model of the company is however facing some serious challenges due to the changes in its business environment. First the company's new product line in maritime surveillance has been exposed to ITAR regulations. This has limited the company in freely offering its products to the international market. It has also forced the company to transfer several employees who have been the core team for company's new technology development. These people did not have enough clearance to work on ITAR enforced technologies. Second the number of projects coming from the US is decreasing. Another challenge is the decline of the US dollar against major currencies including the Canadian dollar. This can potentially affect the company's cash flow as it causes the company to lose its position as a low cost manufacturing destination within Raytheon [11].

Pull vs. Push based Business Model

Since the major revenue of Raytheon has been coming from only few customers, the company does not have plans in place to expand its marketing departments, and invest in marketing research, advertising, and etc. Raytheon divisions have been following the same strategy as the parent company, in seeking DoD like environment in order to minimize their exposure to risks that the company is not prepared to deal with. Having limited number of customers, focusing on cost based contracts, and trying to be considered as the sole vendor, the company did not actively pursue other markets by boosting its marketing efforts.

By adopting the pull system, Raytheon addresses the customer needs only if it is approached by the customers in the form of requests for the proposal (RFP). The production is driven by the demand and the company ideally should not have any inventory unless they are preordered.

The current pull based business model is becoming less efficient for Raytheon Canada as the company tries to explore markets in which the company is not traditionally present and its technologies and products are not known to customers. To go to the new markets or explore the ways to leverage company's capabilities in adjacent markets, Raytheon

Canada needs to integrate push based business model into its current model. Moreover, a way to avoid its product lines to be exposed to ITAR regulations is to develop products for international market.

In a push based business model the consumer does not directly request the product to be developed. It is pushed at the end-user by promotion. At first glance, the pull approach seems more customer friendly and likely to be more effective based on the assumption that the customer knows what he or she needs and therefore they can collect exactly the data or analysis they want, and they are not disrupted by products or technologies which are not relevant to their current needs. One problem is that many customers do not have the time or expertise to visit a number of different vendors outside of their business environment (adjacent markets) to access the various elements they might need. Moreover, customers are sometimes unsure of the big picture and exactly what combinations of solutions could address their needs so they rely on their traditional vendors to address their needs.

By employing the push based system, Raytheon Canada will be able to provide the potential customers in adjacent markets with alternative and non traditional solutions for their needs. Push based systems appear to have a distinct advantage over pull based systems as the delivered solutions are more insight focused and use non-traditional data driven ways where the customers observe no ambiguity in the suggested solutions based on the data.

Combining both business models, the company will have the opportunity of benefitting from the advantages of both models. There are however some challenges in the combined business model such as setting the boundary between two business models. If these challenges are addressed, the combined push-pull system would be an ideal business model for Raytheon Canada. We discuss this subject further in chapter six.

3. Risks in the Business Model

Raytheon Canada is very much exposed to the same risks as its parent company. Identifying these risks is important to validate the sustainability of company's current business model. The risks are listed as follows [22]

1) Relying on US government contracts: Raytheon depends on the U.S. government for a significant portion of its business (up to 84%) and changes in government defense spending could have severe consequences on company's financial position, operations and business. The dependency to US government contracts was intensified by the 2006 sale of Raytheon Aircraft, which derives a substantial majority of its revenues from the sale of business aircraft to commercial customers.

2) Termination: U.S. government contracts generally permit the government to terminate the contract, in whole or in part, without prior notice, at the government's convenience or for default based on performance. In the case of termination for default Raytheon would only be able to collect the payment for the work that has been accepted by the government and the company may be unable to obtain future contracts. This would place Raytheon in a very fragile position in the market as the company heavily relies on governmental contracts.

3) Risk of doing business in foreign countries: The international sales are a significant portion of Raytheon's business. These sales are subject to certain unique and potentially greater risks than company's domestic business as the company needs to face local government regulations and procurement policies and practices which are different than DoD type procurement regulations and policies, including regulations relating to import-export control, investments, exchange controls and repatriation of earnings, as well as to varying currency, geo-political and economic risks. There are also risks associated with using foreign representatives and consultants for international sales and operations and teaming with international subcontractors and suppliers in connection with international programs.

Moreover, to obtain the necessary export licenses and to conduct operations abroad the company needs approval from US state department and Congress and there is risk of not being able to obtain these licenses which could negatively impact the company's results of operations and financial condition.

4) Competition: The Company works in a highly competitive market. The company anticipates increasing competition in some core markets as a result of defense industry consolidation, which has enabled companies to enhance their competitive position, and the anticipated moderation of U.S. defense spending growth, which will limit market opportunities for participants. These markets also are becoming increasingly more concentrated due to the trend of certain customers awarding a smaller number of large multi-service contracts. The company is also facing increasing competition in both domestic and international markets from foreign and multinational firms.

Moreover, some customers, including the DoD, are increasingly turning to commercial contractors, rather than traditional defense contractors, for information technology and other support work.

5) Innovation: The future success of the company depends on keeping new offerings and technologies to address ongoing and upcoming customer needs. These investments are not going to guarantee the timely development of new offerings and technologies due to the design complexity of the products which would result in delays in completing the development and introduction of new products. These delays could result in increased costs of development or deflect resources from other projects.

Moreover, due to uncertainty that resides in the introduction of a new technology to the market, there can be no assurance that the market for new offerings will develop or continue to expand as company currently anticipates. Any failure of the technology to gain market acceptance would significantly reduce the revenues and harm the business. In addition, the company is subject to disruptive technologies coming from competitors

or incumbents which gain market acceptance which might cause the company's existing technology and offerings to become obsolete.

6) *Moving toward fixed-price contracts:* The customers are moving toward fixed price contracts which could place the company to losses in the event that the company misses the schedule. As most of contracts involve developing advanced designs and innovative technologies that have not been done before, the company is exposed to unforeseen technological difficulties and risk of going toward cost overruns and if the initial cost estimates are incorrect, the company would lose money on these contracts.

7) *Doing business in a highly regulated market:* As a government contractor, the company is subject to routine audits and investigations by the government agencies. If an audit uncovers improper or illegal activities, the company will be subject to civil and criminal penalties and administrative sanctions, which may include termination of contracts, forfeiture of profits, suspension of payments, fines and suspension or prohibition from doing business with the government. In addition, the company could suffer serious harm to company's reputation in the market if allegations of impropriety were made against the company. Addressing these requirements increases the performance and compliance costs of doing business with the government and limits its agility to move to non governmental contracts.

8) *Reliance on suppliers and subcontractors:* As a system integrator, the company depends on subcontractor performance and key suppliers to manufacture and deliver its products and services. Due to nature of its business with government, the company must comply with specific procurement requirements, which may, in effect, limit the suppliers and subcontractors it can utilize. In some instances, the company is dependent on sole-source suppliers. If any of these suppliers or subcontractors fails to meet its needs, the company may not have readily available alternatives and this would limit its ability to satisfactorily and timely complete its customer obligations could result in reduced sales, termination of contracts and damage to its reputation and relationships with the customers.

9) *Human factor*: Due to the specialized nature of Raytheon's businesses, the future performance of the company is highly related to hiring and retaining key and talented engineering personnel and managers. Because most of contracts are DoD type projects, the personnel should receive security clearance and substantial training in order to work on certain programs or perform certain tasks. As many graduates of top US engineering schools are international students, this would limit the company ability to hire qualified employees or adequately train employees. The delay in hiring key personnel could seriously harm the business.

10) *Intellectual property*: The U.S. government has licenses in company's patents and certain other intellectual property that are developed in performance of government contracts, and it may use or authorize others to use such patents and intellectual property for government purposes.

Among the above mentioned risks, Raytheon Canada is mainly exposed to the risks involved in the dynamics of the international market. The company's product lines offered to the international market have very similar characteristics to those sold to the US market. Therefore one of the company's major challenges is how to keep its products out of ITAR. The efforts to keep products out of ITAR are costly as the company needs to follow a lengthy process of export-clearing of all product components and also substitute the sensitive components by their corresponding commercial on the shelf (COTS) components. The company also needs to track components which have the potential of being exposed to ITAR. This has increased the risk of losing international customers. That is because a major factor for winning the competitive international bids is the company's ability to provide customers with lifelong support for products sold in the international market.

In fact the company's recently introduced product in the sea domain surveillance has been exposed to ITAR. This has caused some disruption in the process of introducing the product to the market. It has also slowed down the further development of the product

due to the restrictions imposed on the nationality of engineers who can work on this product.

It is important to note the impact of the exchange rate on the business model of Raytheon Canada. When Canadian dollar gains, Raytheon Canada loses its position as a cost effective destination for Raytheon's engineering and defense manufacturing projects.

With US dollar at its minimum value this year ($1\text{US\$}=0.98\text{CAD\$}$), it is actually better to move the manufacturing jobs from Canada to US instead.

Chapter Five

Characteristics of Enterprise Future Business Environment

1. Introduction

Raytheon Canada has been enjoying its position as a global leader for manufacturing superior technologies and product lines mostly in air traffic management systems. However, the company begins to face some serious challenges in conducting business in this market due to changes in the characteristics of the business environment the company is operating in. In this chapter, the goal is to identify and analyze the market and technological trends based on the study of the market research data, customer behavior, strategic goal of parent company, and future product and technology landscape. Through this analysis, the goal is to illustrate the future business environment of Raytheon Canada in more details.

In analyzing the future market environment, first the trend in booking and contract types are discussed. It is shown how the market is changing toward more competitive environment where the customers have more power over the vendors. In this market products are offered with pretty much the same characteristics. Then the trend in customer type is discussed. The study shows that there will be more sales to the international customers compared to current sales which target mostly US and domestic markets. And most of the sales will go to the Middle East with the focus on the homeland security products and Europe with focus mostly on GPS based ATM systems.

In analyzing the future product and technology landscape, first the strategic goal of the parent company is described which is to invest more on products that give higher profit margins but need smaller working capital. In fact the goal is to protect the company against the excessive market risks. In this product landscape depicted by parent company, Raytheon Canada would face challenges in receiving investments from the parent company for its high working capital product lines. For technology landscape, the trend of technology adoption in air traffic management market is depicted. The study shows that the traditional radar based ATM systems are going to be replaced by the GPS based ATM systems. This trend is expected to speed up in the next five years.

Another topic to be discussed in the technology trend is the introduction of HFSWR technology to maritime surveillance and homeland security market.

2. Future Market Characteristics

Booking Type

The market research shows that the company's sole source booking is going to be replaced by the competitive booking in the next five years [11,20]. In this environment, the customers will have more power over the vendors and the companies offer products with similar features. The trend is shown in Fig. 5.1. The company currently has close to 70% of its booking coming from the sole source contracts, while this percentage is going to reduce to less than 20% by year 2012.

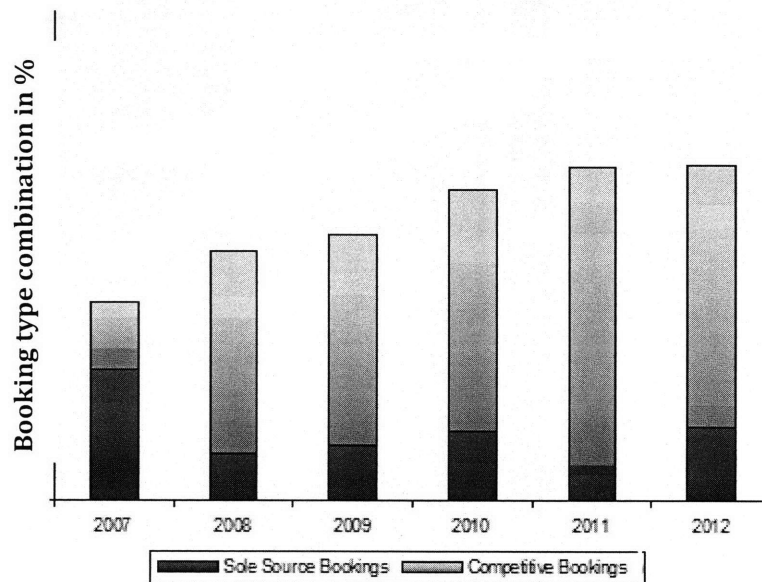


Fig. 5.1 Trend of booking type [20]

The change in the booking type will turn the company position from the sole manufacturer of certain product lines, a position required large investment on R&D and producing highly customized products, to a competitive market in which the companies compete for market share by offering products which are good enough for addressing the

customer needs and have competitive prices with low profit margin. In this new environment, having strong marketing & sales department to find new markets, seeking talented engineers to design products which match the large number of customers and the role of operation managers to plan and implement very cost effective ways to manufacture products are crucial.

Moving from sole source to a competitive based environment requires a change in the business model of the company from a pull based system to a combined push-pull based system. By integrating both push and pull business models, the company is able to address its current markets and at the same time explore new markets. Moving toward mass production of low cost ATM systems for emerging markets and at the same time trying to de-commoditize the ATM system by adding more capabilities needed by high margin customers in developed countries are strategies that Raytheon Canada should consider in its new business model.

Contract Type

Based on a recent study on government’s procurement trend, AMHS, the parent company of Raytheon Canada expects to see a shift in the contract type i.e.from the cost based to fixed price contracts in the coming years [20]. It is anticipated that the cost based contracts will reach its minimum level by year 2009 and after that stabilizes (see Fig. 5.2).

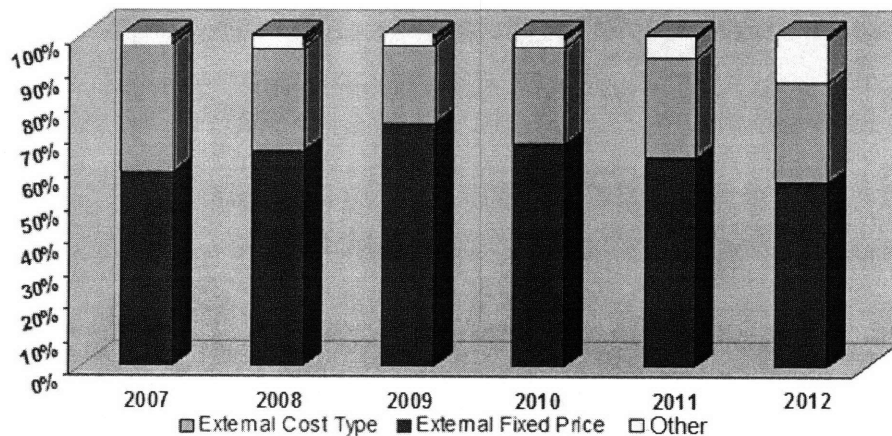


Fig. 5.2 Trend in contract type8 [20]

The prices of the products and the services offered by Raytheon Canada are currently functions of their costs. However, as the company is moving away from DoD like business environment the price of the products are going to be determined by the way they satisfy the customer needs not based on Raytheon's cost structure which corresponds to the efforts and number of different layers of the gate processes used. These processes are used to manage the risks involved in the contracts. A detailed explanation of these processes was given in the previous chapter. As these processes are expensive to pursue, they increase the overall cost of the product which in turn limits Raytheon Canada's ability to come up with a competitive price in a new business environment with growing number of fixed price projects. One suggestion is to adjust the processes based on the size and the scope of the contracts. This way, a competitive price can be set with an acceptable risk level corresponding to the size and the scope of the project. Raytheon has not planned to pursue this strategy yet.

Another challenge is how to adopt a business model which effectively addresses both cost-based and fixed- price contracts. For cost based contracts, there is less incentive for cost cutting. However, for fixed price contracts the story is different and all efforts have to be made toward reducing the cost of the product.

In order to effectively pursue two different pricing strategies within the organization, one suggestion is to revisit the current overhead and cost structure of the company and divide it into two separate accounts each assigned to one pricing strategy.

The discussed trend in the contract type along with the arrival of cheap GPS based ATM systems are pushing the radar manufacturers to offer their products with smaller profit margin. Raytheon Canada is not able to reduce the prices due to the guidelines from its parent company. Therefore, the company needs to work on new technologies and features to reverse the commoditization trend. Accomplishing this with limited and tight R&D budget requires the company to create a very efficient organization for innovation.

Customers

It is predicated that by year 2012, over 60% of AMHS sales will go to its international customers, up by 25% compared to its current sales combination [20] (see Fig. 5.3). This will place the AMHS and its Canadian subsidiary in a new business environment in which the company will be exposed to risks related to different governmental regulations, exchange rates, working cultures, pricing, and competition. Currently, the major contracts of Raytheon Canada are coming from US DoD and FAA so the company needs to expand its international sales to hedge against the expected US sales reduction in the next five years.

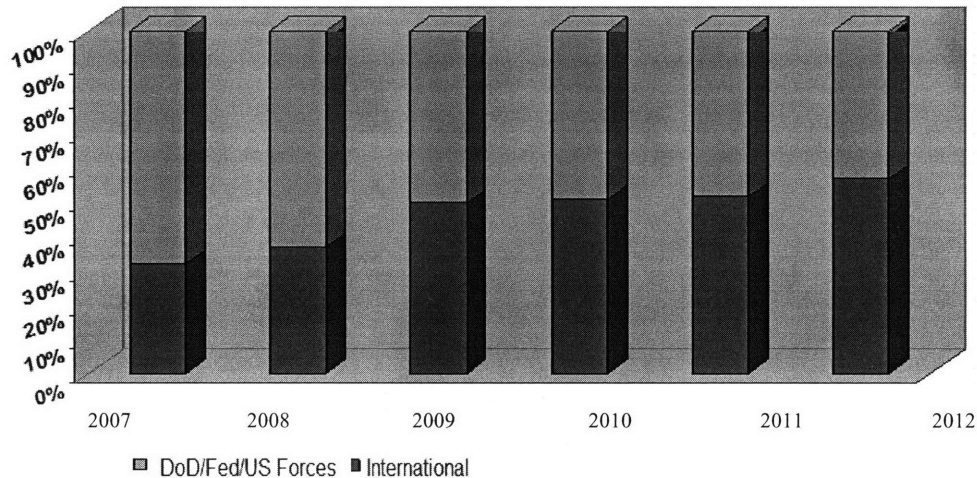


Fig. 5.3 Trend of customer combination [20]

Dividing the international sales based on the continent, Fig. 5.4 shows the largest chunk of international sales will go to the Middle East. The majority of these sales belong to the home land security products where Raytheon Canada offers its MSTT and HFSWR product lines. The next chunk belongs to the European countries in which Raytheon Canada presents its air traffic management systems.

It is important to note that the domestic and also the international homeland security markets are still very fragmented. In order to foster their position in homeland security market, AMHS and Raytheon Canada need to actively participate and collaborate with

government sponsored home land security advanced research projects to understand the priorities of homeland security market.

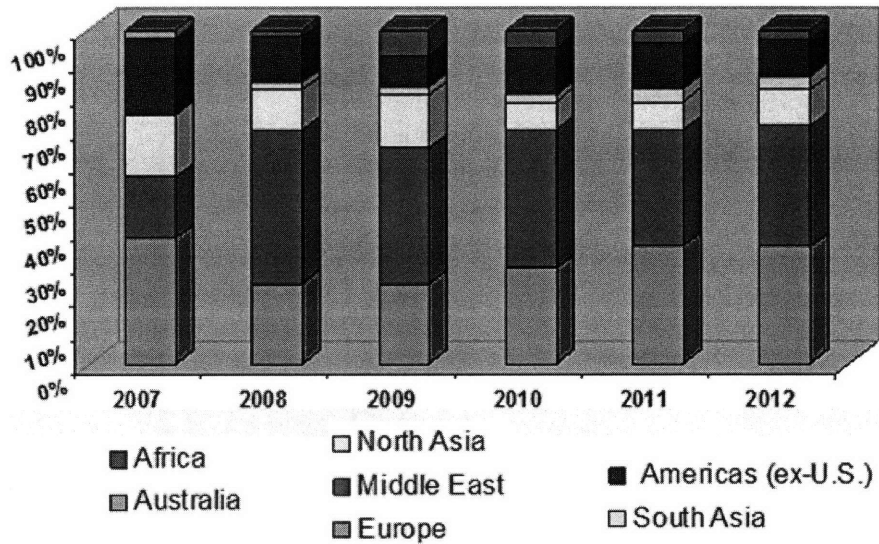


Fig. 5.4 International sales based on the targeting countries [20]

3. Future Product & Technology Landscape

AMHS expects its future product portfolio change from current 70% air traffic management systems (major product lines of Raytheon Canada), 30% other systems to around 45% air traffic management systems and 55% other systems by year 2012 (see Fig. 5.5). This shows a transition of AMHS product portfolio from mostly ATM product lines to higher profit margin systems integration and services particularly in homeland security (HLS) domains. This is a reflection of the market trend and represents Raytheon’s desire to move toward higher margin products and services with smaller working capital. Raytheon Canada needs to align its goals and strategies with these new trends by adopting a new product portfolio in which the more attention should be given to its homeland security product lines such as HFSWR and MSTT and try to provide innovative solutions to the evolving markets in HLS. Since HFSWR is a disruptive technology in the maritime surveillance market, the company needs to take specific

management practice to successfully transfer this product to the mass market. This subject will be discussed in chapter seven.

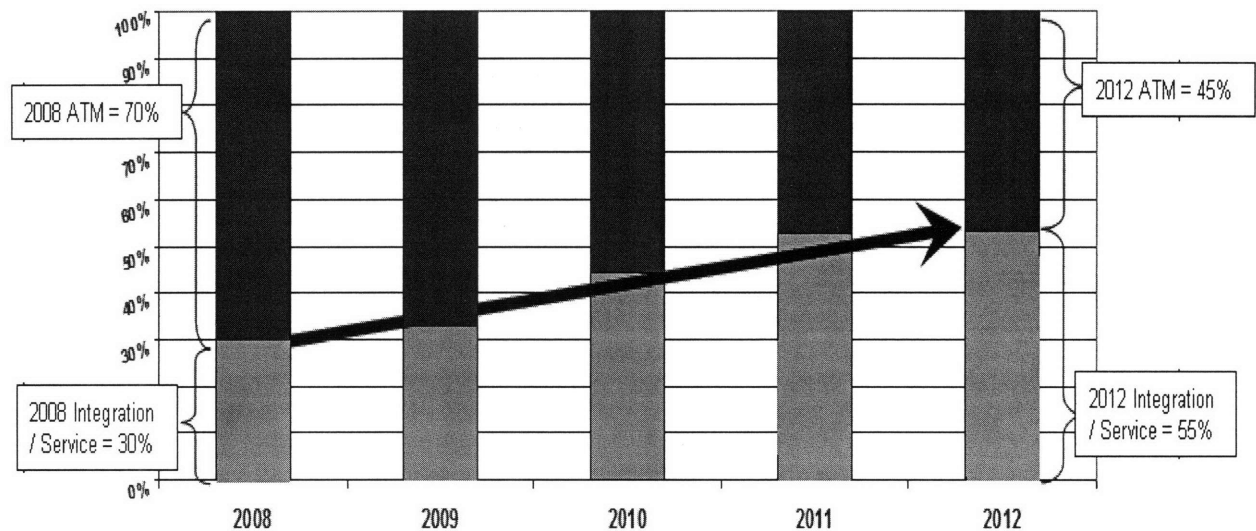


Fig. 5.5 Trend of product portfolio combination [20]

With regards to air traffic management projects, there will be several new initiatives for ATM modernization in every continent. In US, FAA is pursuing NexGen program which transforms the current radar based aviation system to one that uses new technologies, such as global positioning systems and automatic dependent surveillance broadcast [24]. In Europe, the major European program in ATM business area is Single European Sky ATM Research (SESAR) program which is the European air traffic management modernization program [25]. This program is a European Commission initiative to reform the management of European airspace to meet future capacity and safety needs. Another similar program is going to come from Nav Canada for the modernization of ATM systems in Canada [26].

All above programs will not necessarily bring more opportunities to Raytheon Canada due to the arrival of new competitor technologies such as ADS-B in which the company has little or no market share. As an example, the US federal government just awarded a contract in Sept. 2007 worth more than \$1 billion to build the key components of FAA's next-generation air traffic control system. This system relies on satellites, rather than radar, to guide aircraft, and it is expected to allow planes to fly closer together and take

more direct routes, saving fuel and time while reducing pollution. The FAA would eliminate about half of its 398 costly radar installations during the switchover and keeps only some as back-ups in case the satellite system falters and to help detect planes with broken ADS-B devices or planes whose pilots are intentionally trying to avoid detection [27]. A major hurdle in the market acceptance of ADS-B technology is the cost of installing this new technology on every airplane. According to FAA officials, the necessary avionics will be installed on 25 percent of the nation's airline fleet by 2014 and it would take by year 2020 to have all airplanes equipped with this system [28].

This is a blow to AMHS and Raytheon Canada's business sustainability in long run. The company needs to add ADS-B technology to its product portfolio or gradually place itself in a position in this new ATM value chain. The ADS-B is clearly disrupting the current radar based ATM market. The enterprise needs to adopt specific disruptive technology management practice to protect itself against ADS-B technology. This subject is discussed in chapter seven.

For HFSWR, the future landscape is not very clear. The technology is developed to provide countries with a cost effective solution for establishing and maintaining administration, law enforcement and environmental protection over their jurisdiction areas. Currently, the counties use different sensors including very expensive assets such as satellites and airplanes to provide an image of activities over their sea jurisdictions. Comparing the operational costs, the HFSWR costs less than 1% of the operation cost of a typical maritime surveillance system [43]. However, the main problem with the wide acceptance of HFSWR resides in its technical limitations to track targets during night due to the existence of strong clutter coming from ionosphere and also other incoming interferences [43]. Having these technological problems solved, the company still faces the challenges of introducing a disruptive technology to the market. Therefore the trend of technology landscape is very much related to the product strategy taken by Raytheon Canada and also market reaction to this product.

In this chapter some major characteristics of company's future business environment and technology landscape were discussed. In the next chapter, important items that Raytheon Canada has to incorporate in its current business model in order to successfully operate in this new business environment are discussed.

Chapter Six

Transformation to New Business Environment

1. Introduction

By this point, company's current business model and the challenges it faces in executing its business model in a changing business environment are discussed.

In this chapter, after assessing the future business environment of the company, some important items that the company needs to incorporate in its business model in order to successfully operate in the new business environment are discussed. In selecting these items, the goal is to address the most needed changes without affecting the overall business model of the parent company since Raytheon Canada has very limited power to dictate the changes to its parent company.

Based on the market and technology trends in air and sea domain surveillance systems, Raytheon Canada needs to become much more agile in terms of adapting to the new market environment, making strategic decisions to protect itself against disruptive technologies, addressing evolving customer needs through introducing innovative products and services, controlling the cost and coming up with an efficient pricing strategy, and exploring new opportunities to meet the corporate goals.

The above suggestions cannot be effectively implemented unless the company goes through a culture change. Later in this chapter elements for successful culture change including having an effective incentive plan are discussed. In particular the readiness of Raytheon Canada to go through this change is discussed.

2. Transformation to New Market

Booking and Contract Types

The trend in the booking type of Raytheon Canada (from the sole source to competitive environment) indicates that its products are becoming commoditized in the absence of new arrivals to the market. In this environment, the customers have more power over the

vendors and the companies offer products with similar features. The company has invested substantially in the lean and six sigma practice to reduce its operational costs. However, the cost saving was not enough to win some recent international contracts. Raytheon Canada has limitations in reducing the profit margin of its products which is imposed by its parent company. Specifically, Raytheon historically has never been interested in competing in a low margin business environment. The company has built strong capability to introduce innovative solutions and products to its customers. Thus Raytheon Canada needs to reverse the commoditization of its products by introducing new features or add new products to its portfolio. This requires having an organization designed to effectively and efficiently commit to innovation. In the past the cost of developing innovative products was paid by the customers in the form of cost plus based contracts. However, the study shows that the number of these contracts is decreasing specially for international subsidiaries of Raytheon due to their limited access to US DoD projects because of the ITAR regulations. Therefore Raytheon Canada should rely on its own budget to fund R&D and new product development activities. This budget is controlled by AMHS. In recent years, the allocation of R&D budget has been intended to support Raytheon Canada's legacy air traffic systems and replace the obsolete components. There has been less money for introducing new products. In addition, the organization has large overhead charged to the contracted R&D projects.

Considering these factors and adding regulations and other limitations of working on defense projects have created an inefficient environment for innovation within the organization. The company needs to change its organization structure and create an entrepreneurial environment to effectively and efficiently perform innovation. In chapter eight, a new organization structure for innovation is suggested. This proposed organization structure is based on the ambidextrous organization proposed by O'Reilly and Tushman [3].

In the following table the trend in booking and contract type and how to protect the company through changes in the business model are presented.

| Booking & Contract Types | | Why? | How to protect the Enterprise? | Missing in the Current Business Model |
|--|--|---|--|--|
| Current | Future | | | |
| Majority: Sole Source and cost based contracts | Majority: Competitive Source and price based contracts | Commoditization in the absence of new arrivals. | Reverse the commoditization through cost effective innovation, Cut the operation cost (already invested heavily), Match the pricing strategy to the product lifecycle. | An effective and efficient organization for innovation (chapter eight), A new pricing strategy (chapter nine). |

Customers

By looking at the trend of international versus domestic sales for the next five years, it is expected to have a substantial increase in the number of international customers. This will place the company in a highly competitive business environment and expose the enterprise to new risks such as dealing with the variety of regulations, working cultures, exchange rates, etc. The current pull based business model in which the company picks its customers based on their likelihood to the DoD procurement process is not going to address these issues. The company needs to use push based business model to find new customers in the international market. The company should acquire strong knowledge about the new customers, their working cultures, future needs, country regulations, and build partnership with the local companies, invest in the market research, advertising, and train sales and marketing people.

By combining both push and pull business models, Raytheon Canada will be able to address its DoD-alike markets and at the same time explore the new markets. In practice, there are some challenges in the combined push pull business model implementation:

- 1) Company may face cases where two business models overlap. This would generate inefficiencies and confusion in company's marketing and operation activities.

- 2) Designing an incentive plan to address both business models within the organization is challenging and could lead to confusion among participants.

- 3) Managing two business models in one organization is not an easy task for large and established organizations. As each business models requires its own tools, behaviors, management styles, working with suppliers, etc, adopting two business models requires special skills and an agile organization where the decision making process is fast.

- 4) Balancing between two business models needs company’s clear goals and objectives through establishing a portfolio management practice within the organization. This way, the resources are distributed among targeted markets based on company’s long term goals and strategy.

If the above challenges are properly addressed, the combined push-pull system where the pull system is used to address the DoD-alike market and push system used to address adjacent or new markets would be an ideal model for Raytheon Canada’s business model.

| Customers | | Why? | How to protect the Enterprise? | Missing in the Current Business Model |
|---------------------------------------|------------------------------------|--|--|---|
| Current | Future | | | |
| Majority: DoD and domestic customers. | Majority: international customers. | High demand growth in the international markets. Shrinking or flat growth in demand from DoD and domestic market. | Actively pursue new customers in the international market, Investigate adjacent industry for opportunities, Build partnerships, Perform market research , Understand the risks and try to mitigate them. | Combined push-pull business model, building business development and marketing team with specific skills for working in non DoD procurement market. |

3. Transformation to New Technology and Product Landscape

Another trend described in chapter five was the trend in the product portfolio of parent company. It was shown that AMHS portfolio is moving toward products which need less working capital. This forecast places Raytheon Canada with its major product lines in air traffic control systems in a competitive disadvantage position in receiving investments from AMHS for new product development as compared to other subsidiaries of AMHS. Therefore, the company needs to turn its focus to its recently introduced maritime and homeland security product line such as HFSWR. These product lines are currently suffering from underinvestment. As these products are still in their early stage of market introduction constant cash flow is required for product development to address their technical problems. To fund these activities, the company has started selling a few systems to lead users in the market. To price these products the company has adopted its traditional cost plus based pricing methodology. This offers an ineffective way to capture the value of the product and to support product development during its lifecycle. In chapter nine, the dynamics of pricing and its relationship to the product life cycle is discussed followed by some suggestions for an effective pricing strategy within Raytheon Canada.

In chapter five the technology trend of air traffic management system from the traditional radar based to GPS based system was discussed. This trend is expected to speed up in the next five years. Some major contracts have been signed recently to equip airports with this new GPS based technology [26, 27]. In chapter seven the ADS-B technology and how it disrupts the traditional radar based ATM market is discussed in more details. Another exposure to disruptive technology comes from company's HFSWR product line but this time the company behaves as a predator to the maritime surveillance market.

Having its two major product lines exposed to disruptive technologies either as a prey or predator, Raytheon Canada needs to incorporate the best practice in managing disruptive technology in its decision making for investment and product development. Due to the

importance of this subject, the disruptive technology model and best practices based on the product lifecycle are discussed in chapter seven.

| Technology and product | | Why? | How to protect the Enterprise? | Missing in the Business Model |
|------------------------------------|--------------------------|---|---|--|
| Current | Future | | | |
| Majority: Radar based ATM systems. | Majority: ADS-B systems. | Easy to install, Very cheap compared to current radar based systems, Low operating cost, Higher precision | Developing radar based ATM systems which are good enough, Adopt an effective pricing strategy to maximize the return, Limit the investment in legacy systems, Move resources to take position in ADS-B market, Acquisition and partnership. | Disruptive technology management as a pray (chapter seven), New pricing strategy (chapter nine). |

| Technology and product | | Why? | How to protect the Enterprise? | Missing in the Business Model |
|-------------------------------------|---|--|--|---|
| Current | Future | | | |
| A combination of different sensors. | Not clear at this moment, depends upon Raytheon approach. | Easy to install, Very cheap compared to current systems, Low operating cost. | Manage and protect the innovation, Successfully commercialize the product through adopting effective disruptive technology management. | Disruptive technology management as predator (chapter seven), New pricing strategy (chapter nine) |

4. Culture Transformation in the Enterprise

The suggestions made so far cannot be effectively implemented unless the company goes through a culture change. There are different ways to understand the readiness of an enterprise for change. LESAT developed at MIT is an effective tool focusing on the detailed operation of the enterprise [31]. Generally speaking, the culture transformation of an enterprise constitutes eight steps. These steps are shown in the following table.

Table 2.1 Overview of culture transformation steps [29]

| Culture Change Steps | | Tasks |
|----------------------|--|--|
| 1 | Establishing a sense of urgency | Examining the market share of enterprise, its competitive advantages. Identify crises or potential crises and try to find major opportunities |
| 2 | Forming a powerful guiding lead | Forming a group with enough power and sponsorship from top executives to lead the change effort. Encourage different divisions of the enterprise to work with the team. |
| 3 | Creating a vision | Create a vision to help direct the change effort, develop strategies for achieving that vision |
| 4 | Communicating the vision | Using all tools to communicate the new vision and strategies, teaching new behavior by the example of the guiding team members. |
| 5 | Empowering others to act on the vision | Identifying obstacles to change and getting rid of them, changing systems or structure or people that seriously undermine the vision, encouraging risk taking and nontraditional ideas, activities, and actions. |
| 6 | Planning for and creating short term wins | Planning and creating short term and visible performance improvements, recognizing and rewarding people involved in the improvements |
| 7 | Consolidating improvements and producing still more change | Hiring, promoting, and developing employees who can implement the vision, boosting the improvement process with new projects, change agents, and themes, using the credit from short term wins to increase the change activities for systems, structures, and policies that are not aligned with vision. |
| 8 | Institutionalizing new approaches | Articulate the relationship between corporate success and new behaviors, develop incentive plans to motivate people to stay on course, develop leadership to commit and maintain the process. |

Establishing a sense of urgency is the most important step to make a culture change successful. In some cases where the crisis has not been strongly felt by everyone, creating a crisis would be a good way to mobilize the whole enterprise for change. On the surface such moves can look very risky, however the risk of having the company in jeopardy in long term would be much higher if the management play too safe when the urgency is high.

During the course of interviews with several senior managers at Raytheon Canada for this study, the sense of urgency could be seen among them. However, this urgency has not been sensed among senior managers of the parent company yet. There are several reasons

for this misalignment in the sense of urgency for change between Raytheon Canada and Raytheon AMHS management teams. One is due to the strong booking coming from the US government agencies which make the parent company not feeling the punch due to the market share loss in the international markets where Raytheon Canada is a major player. Moreover, since Raytheon Canada provides only small part of the total sales of Raytheon AMHS, there is less attention by the parent company to act upon problems surrounding Raytheon Canada's business environment. These factors along with the current organization structure which gives less decision making power to senior managers of Raytheon Canada have created a misalignment in pushing for changes between Raytheon Canada and its parent company. In order to mobilize the organization for change, more than 75% of senior managers should honestly feel the sense of urgency [29] which as concluded from the interviews is not the case in Raytheon Canada. In forming a powerful guiding team, it is important to bring executives with decision making capabilities on the board. It is not required to bring all company's most executives but the team should constitute powerful people in terms of titles, information and experience, and reputations and relationships.

The vision and strategy have already been articulated by the parent company. The company wants to leverage its expertise to expand and serve international customers so any loss in market share has to be considered seriously. The company is looking for opportunities in adjacent markets so the company needs to build push based business model. Raytheon wants to protect and grow the company business position in core defense markets including C3I (communication, command, control, and intelligent) market [4]. The C3I market is where Raytheon Canada offers its ATM and maritime surveillance systems and is being exposed to disruptive technologies.

Bringing people to help for culture transformation often to the point of making short term sacrifice needs extensive communications through different channels with employees to explain the vision and transformational plan. It is essential to remove any obstacle which prevents employees to participate in change such as removing a few who are blocking the

transformation or changing the organization structure and processes to speed up the transformation process.

Real transformation takes time so that in order to keep the momentum the change plan needs to have some short term success to celebrate. Without short term wins many people give up or actively resist the change. And for institutionalizing changes in the enterprise culture the constant communication with people is required to reiterate that the improved performance is the result of new way of doing business.

Culture Change and Incentive Plan

Any culture transformation requires an effective incentive plan to motivate people to change. In the absence of strong incentive plans in the organization, it is very difficult to change the organization's culture, implement a new strategy, and transfer the organization to a new position consistent with the new market environment.

The current incentive plan at Raytheon Canada comprises of several tangible and non tangible rewards. These rewards are mostly given to few individuals with outstanding performances and achievements. The tangibles are mostly small cash rewards. The emphasis is more toward rewarding individuals for meeting or exceeding the expectations and not on penalizing those for under performing. The bonus system is based on the overall performance of the facility in terms of accounting measures such as sales, profit, and bookings compared to other divisions of Raytheon NCS. The cash bonus calculation is based on a fixed percentage of the employees' annual salaries.

The job growth in Raytheon Canada has separate ladders for engineers and managers consistent with Raytheon's matrix organization structure. This system is not considered as an effective system to motivate people. Moreover, the final decision for job promotion for both managers and senior engineers is made at AMHS and not in Raytheon Canada.

This has created an environment in which it is very difficult to motivate people to change without having commitment of AMHS and Raytheon NCS to change.

In the following section an overview of different incentive plans are discussed followed by recommendations for an effective incentive plan for Raytheon Canada.

An Overview of Incentive Plans

Designing an effective incentive plan which precisely measures the performance of employees as a team or individual is very important in development and execution of the company's culture transformation. The success of an incentive campaign depends on careful planning, clear communications, and accurate administration. The incentive plans discussed here are accounting based incentives and the balanced scorecard.

Incentives Based on Accounting Measures [32, 49, 50]

Accounting measures such as profit, return on equity (ROE), return on invested capital (ROIC), and earning per shares (EPS) are examples being used in this group of incentives. These incentives are easily understood and communicated. The measures are comprised of readily available statistics (particularly for public companies) and are easy to calculate. However, there are some limiting constraints in the use of incentive plans based on accounting measures. These are the impact of tax on calculating the accounting measures, the tendency to focus on short term changes, and the impact of other factors outside of the organization such as exchange rate to accounting measures.

These incentives based on company's long term returns on the invested capital such as Economic Value Added (EVA) [32] have been better suited among other accounting measures. These incentives have the advantage of aligning the management decisions with shareholder wealth. The value based incentive can replace an array of measures already used to express goals and objectives of the companies.

A major problem with value added incentive plans is that they assume that participants understand the entire chain of events that lead to value creation. Therefore, ignoring non-financial measures such as teamwork, customer service, etc which are crucial in creating values but cannot be measured could destroy the value in long term. These plans also have difficulty in measuring some intangible values such as intellectual property and brands.

The Balanced Scorecard

The Balanced Scorecard four performance categories are measured and integrated. These are financial, customer, internal processes, and learning and growth. The financial measures could be simple accounting based or sophisticated value based measurement. For customer aspect, metrics such as responsiveness, quality, and the value added to customers through products and services are measured. In internal processes, the focus would be on productivity and operations. And for learning and growth, the focus would be on how the company develops its skill sets, introduces innovative products and improves its information systems.

The first stage in designing the balanced scorecard is to determine drivers of performance in the organization. Once drivers of performance are correctly identified, designing a customized scorecard is straight forward. For every business units right down to the individual, customized scorecards are developed. By assigning weights to each measure based on its importance and the individual's ability to affect the outcome, the managers can implement their tactics to achieve goals of the organization.

There are several limiting constraints in the use of incentive plans based on the balanced scorecard. Due to several factors incorporated in the balanced scorecard and how they are weighted, there is possibility of being awarded for succeeding in some measures while failing in others. One way to avoid this is to set a lower threshold for each factor so if any of these measures went below its threshold goal, the payout/promotion will not be awarded. An alternative approach could be to allow for negative leverage in certain

measures. In this case, not only could the payout for a measure equal zero, it could in fact subtract from the amounts earned based on performance in the other measures.

There are also some parameters in the balanced scorecard such as the value of the intellectual property which are difficult to quantify. Also if too many parameters are integrated in the balanced scorecard, the incentive plan may lose its focus and participants would be confused in determining the relative importance level of individual measures.

Implementing the balanced scorecard incentive plan takes time and requires management commitment to articulate the company's strategy to participants. A basic scorecard structure might take five to six months to develop, with fine-tuning and adjustments bringing total development time to a year or more.

Recommendations for an Effective Incentive Plan for the Enterprise

Raytheon Canada is using a set of standardized metrics to measure its performance in different aspects of its businesses and operations. These metrics are well designed and provide good understanding of the company's operations. However, the challenge is how to design an incentive plan in order to motivate people for culture transformation. Designing a specific incentive plan for Raytheon Canada is outside of the scope of this thesis as any suggestion for incentive has to be tailored to fit company's detailed operation. There are however some recommendations for designing an effective incentive plan:

1. Incorporate only a few key measures and avoiding integrating too many or too few factors in the incentive plan. Incorporate those factors that are simple to understand and participants have control over them.

2. Set the threshold based on realistic values and avoid all or nothing policy which means that if participants meet the requirement they will receive payment and if not they receive nothing.
3. Have element to support long term goals of the organization through subjective elements such as enhancing team work within the organization or improve the sourcing or establish the culture of innovation.
4. Consider the organization culture in the design of incentive plan. The plan needs to understand the current culture of the organization and incorporate measures accordingly.
5. Have communication up front and continue communication afterwards and provide steady feedbacks to participants. The consistency in plan execution and clarity of the plan would speed up the adoptability of the plan among participants.
6. Revisit the plan often and modify it only if it is necessary. No business environment is static, and the appropriate performance measures today may be irrelevant tomorrow.

Chapter Seven

Disruptive Technology Management

1. Introduction

Raytheon Canada is exposed to two disruptive technologies. First, its ATM product lines are being disrupted by ADS-B technology. At the same time, the company's latest product line in maritime surveillance, HFSWR, is disrupting other technologies currently used in the maritime surveillance market. Currently, the company does not follow a rigorous disruptive technology management practice needed to guarantee its long term sustainability.

In this chapter, first an overview of disruptive technology and its behavior and ways to model it are discussed. Then managing disruptive technology in different stages of product life cycle is discussed. After these introductory sections, the focus will be on ADS-B and HFSWR technologies and on the best tactics to handle them based on their current lifecycle stages.

2. Disruptive Technology Management

Established companies have difficulty embracing new technologies and they sometimes have good reason for it. Moving toward disruptive technologies often means writing off the invested capital for current products or services. It also increases the uncertainty and risks involved in conducting business in the enterprise established market. It has negative short term impact on income statement and balance sheets and makes them instable. That is why the established companies stick to their current management practice and continue to do what they have always done instead of trying to do something they know very little about.

The disruptive technology often leads to the leadership failure, however, it also opens new source of growth opportunities in the market. By looking at the current market size of many technologies tagged as disruptive technologies in the past, it can be seen how these technologies have grown from tiny share of their markets to substantial segment of the market and also have made the whole market grow substantially.

To better understand the disruptive technology, it is important to understand different types of innovation. There are two types of innovations. The first type is a new technology which enables a company to provide better services to its best customers. This type of innovation is favored by many incumbents. Raytheon's DASR radar technology can be placed in this category. The second type of innovation is a new technology which brings to the market something that is simpler and cheaper and not as good as what was historically available. This type of innovation is favored by attackers who seek customers in a less demanding market and constantly improve their products or services. Non-customers are also ideal initial targets for these attackers. This behavior can be explained based on Christensen model [33, 34].

Christensen disruptive technology model

Christensen illustrates two distinct trajectories of technology and customer needs [33]. The performance trajectories define the rate at which the performance of product or service is improving over time. The technology trajectory maps the improvement that innovations in an industry are able to provide to their markets. The customer need trajectory maps the performance improvement that customers in a given tier of a market can absorb over time. This trajectory typically slopes upward over time as customers' sophistication and expectation evolve. These trajectory curves are shown in Fig. 7.1.

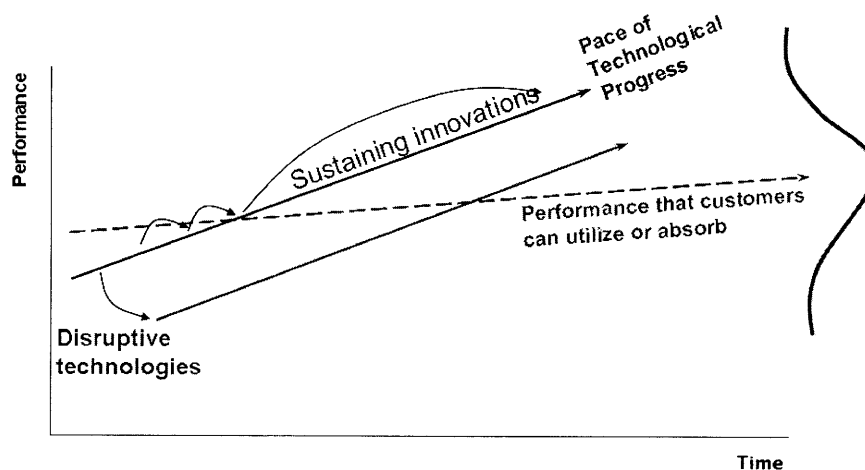


Fig. 7.1 Christensen curves for customer and technology needs [33]

Investigating the above observation in different industries, Christensen has reported that in most industries the slope of technology trajectory is steeper than the slope of the trajectory of customer need. The reason of this difference is that the factors which drive these two trajectories are different. Customer's capacity to absorb technological improvement is affected by how much time they have to learn how to use new product with new features, and how rapidly their work and lifestyles can change to utilize those capabilities. On the other hand, technology trajectory is driven by market's absorption capacity which naturally drive managers to shift the weighted average of product sales into progressively higher tiers of the market since this is the most straight forward path to profitability improvement for most companies as the gross margins of earning in higher tiers of most markets tend to be higher than in the lower tiers.

This so called up-market impetus on managers drive innovations to address customers in higher tiers and fail to do so for those in lower tiers. This creates a vacuum spot in lower tiers of market and a fertile ground for future competitors. The potential competitors use this great opportunity to test their breakthrough or disruptive products or processes which are in their early stages of development and then go through learning-by-doing process to improve their products and move to higher tiers of market which can ultimately become serious threats to existing manufacturer of these products. In short, Christensen model can be interpreted as follows [33]:

- 1) A new disruptive technology initially underperforms the dominant one along the dimensions mainstream customers in major markets have historically valued.
- 2) The disruptive technology has features which new customers value. Products based on disruptive technologies are typically cheaper, simpler, smaller, or more convenient than those established on the dominant technology.
- 3) The leading firms' most profitable customers generally do not want and indeed initially cannot use products based on disruptive technologies. So disruptive technologies are first

commercialized in emerging or insignificant markets and investing in these technologies is not considered a rational financial decision.

4) The new disruptive technology steadily improves in performance until it meets the standards of performance demanded by the mainstream market.

5) At that point, the new (disruptive) technology displaces the dominant one and the new entrant displaces the dominant incumbent(s) in the mainstream market.

The Christensen model has attracted many scholars and industrial leaders. Andrew Grove previous Chairman of Intel called it "Christensen effect" in his talk about Intel strategy and low cost computers for low tiers of market called by him segment zero [35].

The Christensen model has widely been used to explain the relationship between technology and customer need trajectories in many industries and its effect on introducing breakthrough technology. There are however some reports showing extended forms of the Christensen model in which they show that the performance path of some technologies is not linear and as a matter of fact it is punctuated by irregular jumps in performance [37]. Also, these reports show that the customer need trajectory for some technologies is not driven by just price, size, convenience, or simplicity. They believe that the internal cultural aspects of the firm play an important role in the success or failure of the firm. They also showed that large firms are almost as innovative as new entrants in terms of introducing new technologies.

Product Life Cycle Analysis

A new product or service has s-curve shape evolution in terms of cumulative R&D effort. The curve is shown in Fig. 7.2.

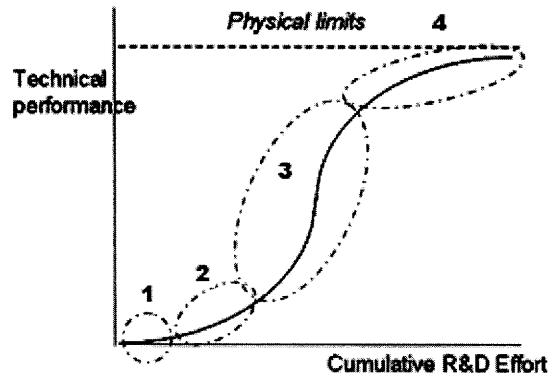


Fig. 7.2 S-curve shape evolution of products

The evolution constitutes the initial stage (stage one) which involves a product filled with many failures, dead ends in product development and many competing versions. This stage requires lots of customizations, working closely with customers, looking for lead users and early adopters, and large growth among lead users.

In subsequent stage of takeoff (stage two), dominant design is evolved and the innovation move to process improvement. In this stage the innovation focuses on product concepts led by small firms. The competition is on features and profits are made through differentiation. The market expands geographically, the sales force starts to grow substantially but not at the same rate of product sales growth.

In stage three, the product or service grows and R&D becomes focused and very productive with few physical barriers. In this stage most firms are forced out and remaining firms are increasingly structured. The profit margin through product differentiation starts to fall. Firms that can exploit economics of scale and mass production, and follow incremental innovation would dominate the industry. In this stage, brand and service become more important and growth starts to fall. There would be channel conflict issue, sales begin to level, new products are derivative, research and development becomes predictable, the firm starts to go after acquisition of other companies to offer an integrated solutions. At final stage (stage four) keeping the product progress becomes more expensive and returns starts diminishing.

As new products or services evolve through their s-curve stages, they require environments with different characteristics in terms of the organization structures, processes, etc. A summary of these characteristics is given below.

Table 7.1 Characteristics of the product environment along its life cycle

| | Product Environment Characteristics | |
|--------------|--|---|
| | Early Stage | Late Stage |
| Product | Several versions | Standard version |
| Process | Skilled labor; General purpose equipment | Specialized equipment; low-skilled labor |
| Organization | Entrepreneurs; High risk | Control; Defined tasks |
| Brand | Not important | Critical |
| Market | Fragmented; Unstable; Rapid feedback | Commodity like; Undifferentiated |
| Competition | Small firms; Unique products | Large and established firms; Similar products |

Managing a disruptive technology involves having managers with special skills to take different approaches based on the product life cycle stage. For example, it is crucial for managers to know that there is a gap on the product lifecycle curve representing the disconnection between early adopters market and the mass market.

In a customer segmentation methodology introduced by Moore [37], he identified a chasm between early stage market and the main stream market. The characteristics of this gap have some misleading points which can confuse managers and make them to take wrong decisions. This chasm is shown below with market size represented by area below each segment.

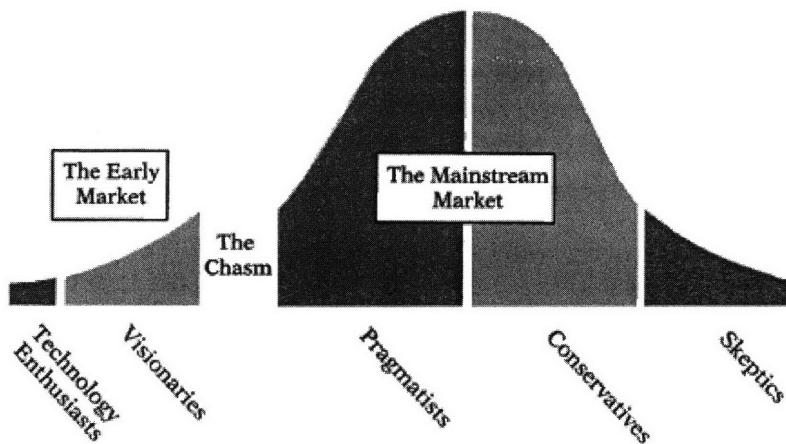


Fig. 7.3 Customer segmentation methodology introduced by Moore showing a chasm between early stage market and main stream market [37]

By studying the Moore gap on the product S-curve (see Fig. 7.4), it was found that the early surge in new product/service demand is related to the strong demand from tech enthusiasts and visionaries. This false surge would pursue some managers to spend their scarce resources and cash on expanding their sales and marketing efforts instead of focusing on research and development efforts to address major inefficiencies of the product/service. The reason is due to the similarity of early false surge and later stage s-curve trend of main steam customers. As the market starts to saturate among visionaries and lead users, the sales techniques stop working, volume drops, morale drops, competition becomes wise and customers become intolerance to product inefficiencies. These factors would pursue managers to stop investing in the product improvement and stop trying to address its major problems and try to divert the resources out of the product/service. These actions would kill the product in its early stages and open the market to competitors who would capture the value by addressing the major issues of the product/service and take the product to pragmatic customers who buy the product for real needs.

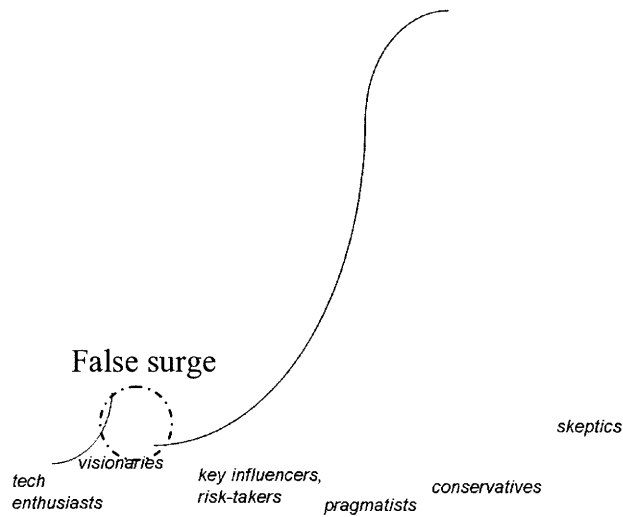


Fig. 7.4 Surge in new product/service demand among tech enthusiasts and visionaries

In the following sections, it is shown that HFSWR and ADS-B technologies can be regarded as disruptive technologies in the sea and air surveillance markets, respectively. Raytheon Canada and in a larger sense AMHS have been targeted by ADS-B, a disruptive technology to the ATM product lines and at the same time Raytheon Canada is disrupting the sea based surveillance market by introducing its HFSWR system.

3. ADS-B, A Disruptive Technology in ATM Market

The Automatic Dependent Surveillance-Broadcast (ADS-B) equipment consists of a simple antenna, a receiver and a target processor, and telecommunications links to send information back to the appropriate control center. The technology is digital, solid state, with no moving parts (e.g., no moving antenna) and a minimal support infrastructure - at a much lower cost than a typical radar site [39]. It gives more accurate aircraft position based on GPS versus radar position, which varies as a function of distance. It has smaller size and portability with significantly lower costs for operations and maintenance. It has

greater durability in remote area with harsh environment or limited access and has less intrusive environmental impact.

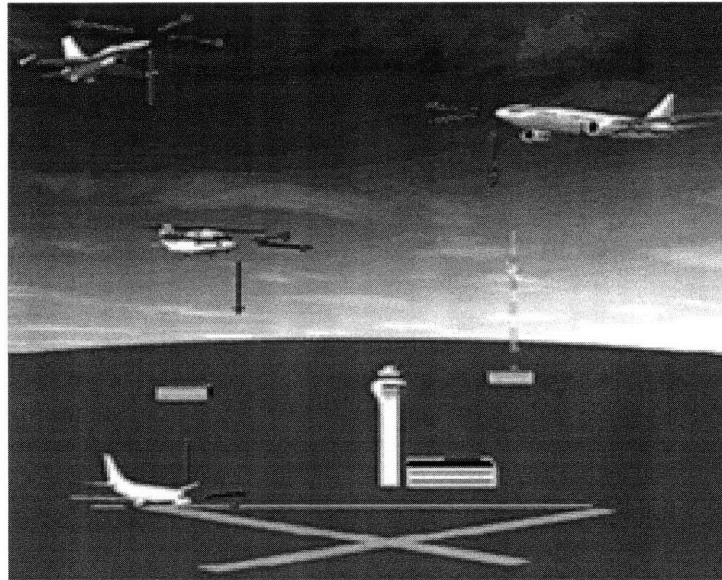


Fig. 7.5 ADS-B Schematic [38]

This technology is a disruptive technology in the ATM market. It has been considered as a substitute for the current air traffic control radar systems; however its technology has not been recognized mature enough to be used in major airports around the globe yet. ADS-B provides a cheaper and simpler way of reporting aircraft positions. This technology was first used in remote areas with no presence of air traffic radar systems. In one example, Nav Canada deployed ADS-B equipment in Hudson Bay to open over 250,000 square nautical miles of new airspace, and reduce the separation standards and expand the airspace capacity by exploring unutilized remote air space area of Hudson Bay [40]. This has provided aircrafts with more fuel-efficient routes and higher altitudes. The technology has been improving to address problems which prevent it from becoming a competitive technology in the air traffic control market. ADS-B is being also installed in the remote areas of Alaska by FAA to provide new economical routes for airlines.

The engagement of two more pragmatic users in air traffic management systems, FAA and Nav. Canada, in the procurement of the ADS-B technology for mostly remote areas,

has placed ADS-B technology somewhere before its taking off stage on the product lifecycle curve. In this stage, the dominant design has been evolved and the innovation is moving toward process improvement. The market is expanding geographically, the sales force starts to grow substantially.

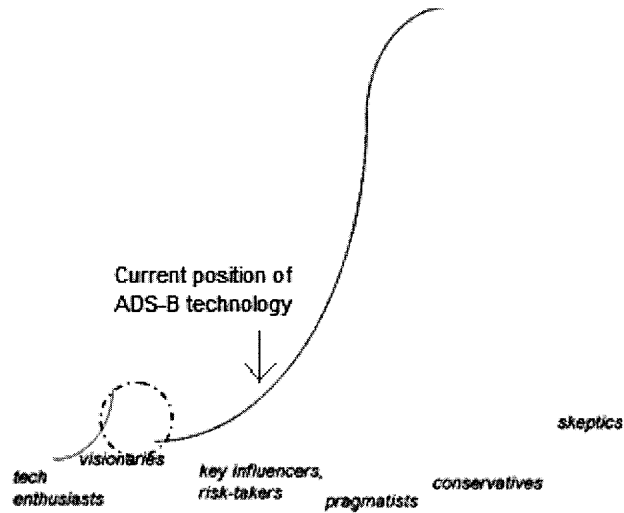


Fig. 7.6 ADS-B technology development stage

The best tactics to protect the company against this evolving technology are:

1. Receive the largest market share of shrinking commercial air traffic control radar systems by aggressively cutting the costs and offering competitive low price systems that are good enough.
2. Limit the amount of investment on its commercial ATM radar and transfer more resources to ADS-B technology and military radar systems.
3. Through acquisition and partnership and use of its current relationship with major customers in the air traffic control market, try to acquire ADS-B technology and gradually increase its market share.

4. HFSWR, A Disruptive Technology in Maritime Surveillance Market

The importance of long range maritime surveillance technology returns to a law passed by the United Nations convention on the law of the sea (UNCLOS) which grants

sovereign rights to coastal nations to over 200 nautical miles of their sea known as the Exclusive Economic Zone (EEZ) [41]. In order to establish and maintain administration, law enforcement and environmental protection, the coastal nations need to procure different surveillance equipments and sensors to gather, assimilate, process, and share data and information up and beyond 200nm from the sea as seamlessly and quickly as possible.

To reach this capability, it is currently required to procure very expensive assets and equipments to provide layered maritime defenses from the ports and coastlines many hundreds of miles to sea. As an example, US Deepwater program which is designed to provide a wide screen of all activities in sea is expected to cost over \$24 billion over 25 years [42]. The program is integrating many assets and sensors including cutters, search aircrafts, choppers, satellites, UAVs, etc. A schematic picture of the program is shown in Fig. 7.7.

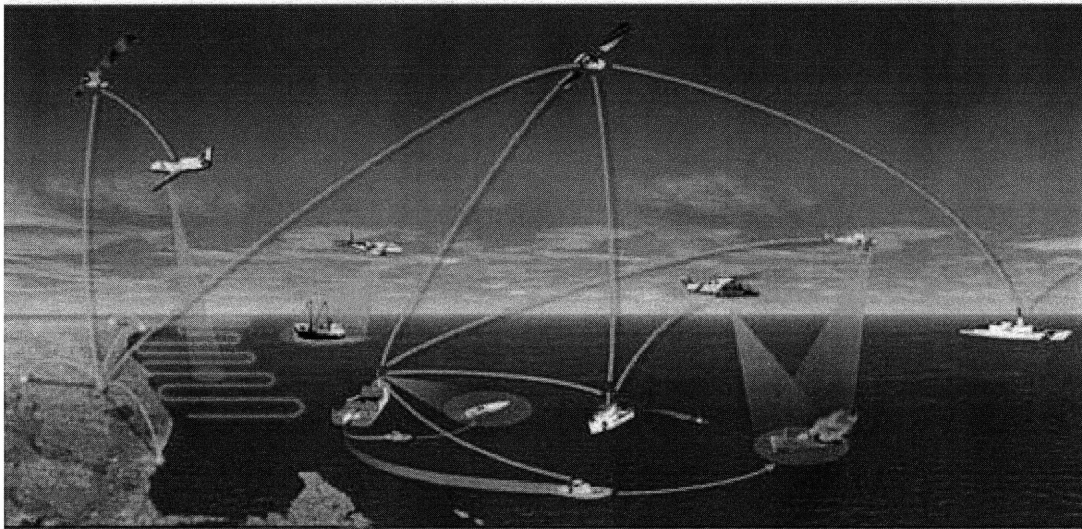


Fig. 7.7 US deep water schematic [42]

Today surveillance's equipments and sensors are extremely limited in terms of their areas of coverage. Available assets are generally deployed in only the most critical areas and are easily bypassed. For example, shore based microwave radars are limited to line of sight (~ 30 nm), airborne radar provides only a snap shot in time of activity in patrol area,

and satellites have neither the spatial or temporal resolution to provide the necessary level of real-time surveillance.

High Frequency Surface Wave Radar (HFSWR) technology is developed to provide coastal nations with a real time 24/7 picture of both surface and air targets throughout the EEZ. Through its traveling waves over the ocean surface, the sensor could detect and track targets beyond EEZ. A comparison of HFSWR coverage and typical marine microwave radar is given below:

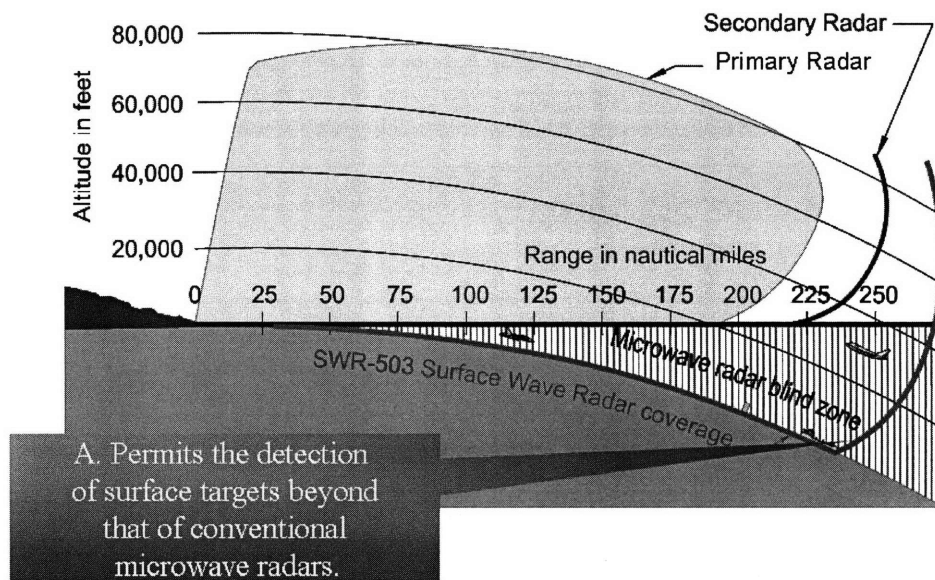


Fig. 7.8 Comparison of HFSWR coverage and typical marine microwave radar [43]

Regarding the surveillance operating cost, if the cost of HFSWR operation is compared against the operating expenses of only three surveillance aircrafts plus one cutter which are enough to provide a basic surveillance coverage over small area, the cost of HFSWR is only 1% of the total operating costs of running above equipments whereas HFSWR could provide 24/7 coverage of over 150,000 square miles.

| Comparison of Cost Saving Benefits from Addition of HF Radar Surveillance: | | |
|---|---------------------------------------|---|
| Asset | Typical Operating Cost (\$CAD) | Annual Cost |
| King Air Aircraft | \$750 per hour | \$3.75M (Typical subcontract for surveillance) |
| Challenger Jet | \$4K per hour | \$1.5M (One 8-hour flight per week) |
| Aurora Patrol Aircraft | \$15K per hour | \$3M (One 8-hour flight every 2 weeks) |
| Coast Guard Cutter | \$6K per hour | \$12M (Seven days at sea per month) |
| Total Annual Cost: | | \$20.5M |
| HF Radar | \$20K per month | 1% of above |

Fig. 7.9 Comparison of cost saving benefits by using HFSWR [43]

A network of HFSWR has already been deployed on the east coast of Canada for several years. It is a proven surveillance technology; however it is still facing some serious technological challenges. Due to operating in a very congested frequency band, the radar is receiving strong noises and external interferences which limit the performance of the radar. Moreover, during the night the reflection from F layer ionosphere generates very strong clutter which substantially limits the radar coverage during the night. The frequency allocation is another challenge which requires a lengthy process of paperwork with different governmental agencies, nationally and internationally. These problems have limited this technology to be acquired by major market players such as US coast guard and Navy.

Given the above facts and by studying them using the Christensen model, the author believes that HFSWR is a disruptive technology to the maritime surveillance market. If its technological problems are addressed and its license for operation in the HF band is granted, this technology could provide customers with much cheaper, more efficient and very effective surveillance capability in comparison to current expensive substitute technologies in the market.

The HFSWR system is gradually addressing its technological problems. Supported by several patented technologies, the radar has fewer problems in terms of being congested by the external interferences. After unsuccessfully marketing this radar among developed countries which are more conservative in making decision to replace their current assets by this radar (because these countries have already invested heavily on alternatives technologies), the HFSWR was receive well by developing countries which do not have an effective maritime surveillance system to protect their coast lines due to very high price tags of alternative technologies in the market. The radar has been sold to countries such as Angola, Sri Lanka, Romania, and etc. The market penetration is precisely following Christensen’s disruptive technology model discussed earlier.

The engagement of countries which are in the desperate need of maritime surveillance system but lack the large amount of cash and resources to acquire current proven but expensive assets has placed these countries as the lead users and risk takers in the maritime surveillance market. This would place HFSWR half way of its early stage toward take off stage (see Fig. 7.10).

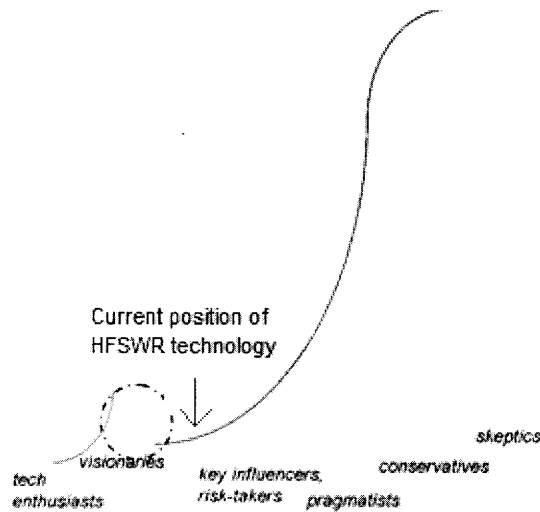


Fig. 7.10 HFSWR technology development stage

In this stage, the best strategy should address the following:

1. The technology still needs customizations. Therefore working closely with customers, addressing key technological barriers, and looking for lead users and early adopters

are of great importance. It is necessary to boost R&D teams and invest heavily to address the above barriers.

2. As it is getting close to the subsequent stage of takeoff, where the dominant design has already been evolved, the innovation needs to move toward the process improvement in order to reduce the cost of developing this product.
3. The competition is on the features, and the profits are made through differentiation so it is required to keep R&D team strong and expanding.
4. As the market gradually expands geographically, the sales force and business support need to grow accordingly to capture the value of the offered technology and acquire more market share. Having an effective pricing strategy would help Raytheon Canada to capture the most value from its new product offering while expanding its market.

Chapter Eight

Organization for Innovation

1. Introduction

The market for the legacy ATM product lines of Raytheon Canada is shrinking and the company needs to focus on developing innovative products and systems in order to compensate the revenue loss and guarantee its growth, profitability, and sustainability.

For the past several years, the company has been spending most of its research and development resources on the incremental innovation of its legacy ATM product lines, adding more features and offering highly customized products to its major customers such as FAA and DoD. Most of the funding for these activities is provided by the customers. The company's R&D operation is costly; therefore as the market is moving toward fixed price contracts, the company becomes less competitive in winning bids and making profit in contracts which require substantial R&D work. Moreover, when it comes to building new capabilities within the organization and investing on innovative products using company's internal research and development budget, it becomes more challenging to achieve company's goals due to the high cost of performing R&D projects and lack of entrepreneurship culture within the organization.

In this chapter a new organization for conducting cost effective R&D projects is suggested. The proposed organization is based on the ambidextrous organization proposed by O'Reilly and Tushman from Harvard Business School. First, the challenges of creating an organization for innovation are discussed. An overview of ambidextrous organization is given next. A quasi ambidextrous organization structure is proposed later in this chapter for Raytheon Canada. .

2. Challenges of Making an Enterprise Innovative

Innovation is the only way for many companies to sustain over the long run. The innovation appears in the form of incremental improvements in the existing products and services or breakthrough innovation which offers radical change in the existing products. A challenge in Raytheon Canada and similar organizations with mature products is how

to constantly attend to the products and processes of the past which provides the major cash flow to the organization, while also looking forward, investing in the innovations that will secure the future of the organization. Most organizations are busy with refining their current products, but they fail when it comes to pioneering radically new products and services. The reason for this failure is due to the difference between goals and strategies specified for exploitative organizations which stick to their products and processes of the past and exploratory organizations which are looking forward and investing on innovation. These differences are stated below:

| <i>Features</i> | <i>Mature Business</i> | <i>Exploratory Business</i> |
|-------------------|--|---|
| Strategic intent | Reduce cost, increase profit | Innovation, growth |
| Critical tasks | Operations, efficiency, incremental innovation | Adaptability, new products, breakthrough innovation |
| Competencies | Operational | Entrepreneurial |
| Structure | Formal, matrix | Adaptive, loose, flat |
| Controls, rewards | Margins, productivity | Milestone, growth |
| Culture | Efficiency, low risk, quality, customers | Risk taking, speed, flexibility, experimentation |
| Leadership role | Authoritative, top down | Visionary, involved |

The failure to achieve breakthrough innovations in a cost effective manner while also making steady improvements to an existing business is a challenge facing many organizations. There have been many theories to describe this problem and provide solutions for it. Some propose that established companies need to used venture capital model, funding innovative products developed outside and try to stay out of their way.

Others suggest cross-functional teams as the key to creating breakthrough innovations. There are also people who believe that the company needs to go back and forth between different organizational structures in order to match to the dynamics of the market.

The author believes the venture capital solution provides a good way to achieve company's goals in terms of ROIC. However, there is a risk of losing the company's competitive advantage due to the exposure of company's IP to outsiders and the company's inability to develop and build expertise inside the enterprise.

To address these problems, O'Reilly and Tushman proposed a new organization structure called ambidextrous organization [3] which can be useful for Raytheon Canada.

3. Overview of Ambidextrous Organization

O'Reilly and Tushman studied several companies in nine different industries [3]. These companies were simultaneously pursuing modest, incremental innovations and more dramatic, breakthrough innovations. The companies had chosen different approaches to develop the breakthrough projects. Some completely integrated their breakthrough activities within their regular organizational and management structure. Some others set up a cross-functional teams operating within the established organization but outside the existing management hierarchy. Some took the form of unsupported teams independent units set up outside of their established organization and management hierarchy. And the rest pursued through ambidextrous organization where the breakthrough efforts were organized as structurally independent units, each having its own processes, structures, and cultures but integrated into the existing senior management hierarchy.

O'Reilly and Tushman discovered that companies which have been quite successful at both exploiting the present and exploring the future have separated exploratory units and traditional exploitative ones. This would allow the organizations to simultaneously adopt different processes, structures, and cultures. These organizations however maintain tight

links across units at the senior executive level. They called these companies ambidextrous organizations [3].

Through several attempts to launch breakthrough innovations, the ambidextrous organizations were significantly more successful than the other three structures. None of the cross-functional or unsupported teams and only a quarter of the functional designs produced real innovations. Even for cases in which a company originally organized its breakthrough initiative around functional designs, cross-functional teams, or unsupported teams and then shifted to an ambidextrous design the initiative's performance increased substantially after the change. In contrast, those companies started from an ambidextrous design and then moved to one of the others; performance decreased substantially.

The ambidextrous organization is offering a practical model to pioneer radical innovations while pursuing incremental gains. The purpose of ambidextrous organizations is to let cross-fertilization among units while preventing cross contamination. The tight coordination at the managerial level enables the new units to share important resources from the traditional units such as talent, expertise, customers, and so on but the organizational separation ensures that the new units have distinctive processes, structures, and cultures and they are not overwhelmed by the forces of business as usual. At the same time, the established units are separated from the distractions of launching new businesses so they can continue to focus all their attention and energy on refining their operations, improving their products, and serving their customers [3,44].

4. Pseudo Ambidextrous Organization for Raytheon Canada

In recent years, Raytheon Canada has been using almost all its R&D budget on incremental improvements of its legacy ATM product lines. The company has very limited control over its R&D planning and expenditure. The budget is set by AMHS based on the customer needs and the amount of investment required for upgrading the ATM systems. The company uses COTS components for making its radar systems. Due

to the short life cycle of COTS components in comparison with the long life cycle of ATM systems, the company needs to continuously commit resources from its R&D budget to support the products, upgrade them, and keep them running for long time. This has added extensive pressure on the company's scarce R&D budget and resources. It has become very challenging to allocate the talents and capital to introduce innovative products and systems other than ATM systems. Moreover, due to the high cost of working on the ATM systems, the company has large overhead cost charged to every company's contract including R&D activities regardless of the mission of the work. This has increased the cost of conducting R&D activities within the organization. As the number of contracted R&D projects is decreasing, the company is increasingly relying on its scarce internal resources which are not enough to fund innovative new products and services. The organization is currently facing the challenge of not being able to achieve company's goals in innovation and long term sustainability.

Having this challenge, Raytheon Canada has started implementing some action plans to reduce the cost of innovation within the company. In one plan, the company has started to treat the contracted research and development projects similar to its internal research and development activities. This way the company charges the overhead which includes items such as office supplies, hydro/water/fuel, transportation, repairs, etc in contrast to previous overhead charges which included other items such as profit, sustainability engineering cost, etc sometime doubling the cost.

Although above action plans have been crucial in making the company more efficient in performing research and development projects, there are still much more work needed to be done to make the organization more efficient. The author's suggestion for Raytheon Canada is to form a small scale ambidextrous organization within the company headed by one of the company's technical leaders who has excellent business knowledge and extensive experience working with customers.

Since Raytheon Canada is working in a highly regulated defense industry, all of its activities and businesses have to be controlled carefully. Therefore, the new organization

has to keep its connection with the company's regulation and compliance department. The head of new ambidextrous organization has to work closely with the rest of the company to make sure the new organization is not caught in the middle of typically long bureaucratic processes. Keeping this connection with the rest of the company and trying to comply with regulations would turn the new organization somehow distant from what O'Reilly and Tushman characterized as a true ambidextrous organization. That is why it is called pseudo ambidextrous organization.

In studying company's barriers for innovation and new product development, it is found that the company is taking all the project risks itself. As a matter of fact, the goal of IPDS and other management tools are to minimize the risk of new product development and commercialization for the company. This has created a risk-averse culture within the organization. The company goal has been to transfer all or at least most of the risks involved in the new product developments to its customers through cost based contracts.

Due to the changes in the market and moving toward fixed price contracts, an action plan should be taken to balance the risks among all stakeholders and not just shareholders of the company. In order to motivate employees and at the same time encourage the company to increase its seed money investment in R&D and new product development, it is suggested that the employees of the new ambidextrous organization as well as the suppliers and the customers split the risks based on their shares in the project outcomes. This way, the company could reduce the initial cost of the product development by paying part of the employees' compensations after the products become profitable with stable cash flow. To motivate employees, the compensation should be inflated by additional bonus based on the amount of risks taken by the individuals/teams and their level of participation in the project.

For suppliers and customers, similar action plans should be conducted to balance the risk.

Chapter Nine

Pricing Strategy

1. Introduction

Designing an appropriate pricing strategy for the new product is a challenging task as it involves the complex dynamics associated with the diffusion of the product in a given market. Pricing decisions usually have to be made recognizing wide margins of error in the forecasts of demand, cost, and competitors' capabilities. The difficulty of pricing new products is amplified by the dynamic deterioration of the competitive status of most new products speeded by today's high rate of innovations. This makes the life cycle of a new product's economic status a strategic consideration in practical pricing.

Raytheon Canada traditionally uses cost plus based pricing technique. This offers a non effective way of capturing value when introducing its innovative products such as HFSWR to the market. It also places the company in a competitive disadvantage position as the market for its legacy ATM systems is declining. Moreover, market trend from cost based contracts to fixed price contracts requires adopting a dynamic pricing strategy matched to product lifecycle.

In this chapter first different pricing strategies are discussed along with their pros and cons. The dynamics of pricing strategy and its relationship to product life cycle stages is discussed next. Suggestions for incorporating an effective pricing strategy for Raytheon Canada are provided later.

2. Overview of Different Pricing Strategies

In this section different pricing strategies including cost based pricing, customer based pricing, economy value based pricing, and their cons and pros are discussed.

Cost Based Pricing

In this procedure, the strategy is to set a price which covers the costs and also achieve the profit objectives of the organization. This strategy is not effective since it does not capture the whole value created by introducing the innovative product to the market. Bringing the cost factor in the pricing is for answering questions such as how much sales loss is tolerable by the organization to profit from a price increase or how much sales gain is required to profit from a price cut.

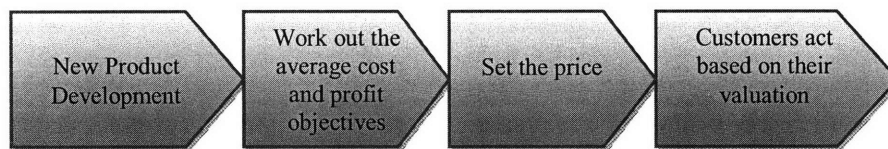


Fig. 9.1 Cost based pricing strategy

Customer Based Pricing

In this pricing strategy, the goal is to set the product price based on what the customer is willing to pay. The vendor tries to fit its cost structure and expected profit to the customer budget. This pricing strategy has some flaws since the price does not reflect the true value of the product to the customer. The customer factor in pricing should be used in segmenting the market based on the amount of values received by different customers. The segmentation results are used to convince buyers to prices supported by the amount of value delivered to the customers.

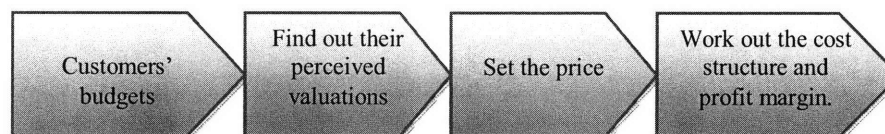


Fig. 9.2 Customer based pricing strategy

Competition Based Pricing

In the competitive based pricing, the goal of pricing strategy is to achieve the targeted sales level and market share. The advantage of this pricing if planned carefully and the company could tolerate loss for some time, is quickly gaining market share from competitors and eventually move them out of the business. If this plan is executed successfully, the organization would be able to recover its loss through its dominant position in the market.

But this pricing is very risky and has some flaws. It is not trying to maximize the profit and may end up to price war which impacts the organization profitability. It also does not reflect the value perceived by the customers. The competition factor should be used to identify market segments which the organization can make the most profit and avoid price war.

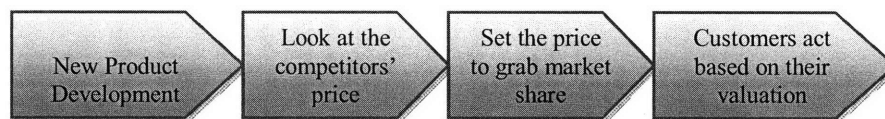


Fig. 9.3 Competition based pricing strategy

Economy Value Based Pricing

The maximum amount a customer is willing to pay assuming that they are fully informed about the benefits of the product and the offering of the competitors is called the economic value to the customer (EVC) [45]. It is a common-sense framework for pricing of non-homogenous goods. The EVC is equal to reference price plus differentiation value. The reference price is the price of substitute asset or comparable product. The customer chooses a product over its comparable assets if that product provides additional value over its comparable assets and this additional value plus the substitute asset price exceeds the product price.

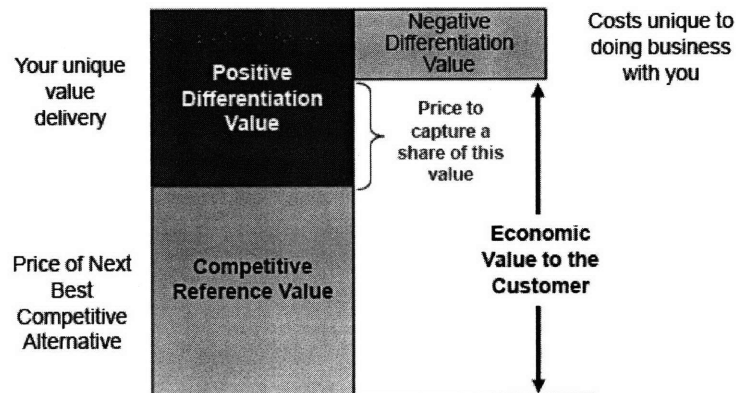


Fig. 9.4 EVC based price determination [45]

One way which customer values the product is based on the rate of return methodology. In this way, the customer looks at the price as an investment. The customer recognizes that the upper limit is the price which will produce the minimum acceptable rate-of-return on the customer's investment. The added profits obtainable from the use of the product differ among customers and among applications from the same customer.

The EVC should always be used for pricing unless there is a failure on having effective communication with the customer or a strategic reason for not doing it. The steps involved in order to execute a successful EVC pricing strategy are [45,47,and 48]:

1. *Understand the customer:* In this stage, the benefit of new products to address the customer's needs is identified. Understanding the sales cycle, customer decision making process, identifying decision makers and the urgency level of needs are considered in this stage.
2. *Identify the price of closest competitive or substitute asset benefit:* In this stage, the substitute asset and closest competitive products are identified and their prices to customers are recognized. The prices are used as the reference.

3. *Identify differentiation factors and their corresponding values:* In this stage, all factors which differentiate the new product from the substitute assets and comparable products are identified. The values corresponding to these factors are then determined.
4. *Determine economic value to the customer (EVC):* In this stage, the reference price is summed or subtracted based on prices corresponding to differentiation factors.
5. *Develop EVC profile for each market segment:* Market segmentation is conducted based on the urgency level of customer needs, the amount of benefit perceived by customers. For each segment, an EVC profile is developed.
6. *Develop marketing program to educate customer about EVC:* The customer needs to be educated about the benefit of the product and a scientific comparison should be given to the customer to recognize the factors which differentiate the new product against its substitute assets and comparable products. The fact that consumers are not buying the product is not by itself a reason to cut price. It may be a reason to change your marketing program to justify the price.

There are however cases where it may be better not pricing at the EVC. Some of these cases are:

1. Differentiation value is hard to quantify.
2. Market winner would take all the market. In this case, the goal of pricing is to evict the competitors from the market and make the winner as the dominant design.
3. Communicating value to the customers or convincing the customers to appreciate the differentiation values is too costly. There are also cases where the pricing might be perceived as unfair and there is no way to convince the customers by finding right communication channels.

4. The barrier of entry is high and there is no way to enter in the market without compromising on lowering the price.
5. The switching costs of products in use are high. In this case, penetration can be made through offering attractive price.

In all above cases, adopting a pricing strategy other than EVC would be considered as a short term strategy to achieve some very important organization goals. The strategy should be switched to EVC based pricing after this transient stage passes. Even in the transient stage, the author believes that the offering prices should be communicated with customers as discounted price rather actual price.

3. Dynamic of Pricing in Different Product Life Cycle Stages

The relationship between the sales volume, cost, and the price of a product during its life cycle stages is shown in Fig. 9.5. In its introduction stage, the new product has a protected distinctiveness which is gradually being diminished by competitive. In this stage, the product needs to be priced using EVC pricing strategy. In order to penetrate in the market, the price may need to be lowered as promotion or discount at early stage of introduction stage. The perceived differentiation value needs to be communicated with the customers and vendor has the power over its competitors. In growth stage, the communication becomes easy due to customer knowledge. The EVC without promotion should be used for pricing as long as the product keeps its distinctive features in the market. As new competitor products enter the field, and as their innovations narrow the gap of distinctiveness between your new product and its substitutes, the comfort zone of pricing discretion narrows. In the maturity stage, the price is determined through the substitute asset and competitive products in the market.

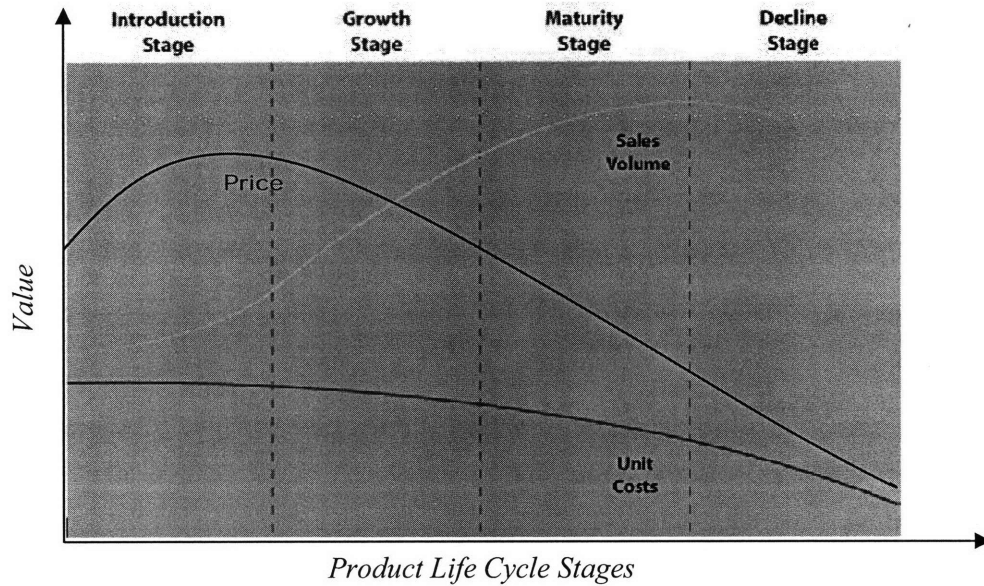


Fig. 9.5 Dynamic of pricing in terms of sales volume, cost, and the price of a product [46]

The maturity happens in three ways:

1. *Technical maturity*: Indicated by declining rate of product development, increasing standardization among brands, and increasing stability of manufacturing processes and knowledge about them.
2. *Market maturity*: Indicated by consumer acceptance of the basic service idea, by widespread belief that the products of most manufacturers will perform satisfactorily, and by enough familiarity and sophistication to permit consumers to compare brands competently.
3. *Rivalry maturity*: Indicated by increasing stability of market shares and price structures.

In the decline stage, keeping the differentiation value is hard. The distinctive features fades into a commodity which is so little differentiated from other products that the seller has limited independence in pricing, even if rivals are few. Throughout the product life

cycle, continual changes occur in promotional and price elasticity and in costs of production and of distribution. These changes call for adjustments in price policy.

The effect of the price of the new product on its volume of sales is the most important and most difficult estimate in pricing. Generally speaking, the lower the price, the greater the volume of sales and the faster its rate of growth. One way to predict the effect of price on sales volume for a new product is by controlled experiments. In this way the product is offered at different prices in comparable test markets under realistic sales conditions.

4. A Pricing Strategy for Raytheon Canada

Raytheon Canada has been traditionally adopting the cost plus based pricing strategy for its products due to requirement imposed by its traditional customers such as US DoD, FAA and Canadian Government. As Raytheon Canada is moving toward international markets where the contracts are going to be more fixed price, the company needs to revisit its pricing strategy and apply the EVC pricing methodology for its products. Currently, the company has started selling a few of its latest developed maritime surveillance systems to the international market through customer based or cost based pricing methodologies. The company has not fully explored the relationship between the product life cycle stages and appropriate pricing for each stage to maximize its profit. In order to implement EVC pricing strategy, the company needs to do a comprehensive study of customer needs and valuation, substitute assets and comparable products (reference point and differentiation value), and product life cycle analysis in order to come up with an effective design for the pricing of its products and services during their life cycles.

The authors suggestion to Raytheon Canada is to adopt the strategy of starting with high prices in the early stages of the market development and then lowering prices at later stages. This strategy has the following advantages:

1. Launching a new product with a high price is an efficient device for breaking the market up into segments that differ in price elasticity of demand. The initial high price targets the market that is relatively insensitive to price. Subsequent price reductions tap successively more elastic sectors of the market.
2. High prices frequently produce a greater dollar volume of sales in the early stages of market development than are produced by low initial prices. When this is the case, high pricing will provide funds to finance expansion into the larger volume sectors of the market.

High initial prices may maximize profits during the early stages of product introduction. They may also prevent sales to many of the buyers upon whom the company must rely for a mass market. A solution to avoid this is to use a few large discount or promotion as an entering point to get into the mass market and discourage competitors to enter into the market.

Chapter Ten

Conclusion

In this thesis, a presupposed work scheme is worked out for new conditions, defined objectives and priorities of the future business model of Raytheon Canada through analyzing the company's current business model and studying its future business environment. The most critical missing elements in the current business model of the company in order to address the future business environment challenges are as follow:

- 1) A combined push-pull based business model
- 2) An effective and efficient organization for innovation
- 3) Disruptive technology management
- 4) Effective pricing strategy
- 5) An effective incentive plan

Solutions are suggested for developing a realistic roadmap to transform the current business model of the company to address the future business environment challenges. In articulating these solutions, attempts were made to minimize the impact on the overall business model of the parent company as Raytheon Canada has very limited power to dictate changes to its parent company. The suggested solutions are as follows:

- 1) Push-pull based business model: By looking at the trend of international versus domestic sales for the next five years, a substantial increase in the number of international customers is expected. The current pull based business model in which the company picks its customers based on their process likelihood to DoD procurement process is not going to help the company to capture these markets. The company needs to integrate the push based business model in its operation to find new customers in the international market. The company should acquire strong knowledge about the customers, their working culture, future needs, country regulations, and build partnership with local companies, invest in the market research, advertising, and train sales and marketing people. The specifications of combined push-pull business model for Raytheon Canada were discussed in chapter 6.

- 2) **Organization for innovation:** The market study shows that the sole source booking position of the company is going to be replaced by competitive booking in the next five years. Also based on a recent study on government's procurement trend, the company expects to see a shift in the contract type from the cost based to fixed price contracts. These trends indicate that the products are becoming commoditized in the absence of new arrivals to the market. Raytheon Canada needs to reverse the commoditization of its products by introducing new features or add new products to its portfolio. This requires having an organization designed to effectively and efficiently commit to innovation.

The company currently has very large overhead which prevents it from efficiently introducing new products. Moreover, the company's current organization lacks the entrepreneurship atmosphere needed to introduce innovative products. A new organization structure to conduct cost effective research and development projects was suggested for Raytheon Canada in chapter eight. The proposed organization structure called pseudo ambidextrous organization is based on the organization proposed by O'Reilly and Tushman [3].

- 3) **Disruptive technology management:** Raytheon Canada is exposed to two disruptive technologies. First, its ATM product lines are being disrupted by ADS-B technology. At the same time, the company's latest product line in maritime surveillance, HFSWR, is disrupting other technologies currently used in the maritime surveillance market. The company needs to follow a rigorous disruptive technology management practice needed to guarantee its long term sustainability. In this thesis, the best tactics to deal with ADS-B technology and how to pursue on the HFSWR technology were suggested.
- 4) **Effective pricing strategy:** The current pricing system used in the company offers a non effective way of capturing the value when introducing company's innovative products such as HFSWR to the market. Also this pricing system places the company in a competitive disadvantage position as the market pushes the company to lower the

prices of its legacy ATM systems. Moreover, the market trend from the cost plus based contracts to fixed price contracts requires the company to adopt a dynamic pricing strategy matched to the product lifecycle. In this thesis, a new pricing strategy was suggested for Raytheon Canada based on the economy value based (EVC) pricing methodology with a dynamic matched to the product life cycle.

- 5) Incentive plan: The above suggestions cannot be effectively implemented unless the enterprise goes through a culture change. In this thesis the readiness of Raytheon Canada to go through this change was discussed and recommendations for establishing an effective incentive plan for Raytheon Canada were made.

The company's limiting factors in successfully transforming its business model are:

- 1) The limiting regulatory environment imposed by International Traffic in Arms Regulations (ITAR).
- 2) The double reporting hierarchy which connects the individual units to the parent company.
- 3) The company's widely-used IPDS system. This system is optimized to address DoD type contracts. This system can not fully address the challenges of working in the highly dynamic international market.
- 4) Lack of strong motivation and wide spread acknowledgement of the need for change among majority of senior managers in both Raytheon Canada and AMHS.

Raytheon Canada needs to work with its parent company to resolve the above limiting factors which could slow down or stop the transformation process. The need for change is clear based on the facts from the market research data and the company's own data sources. The crisis has not been strongly felt by everyone in Raytheon, therefore more communications are needed to mobilize the whole enterprise for change and to start to incorporate the solution proposed in this thesis in the company's business model.

At the end it is my belief that through implementing the solutions proposed in this thesis Raytheon Canada would succeed in adopting a new business model matched to the evolving business environment and continue bringing innovative solutions to the market as it has been doing for over 50 years.

References

1. A. Ostewalder, Y. Pigneur, C. Tucci, "Clarifying business models: Origins, present, and future of the concept", *Communications of AIS*, Vol. 15, pp. 1-43, 2005
2. "The international traffic in arms regulations (ITAR)", Directorate of Defense Trade Controls, US Department of State, Oct. 2007
3. C. O'reilly, M. Tushman, "The ambidextrous organization", *Harvard Business Review*, Vol. 82, No 4, pp. 74-81, 2004
4. "Raytheon's Vision, Strategy, Goals, and Values", 2007 (<http://www.raytheon.com/about/vsgv/index.html>)
5. D. Kim, "Raytheon IDS Engineering, Enterprise Architecture and Communication ", Enterprise Architecture Course, MIT, 2006
6. Q. Fleming, J. Koppelman, "Earned Value Project Management", Third Edition, Project Management Institute, 2005
7. CMMI Information Sources, Software Engineering Institutes, Carnegie Mellon (<http://www.sei.cmu.edu/cmmi/general/>)
8. H. Watts, "Managing the Software Process", Addison Wesley Professional, Massachusetts, 1989
9. http://www.raytheon.ca/ATC_Radar_Systems/index.asp
10. Internal Reports, Raytheon Canada, Waterloo, ON, 2007
11. Interview With Raytheon Canada Senior Managers, June-August 2007
12. T. Allen's Organizing for Innovative Product Development Class, Spring 2006
13. J. J. McCarthy, P.E., PMP, and G. E. Matthern, "Matrix Management of a Functional Organization during Change-Case History", *Technology and Innovation Management. PICMET'99*, Portland, 1999
14. Allen, Thomas J., *Managing the Flow of Technology*, MIT Press, 1984
15. <http://www.raytheon.com/about/r6s/index.html>
16. B. Blair, J. McKenzie, " Raytheon, New Challenges, New Solutions, and Documented Results", www.dau.mil/pubs/arq/2004arq/Blair.pdf, 2004
17. J. Raynolds, "U.S. Expands Significantly The Scope Of The Canadian Exemption To The International Traffic In Arms Regulations", Wiley Rein LLP, April 2001 (http://www.wileyrein.com/publication.cfm?publication_id=7943)

18. "Canada and the United States Sign Arrangement Regarding Application of International Traffic in Arms Regulations", Department of National Defense Canada, News Release, May 2007
19. "Canada's Ethnocultural Portrait: The changing Mosaic", Statistics Canada, 2006
20. AMHS Strategy Report, April 2007
21. "North American Market for Air Traffic Management Systems", Frost & Sullivan, 2006 & "World Air Traffic Control Equipment Market", Frost & Sullivan 1999
22. Raytheon's 10k, 2006
23. Yahoo Finance
24. "NextGen Goal: Performance-Based Navigation", Federal Aviation Administration, Oct. 2007
25. "SESAR, Single European Sky ATM Research, Air Transport Portal of the European Commission" (http://ec.europa.eu/transport/air_portal/sesame/index_en.htm)
26. Business plan for 2005-2008, Vav Canada
27. "Automatic Dependent Surveillance-Broadcast (ADS-B)", Federal Aviation Administration News Release, June 2007 (http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=7131)
28. "FAA Targets 2020 for ADS-B Aircraft Datalink Avionics Equipage", Air Transport Association, March 2007 (<http://www.airlines.org/operationsandsafety/flightops/faa-targets-2020.htm>)
29. J. Kotter, "Why Transformation Efforts Fail", Harvard Business Review Journal, March 1995
30. M. Beer, N. Nohira, "Cracking the Code of Change", Harvard Business Review, May 2000
31. D. Nightingale, Lean Enterprise Self Assessment Tool (LESAT), Lean Advancement Initiative, MIT, 2000
32. S. Chen, J. Dodd, "Economic Value Added: an empirical examination of a new corporate performance measure", Journal of Managerial Issues, Vol. 9, 1997
33. Christensen, Clayton M., The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Boston: Harvard Business School Press, 1997.

34. Christensen, Clayton M. *Innovation and the General Manager*. Homewood, Ill.: Richard D. Irwin, 1999.
35. A. S. Grove, Academy of Management Annual Meeting Keynote Speaker, Aug. 1998 (<http://www.intel.com/pressroom/archive/speeches/ag080998.htm>)
36. E. Danneels, "Disruptive Technology Reconsidered: A Critique and Research Agenda", *Journal of Product Innovation Management*, 21:246-258,2004
37. G. Moore, *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*, HarperCollins Pub., 1995
38. "Surveillance and Broadcast Services, Federal Aviation Administration", July 2007. (<http://www.adsb.gov/>)
39. Frost & Sullivan Report
40. "Nav Canada Makes Move to New Air Traffic Surveillance Technology as Part of \$100 Million Capital Program: First Deployment in Hudson Bay Airspace", News Releases, Nav Canada, 2006
41. "United Nations Convention on the Law of the Sea of 10 December 1982", *Ocean and Law of the Sea*, Division for Ocean Affairs and the Law of the Sea, United Nations.
42. "Integrated Deepwater System Fact Sheet", Acquisition Directorate, United States Coast Guard, <http://www.uscg.mil/acquisition/programs/pdf/deepwater.pdf>
43. HFSWR Technical and Marketing Catalogs
44. Tushman, M.L. & Murmann, J.P., "Dominant designs, technology cycles, and organizational outcomes", *Research in Organizational Behavior*, 20: 213-266, 1998.
45. T. Ambler, "Value-based marketing: Marketing strategies for corporate growth and shareholder value", *The Journal of Brand Management*, Volume 8, No. 6, pp. 463-466, July 2001
46. T. Krishnan, F. Bass, D. Jain, "Optimal Pricing Strategy for New Products", *Management Science Journal*, Vol. 45, No. 12, pp. 1650-1663, 1999
47. J. Dean, "Pricing Pioneering Products", *The Journal of Industrial Economics*, Vol. 17, No. 3, pp. 165-179, 1969
48. C. Tucker, *Lectures on Pricing*, MIT Sloan School of Management, 2007

49. F. C. McKenzie; M. D. Shilling, "Avoiding Performance Measurement Traps: Ensuring Effective Incentive Design and Implementation", *Compensation and Benefits Review*; Jul/Aug 1998; 30, pg. 57-67
50. Kaplan, Robert S., Norton, David P., "Using the Balanced Scorecard as a Strategic Management System", *Harvard Business Review*; Jan/Feb96, Vol. 74 Issue 1, p75-85