The Bluest Ocean Strategy for Emerging ICT Business

Final Report

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School of Management

Contents

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I. Research Overview

1.1 Research Team

Researcher	Name	Position	Specialty
Principal Researcher	GeunHo Lee	Visiting Professor BUILDE School of Management Boston University	Emerging ICT Strategy
Co-Principal Researcher	Mark Gaynor	Professor BUILDE School of Management Boston University	real option applications in ICT Services
Research Assistant	Alan Meirzon Kevin Huang Thanh Tran	Graduate Student School of Management Boston University	Management of Information Systems

1.2 Research Plan

1.2.1 Purpose

The proposed project will combine research about Blue Ocean strategies as described in “Blue Ocean Strategy” by W. Chan Kim and Renee Mauborgne[1] at INSIED, and a real options framework[2] based on Prof. Mark Gaynor’s (at BUILDE of Boston University’s School of Management) PhD thesis, and his book “Network Services Investment Guide” published by Wiley[3] that help quantify the value of experimentation and choice in technology markets.

The goal of this combined approach is developing tools useful to emerging u-ICT (ubiquitous information and communication technology) business that will help chart the most successful strategies for emerging technologies such as convergence network services and RFID/USN (Ubiquitous Sensor Networks).

1.2.2 Development approach

The Blue Ocean Strategy provides a framework and tool set for discovering new markets in traditionally filled spaces by changing the nature of competition away from the normal direction of the industry. This methodology utilizes tools such as the Value Canvas that aids in creating a value curve, the Eliminate-Reduce-Raise-Create grid to help create a strategy, and the Four Steps of Visualizing Strategy to help achieve the desired result.

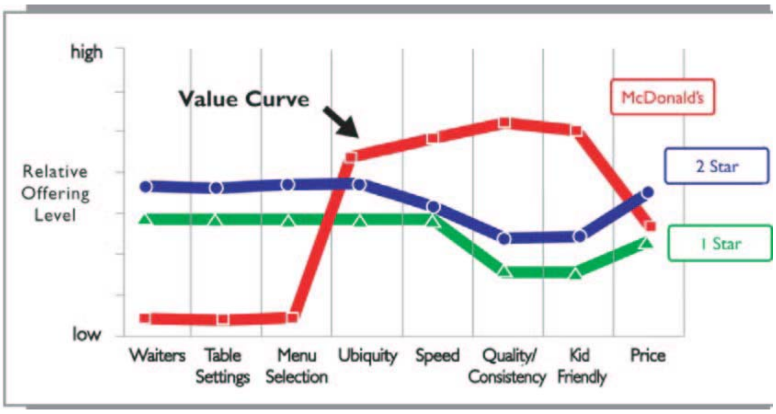

Fig 1.1 Example for Value Canvas

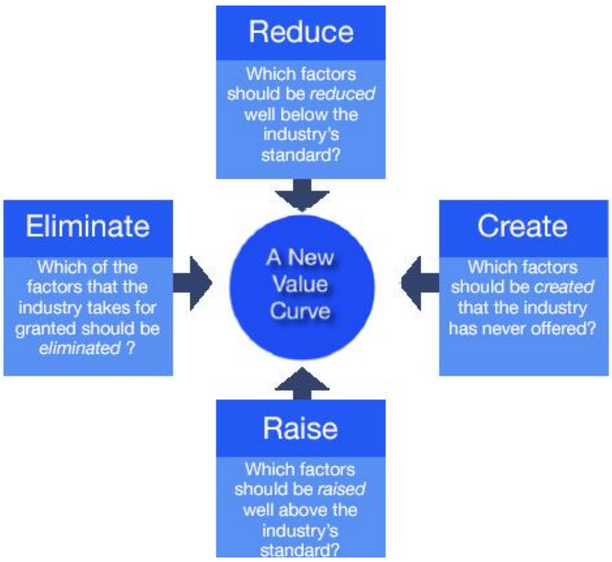

Fig 1.2 Four Actions Framework

This tool set allows discovery of where the blue ocean opportunities are and helps craft a strategy leading to the capture of this uncharted territory. There are many examples of blue ocean strategies that have succeeded in diverse industries from auto manufacturing to mobile network services.

There are limitations to the current blue ocean strategy, namely it does not account for uncertainty in emerging markets (see appendix for details about market uncertainty). The blue ocean method describes how to find a new value curve that shifts competition form traditional markets to uncharted and uncertain markets, but does not help in designing a strategy that maximizes this new market. It does not help manage the new market to benefit from the inherent uncertainty. The current blue ocean methodology does not answer important questions such as: What are the most important characteristics of the value curve to eliminate, reduce, raise, and create? How should you structure new parameters to compete on, when there is uncertainty in this new, uncharted market?

The real options framework developed by Gaynor is one approach to cope with uncertainty in emerging technology markets. This work links the value of experimentation and user choice to market uncertainty. It explains that when uncertainty is high, a more expensive and more flexible infrastructure creates the most long term value, but in cases where there is little or no uncertainty an efficient architecture creates the most value even when it lacks flexibility. Gaynor has applied this framework to network design, service oriented architecture, and communication protocols:

Our research project will merge the blue ocean strategy with a real options framework leading to a set of tools helpful in guiding management towards the biggest untapped market. This combined approach will focus on areas of greatest uncertainty, and suggest strategies that encourage experimentation in these highly uncertain regions, thus maximizing the long term expected value of the blue ocean strategy, in effect helping find the bluest ocean. The real options based blue model strategy is more effective because it enables management to better manage highly uncertain emerging markets.

One example illustrating how a real options framework enhances the descriptive power of the blue ocean model is DoCoMo's i-mode service. This Japanese wireless internet service has proven far more successful than other attempts at wireless mobile Internet services. Unlike other wireless Internet offerings, i-mode offered services that users wanted and were willing to pay for. The blue ocean lens highlights two important attributes of i-mode: a tiered relationship structure, and flexible technology. However, an analysis from the combined theory provides a better understanding of i-mode's success: the tiered service provider relationship, and use of c-HTML protocol (instead of the less flexible WAP) both are strong inducements towards experimentation. By building flexibility in the type of partnerships possible with i-mode, new innovative services were encouraged from both traditional and boutique service providers. The structured nature of these partnerships allowed many service providers to experiment without a formal relationship. Successful services such as "hello kitty" could then evolve their partnership. Combined with a protocol choice of c-HTML instead of the less flexible WAP environment further encouraged experimentation with services and content because it was easier for i-mode service providers to experiment and meet the uncertain market. By adopting policies and technology that encouraged innovation via experimentation i-mode was a stunning success.

1.2.3 Project deliverables

The final deliverable for this project are mid and final report in English and one day workshop presenting our results, and discussing related research ideas with invited Korean and BUILDE affiliated organizations. This workshop lead by BUILDE visiting professor GeunHo Lee, and Professor Gaynor will explore the bluest ocean strategy, and discuss ways to apply it to current technologies of interest such as applications of VoIP services in converged networks and RFID/USN.

1.2.4 Project milestones

Contents	Schedule						Pesearcher
	10	11	12	1	2	3	
Emerging u-ICT Business Blue Ocean Strategy							Lee & R.As
- Strategy Canvas							
- Action Framework							
- Market/BM for uBiz							
Real Options Analysis							Gaynor. & R.As
-Experimental Method Development							
-Analysis for the Bluest Market/BM VoIP Case Study							All
Midterm Report							
Final Report							
Total Progress(%)			50			100	100

II. Review of Blue Ocean Strategy

2.1 Principles of Blue Ocean Strategy

The authors analyzed 150 strategic moves over the past 120 years, and found most enterprises relied primarily on price competition and market segmentation to attract customers. However, the price competition only results in a "Red Ocean," where the costs of competition are very high and the rewards are relatively low. To maintain sustainable growth, the companies need to go beyond competition and create Blue Oceans – "Winning by making the competition irrelevant."

From fundamental economic theories, we know that if the products are homogenous and there is no monopolistic player in the market, then pure price competition will be the result. Basically, price competition is a zero sum game, and the consumers will be the only winners. Therefore the companies only have two choices: either to be the lowest priced product provider or to create heterogeneous products with unique qualities instead, hoping that the customer will be willing to pay a price premium for added benefits. While there is a lot of research about the sources of innovation and the relationship between innovation and productivity, most of the discussion is focused on "product innovation" not "value innovation." Value innovation is the strategy that embraces the entire system of a company's activities. Value innovation requires companies to orient the whole system toward a leap in value for both buyers and themselves.

Hence value innovation goes beyond product innovation. Competition-based "red ocean" strategy assumes that an industry's structural conditions are given and that firms are forced to compete within them. However, value innovation is based on the view that market boundaries and industry structures are not given and can be reconstructed. Therefore, the main idea of Blue Ocean Strategy is how to change the rules and lift the constraints.

While there are plenty of examples of companies who successfully make strategic moves and are rewarded, there are still more of companies that tried and failed. Just like explorers sailing into uncharted waters, companies may find new oceans or get hopelessly lost. Distinguishing the short-term noise from long term trends and finding the right changes to make is not easy. It is risky for any company to move out of their comfort zone. To minimize these risks, the authors proposed six principles of Blue Ocean Strategy:

1. Reconstruct market boundaries
2. Focus on the big picture, not the numbers
3. Reach beyond existing demand
4. Get the strategy sequence right
5. Overcome organization hurdles
6. Build execution into strategy.

Principles 1-4 are formulation principles, and principles 5-6 are execution principles.

Before going into the details of the six principles, companies need to review their competitive situation and challenge an industry's strategic logic and business model. The book suggests the companies ask the following four questions:

1. Which of the factors that the industry takes for granted should be eliminated?
2. Which factors should be reduced well below the industry standard?
3. Which factors should be raised well above the industry standard?
4. Which factors should be created that the industry has never offered?

These four questions can be converted into the eliminate-reduce-raise-create grid. The grid pushes the companies not only to ask all four questions in the four actions framework but also to act on all four to create a new value curve.
In order to put the Blue Ocean Strategy in the practical business applications, the authors articulate the six principles one by one:

1. Reconstruct market boundaries

This addresses the main issue of Blue Ocean Strategy: How to identify and search for a blue ocean market. The authors recommend looking both at static competition and the dynamic changes in the industry. Here, they provide six paths to examine the competition environment:

a. Look across alternative industries
b. Look across strategic groups within industries
c. Look across the chain of buyers
d. Look across complementary product and service offerings
e. Look across functional or emotional appeal to buyers
f. Look across time

2. Focus on the big picture, not the numbers

Most companies don't have a clear and consistent strategy planning, so they are still competing with each other in the existing market. The solution to this problem is to make a strategy canvas. Drawing a strategy canvas does three things. First, it shows the strategic profile of an industry by depicting very clearly the factors that affect competition among industry players. Second, it shows the strategic profile of current and potential competitors, identifying which factors they invest in strategically. Finally, it shows the company's strategic profile or value curve - depicting how it invests in the factors of competition and how it might invest in them in the future.

3. Reach beyond existing demand

To maximize the size of a blue ocean, the companies need to abandon two conventional strategy practices: 1) the focus on existing customers, 2) the drive for finer segmentation to accommodate buyer differences. Because every company in the industry does these two things, this strategy only leads to the red oceans of bloody competition. In a blue ocean, companies need to take a reverse course, and find new customers. The book defines three tiers of non-customers, and provides the ways to reach these customers.

4. Get the strategy sequence right

The companies need to build their blue ocean strategy in the sequence of buyer utility, price, cost, and adoption. The books build a BOI (Blue Ocean Idea) index to examine the ideas in the four dimensions:

a. Utility: Is there exceptional utility? Are there compelling reasons to buy your offering?
b. Price: Is your price easily accessible to the mass of buyers?
c. Cost: Does your cost structure meet the target cost?
d. Adoption: Have you addressed adoption hurdles up front?

After passing the blue ocean idea index, companies are ready to shift gears from the formulation side of blue ocean strategy to its execution.

Principles five and six are execution principles. There are four hurdles in executing the blue ocean strategy: Cognitive, limited resources, motivation, and politics. These organizational behaviors may hamper the success of Blue Ocean Strategy. By clearly addressing the hurdles to strategy execution and focusing on factors of disproportionate influence, the companies can either win them over or neutralize them to actualize strategic shifts. By organizing the strategy formulation process around the principles of fair process, the companies can build execution into strategy-making from the start. With fair process, people tend to be committed to support the resulting strategy even when it is viewed as not favorable or at odds with their perception of what is strategically correct for their units.

Blue oceans will turn into red oceans eventually; however, there are some ways to set up the barriers to block the imitators, such as patent protection, network externality, and the economy of scale. But these ways cannot stop competitors forever and it may cost a lot of money and effort to build these entry barriers, so the companies have to keep searching for new blue oceans.

2.2 Issues with the Blue Ocean Strategy

Successful implementation of the *Blue Ocean Strategy* relies on a company's ability to offer customers products that are considered true leaps in value. While the authors offer guidelines for creating new products/services, their advice is largely procedural rather than strategic. By examining the mobile services market, we seek to identify the factors that lead to successful creation of a blue ocean, as well as the factors that lead to failure.

Kim and Mauborg outline two different paths toward a blue ocean: by creating entirely new industries, as Cirque du Soleil did with its innovative circus/theater/dance hybrid, and by expanding the current boundaries of existing markets, as [yellowtail] did with its beginner-accessible wines. Both methods require companies to successfully predict customer desires, often years in advance. Moreover, they suggest that companies start by focusing on their non-customers – a far larger cohort for which most companies have far less information than they do about their current customers.

The Blue Ocean strategy relies on giving customers something new that they will want, but obtaining that information is easier said than done. Market research is an imperfect science at best, as the high rate of new product/service failures can attest. This task is made harder because customers often don't actually know what they want, especially when asked to evaluate an entirely new blue ocean product. For instance, the strategy canvas, one of Kim and Mauborg's key tools for determining what constitutes a true value innovation only helps companies determine what other companies are doing, not what the customers themselves value. Similarly, the eliminate-reduce-raise-create grid is only useful if customers agree with a company's interpretation of what is important. For this reason, it can be difficult for a company to attempt to create blue oceans without sustaining considerable risk.

At heart, then, the blue market strategy is about making the best strategic decisions amidst uncertain market conditions. Consequently, managers can evaluate potential investments and increase the chances of a successful blue ocean implementation by using real options theory, which attempts to quantify these risks. By using real options rather than more traditional methods, companies can more accurately estimate the true value of their blue ocean opportunities, and pursue the most promising ones.

We propose that by examining the ICT industry through a real options framework, we will find that high levels of experimentation is required to discover which services the customer will pay for in new markets where their needs are unknown. Moreover, the risks and costs of such experimentation are lower when distributed, open systems are favored over centralized, closed systems.

2.2.1 Identifying mobile telecommunication market metrics

The high level of competition in the wireless phone industry has heightened companies' efforts toward attracting customers and keeping existing subscribers from migrating to competitors. A relative lack of distinguishing features, both in mobile phone technology offerings and in service fees, has made customers ambivalent to which company to subscribe with. Furthermore, they continually seek new ways to evaluate the mobile market competitors. Their decision-making has shifted away from the financial analysis of service plan pricing and moved toward a subjective evaluation of customer satisfaction levels and perceived signal quality and coverage.

To adapt to this new scrutiny, companies must complement their cost reduction and margin raising strategies with a focus on unlocking greater customer value in their product offerings. However, they must also be able to accomplish this without segregating their existing commercial and corporate clients and government contracts. The resulting challenge is increasing customer value without decreasing the company's share of the market.

The following nine metrics identify how the principle mobile technology competitors attempt to maintain market share and attract new customers. An understanding of each category will help us identify where value innovation can help companies break into a Blue Ocean of profitability.

1. Cost Structure

To attract customers, mobile service providers are forced to cut costs on brand new phone models. Although this strategy helps to generate an increase in long-term subscriptions (by proportionally lowering the cost of an expensive new phone for each year of contractual obligation), the lower price cuts into the margin per unit of sale.

In addition, mobile carriers are paying royalties to manufacturers for exclusive rights to sell particular phone units before other competitors, as well as for licensing the proprietary network technologies that facilitate mobile communications and other distinct features. Balancing these costs with the revenues generated from unit sales and monthly subscription fees is vital to assessing both the wireless company's profitability and its appetite for experimentation in new value offerings.

2. Customer Satisfaction

The internet is a valuable resource for wireless customers considering a transfer to a new service. Popular websites such as epinions.com have allowed existing mobile users to comment on the services provided by a company and this information is made available to any visitor to the site. As such, companies face the need to keep customers satisfied not only for the risk of losing subscription revenue, but because of the potential for a client's dissatisfaction to dissuade new customers from subscribing.

Customer satisfaction is a difficult metric to excel in, yet in the United States, T-Mobile has managed to consistently maintain the top rankings in the category, despite possessing only half the subscriber base of the larger domestic carriers. In fact, according to surveys, the satisfaction margin over its competitors is considerable. This has contributed to the company's recent growth, while larger competitors continue to exhibit poor quarterly results. It also serves as an indication that perhaps segregating the customer base (and thereby reducing the client pool) can perhaps yield a positive net effect.

3. Coverage

The mobile market uses the number of dedicated cell towers as a competitive advantage in both marketing and sales campaigns. This translates into assured connection signals, but surprisingly, not into voice and data quality, which are instead dependent on the network technology. A company's wireless coverage area either establishes it as a likely candidate for customers or it can reveal one of the reasons for poor adoption rates. Mobile carriers frequently build additional cell towers in underperforming markets. In employing this strategy, companies believe that increasing regional coverage will lead to greater sales, purely by eliminating reasons not to subscribe with that carrier.

Another coverage metric that can be considered concerns domestic versus international service availability. Although this presents more of a concern for corporate clients, wireless carriers that limit their phone capabilities to only domestic service segregate the business users that rely on international coverage. Conversely, a company may find that the financial costs of maintaining necessary partnerships with foreign carriers to provide international coverage may prove too costly. As a result, streamlining the business model can be a profitable idea by altering the cost structure.

4. Innovative Offerings

Recent innovations in wireless technologies have been incorporated into mobile phones. Digital cameras, Wi-Fi connectivity, MP3 capabilities, and even web browsing and email clients are increasingly common among the majority of phone models. This “feature flood” is primarily driven by mobile phone manufacturers, looking to add greater value into each unit sold, while trying to justify rising costs of new models and research and development.

The resulting question is how does this innovation translate into the success of a mobile technology carrier, who is primarily concerned with taking advantage of the manufacturer’s new technologies? Put simply, the introduction of more features translates into more value to company, as the carrier is also able to command a greater margin from unit sales. However, the customer does not necessarily realize this increased value and may therefore find the increased costs a reason to switch to another service provider, offering phone models with fewer features, but at a more appealing price.

5. Exclusive Partnerships with Manufacturers

Mobile service providers continue to maintain lucrative relationships with technology providers. By partnering with both phone manufacturers and wireless technology companies, the carriers ensure that it offers customers the latest phone models and high quality voice and data networks, but at what cost to both the customer and to the carriers' bottom-line?

In the example of the recent Sprint/NEXTEL merger, both companies made separate investments in incompatible network infrastructures (CDMA and iDEN, respectively). After the merger, the joint company discussed the possibility of taking advantage of these disparate networks by using an innovative "bridge" built into new phone models. However, the attractiveness as well as the excitement surrounding this innovation has been diminished due to the increased royalties and resulting higher cost of the phones.

Could consolidating both networks into one have been a feasible alternative? Not when it risked losing a significant number of customers dependent on the sacrificed network. Perhaps another solution would be to strategically migrate all existing customers to a new, yet backward-compatible network topology. Such an innovation would no doubt introduce significant research and development and implementation costs, with only a modest impact, at best (since it targets only existing customers). Instead, the best solution would be to encourage customers to adopt the new phones using an incentive program, leveraging either discounts, or reduced prices on new units.

6. Number of Subscribers

The number of subscribers serviced by a mobile carrier has several implications on its profitability and position as competitor in the mobile technology market. Besides the immediate impact on the company's revenue, the figure also represents a clear metric regarding its client growth and from a more subjective standpoint, the popularity of its service.

However, as we have already seen in the above T-Mobile example, despite trailing other competitors with only half the subscriber base, the company continues to lead in customer value and satisfaction surveys. T-Mobile is often noted for not offering the latest phone models, but at the same time, it receives industry praise for exhibiting a highly efficient cost model. Combined with the favorable customer satisfaction and value results, it would appear that the company's strategy has been very successful, despite its alienation with that of its larger competitors.

7. Distinctiveness

In a market where sales revenue is tied to the availability of new models and where wireless subscription plans and fees offer little distinction between companies, wireless service providers use their network topology and their respective features as a primary source of distinction among its competitors. For example, superior voice clarity and push-to-talk communications are seen as advantages of choosing one carrier over another competitor; a distinction purely based on the implemented network system.

As phone model exclusivity to one company is rarely a permanent fixture and more often a result of which units are compatible with certain networks, mobile carriers struggle to find new ways to distinguish themselves. Attempts to label them as anything more than just mobile technology companies can create confusion in the market and potentially segregate an already strained market. Breaking into any other markets requires changing the company's identity in some way and this could impact existing sales and subscriber figures.

Both Verizon and T-Mobile introduced Wi-Fi services, hoping to complement their existing wireless technology offerings while distinguishing themselves from their competitors. In the case of T-Mobile, its HotSpot service has grown to 5,700 public locations and is the largest carrier-owned Wi-Fi network in the world. Verizon's efforts at introducing similar features have been successful on a corporate level, but the lack of public locations and difficulty of use (as it requires proprietary hardware) has limited its market penetration. Therefore, T-Mobile's attempt to offer an additional service capacity was highly successful in distinguishing itself from its competitors and it was able to accomplish this without segregating or losing existing customers.

8. Experimentation

Market uncertainty plays a significant role in a company's ability to benefit from new innovation and trends, but it also presents an impressive risk to the firm's stability. As such, any sign of a mobile carrier's attempts to break into new markets, expand their current market or introduce new categories of customers to its present offering, shows willingness for experimentation. What must be assessed at the same time is the company's capacity to endure a failure of this effort as well as the amount of emphasis and resources it dedicates to realizing the potential benefits.

Even evolutionary features can present a form of experimentation with the current product line. Cingular's offering of the Motorola ROKR phone, featuring MP3 playing capabilities and synchronization with the Apple iTunes software, was an ambitious attempt to expand its market to include customers interested in purchasing an MP3 player, but without carrying an additional device. The consolidation of the two devices was lauded as a fantastic innovation, but met with overwhelming curiosity, centering on why other, similarly equipped Motorola phones could not also have this software feature.

9. Value to Customers

Figure 2.1 reveals that the majority of mobile technology use is made up of voice communication and address book utility. Why is it then, that clarity of voice data and improved address book features are not strategic initiatives of mobile carriers or manufacturers? The mobile carriers are advertising new phones with digital cameras, and MP3 players, but these are among the least utilized features. Should we extend this analysis to say that wireless companies and mobile phone manufacturers are introducing features that are incongruent with the greatest values exhibited by customers? The Blue Ocean Strategy supports the strategic use of value innovation to break into unexplored markets of opportunity, but by adding new features "for the sake of being innovative," companies are not focusing on the values of the users.

The current wireless phone offerings are ubiquitous, regardless of carrier. This situation in the industry reveals that the companies are shifting away from a customer-focused value model and toward driving demand through the introduction of new, unproven features. This was the case with Cingular's ROKR phone, whose use was easily understood, but the adoption rate and sales were disappointing. The situation also offers an opportunity to shift away from the industry's trend and begin focusing on customer needs to present true value innovation. It will be the company that realizes this opportunity that can successfully move into a Blue Ocean of profitability.

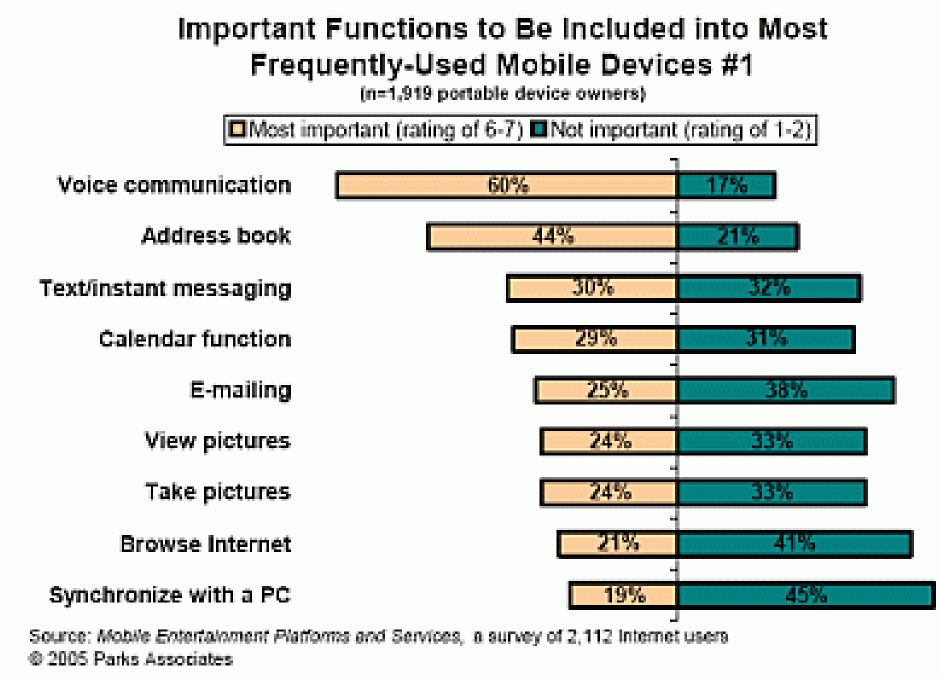

Fig 2.1 Understanding the key values for users

For a contrasting approach to the mobile market, we look at i-mode, arguably the most successful mobile services company in the world. The Japanese telecommunication company NTT DoCoMo launched i-mode February 22, 1999. In the first twenty days, it gained 200,000 customers, and within six months, the customer base reached one million. Now i-mode has over 45 million subscribers and it is the world's most popular mobile internet service. DoCoMo created a new market between the PC-internet market and the cell phone voice-service market. i-mode provides internet services on mobile phones, allowing customers to browse the i-mode sites via their cell phones[1]. Customers not only can check e-mail, but can also search for information about restaurants and movie theaters, download ringing tones and wallpapers, or trade securities through i-mode services.

While there is no doubt that i-mode was popular and successful in Japan, when

[1] I-mode websites are written by c-HTML (compact-Hyper Text Markup Language), so internet sites that are not written by c-HTML may not be displayed properly

DoCoMo tried to apply its successful experience in the international markets, it was unable to replicate its success. There are some possible reasons: 1) the infrastructure in other countries was different, requiring operators to build new systems or upgrade current ones at considerable cost; 2) some of DoCoMo's partners were not the leading operators in their markets[2]; 3) i-mode services are the main attraction to the customers, and due to different cultures and preferences, DoCoMo couldn't just transplant its i-mode websites into different markets; and 4) timing: According to NTT DoCoMo's i-mode report, in 1999, when i-mode service was introduced, the internet penetration rate in Japan was only 15%. This not only increased incentives for consumers to use i-mode, but also allowed i-mode to benefit from lack of competition from other mobile devices and home internet connections. However, internet access is much more pervasive now, and customers need not rely on their cell phones for this purpose.

If we examine i-mode through the strategy canvas and compare it with the US providers, we find that i-mode focused on only a few key metrics: innovation, distinctive services, and experimentation. It made accessing i-mode through its phones very easy to use. Micro-billing allows users to pay for value-added services through their phone bills, and the development of c-HTML, a subset of HTML, made it easy for content providers to provide services. Unlike the circuit-switched networks chosen by WAP adopters in the US, the packet-switched network chosen by DoCoMo allowed for "always-on" connectivity, giving users access to i-mode services whenever they were in the DoCoMo coverage area. WAP users, on the other hand, have to wait for connections to be established before accessing internet services on their phones.

Since we know that the wide variety of services and information provided by i-mode are the key to its success, we need to know how DoCoMo accomplished the development of so many popular applications. Surprisingly, we found that DoCoMo operates less than 10% of the i-mode websites; the content providers run over 90% of these websites. That is, DoCoMo deems i-mode as an open platform, allowing any content provider can provide services to the customers. Certainly, some of them may succeed, and some may not. However, it doesn't

[2] DoCoMo cooperated with Hutchison 3G in Hong Kong, AT&T in U.S.A., KG Telecom in Taiwan, KPN in Netherlands, Bouygues in France.

affect the overall success of i-mode, because it is just a platform. Any innovative idea can be tested in this platform, and the idea will survive only if the customers like it. In fact, this structure's success relies not on extensive and complicated predictions of customer desires, but on well-known market mechanisms, and i-mode's only task is to make sure the market can run efficiently. By passing the cost of experimentation to the content providers, i-mode in Japan was able to lower the cost of experimentation by spreading it across multiple players. This higher level of experimentation in turn generated greater levels of customer satisfaction, and thus greater demand for services.

The following table shows the key factors for i-Mode's strategy canvas:

Attribute	Description
Service Richness	How much the service is full of applications: i-Mode provides only a few killer applications.
Implementation Flexibility	To what extent can the content providers provide new services easily: i-Mode used c-HTML, not WAP.
Connectivity	This value measures the easiness of use for connecting services: i-Mode can connect to a service in one touch button and no logging on process is needed.
Price Model	Measures a company's price competitiveness i-Mode sets the price that was attractive to the mass of buyers by creating a win-win partnership network.
Billing Model	Micro-billing allows users to pay for value-added services through i-Mode bills at one time.
Innovation Potential	A company's business system which can support innovative use and further development: i-mode, as an open platform, allows any content provider can provide services to the customers.

Figure 2.2 shows the strategy canvas for NTT DoCoMo's i-Mode and other conventional (voce over mobile phone and internet over PC) business.

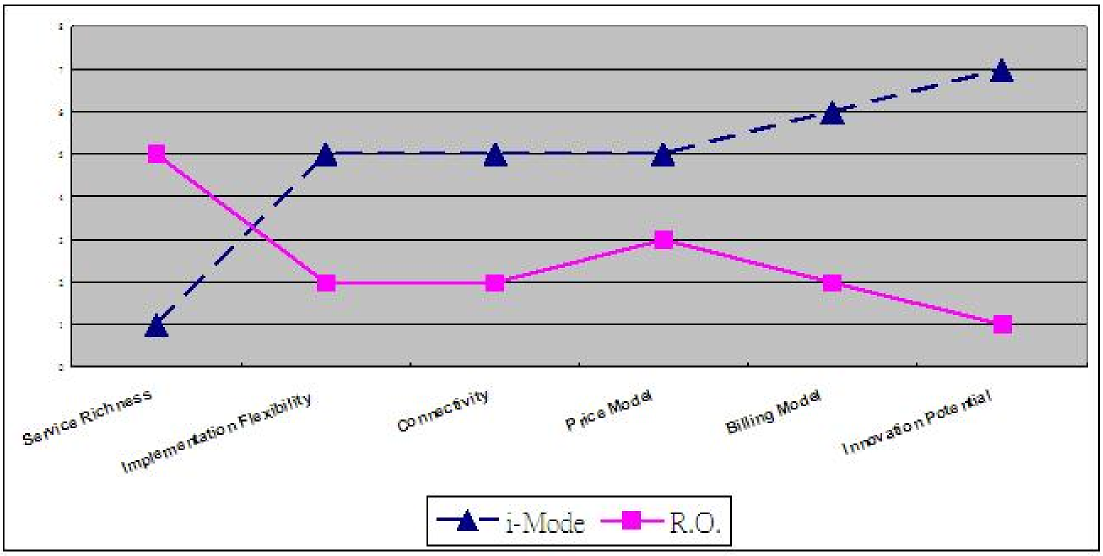

Fig 2.2 Strategy canvas for i-Mode and conventional business.

III. Real Options Based Model

The formal theory presented in this chapter is the framework for a mathematical model that illustrates the tradeoff between market uncertainty and how many experiments there are and the benefits of type of management. The complex interrelationships between the factors influencing the choice of management structure are clearer when the components affecting the choice have a visual representation. This model based on real options, is a visualization tool to help illustrate how these different factors interrelate with each other.

This theory is based on a set of assumptions about network-based services and how users adopt such services in uncertain markets. The theory starts out by examining the value of a network-based service that only has a single generation. The theory is expanded to account for how network-based services evolve over time, and how both service providers and users learn from past generations of the service. This theory explains why market uncertainty increases the value of experimentation and choice, and the importance of market uncertainty to the evolution of network-based services. It illustrates how services evolve from generation to generation as market uncertainty changes, based on the current conditions.

This chapter develops a mathematical model linking the business concept of market uncertainty to the technical aspects of designing and implementing network-based services. The model illustrates the value of a network-based service to its provider as the service evolves in uncertain markets. This model is a framework to aid in understanding the tradeoffs between market uncertainty, the ability of the management structure to foster innovation, and the business and/or technical advantages of building services with management structure.

The model shows that when market uncertainty is high, highly centralized management structure results in services that poorly match the market and often fail. Features that users ultimately want may be difficult to implement with less flexible, centrally managed architectures. This model helps understand how and why the Internet has been so successful in creating services that meet market need, and will enable current architects of the Internet to continue its successful evolution. In addition, the model sheds light on the implication of current important architectural fog, such as Network Address Translation (NATs) and Firewalls, with regard to the cost of such devices in terms of lost innovation in network-based services.

The theory in this chapter agrees with the results of the two case studies discussed in Gaynor's book[3]. Both voice and email services have similarities in the context of what management structures users favored and when. In both cases users migrated to more centralized architecture when market uncertainty was low. Users favored distributed structure when market uncertainty was high because of the need for experimentation. Finding agreement with services from the stupid Internet and the smart PSTN is strong evidence in support of this theory and model.

The first section of this chapter promulgates Gaynor's theory of network-based service architecture. First, the theory defines a set of assumptions to classify types of services and the conditions in which the services evolve. Then, it helps determine the value of a group of services, given that the services and the market for these services follow the assumptions. An explanation of one fundamental concept in real options, the value of the best of many experiments, follows. This theory forms a baseline of a mathematical model validating these ideas.

3.1 Assumptions and Rules

This theory provides a framework useful for analyzing what management structure works best for a network-based service. It does not provide absolute numbers or rules. It illustrates general relationships between market uncertainty and the power of parallel experimentation with market selection compared to the benefit of central management. This framework is useful for developing a strategy to maximize the expected return from investments when building new network-based services, by structuring the service management architecture to allow a proper amount of innovation in feature development, given the market uncertainty.

There are three stages in this theory, beginning with a few simple assumptions and an explanation of the value of providing a choice of services to users, then progressing to a more complete accounting of how services evolve over time in response to market pressures. The first stage shows that the value a provider of a service receives can be random due to the effects of market uncertainty. Next, we show that giving users many options to pick from provides the best chance of achieving a service with a superior market match. Essentially, if users' needs are unpredictable, then by giving them many choices, a really good fit with the market is likely. In the worst case, users will always be just as happy if they only had one choice. In the second stage, the theory expands to account for management advantages gained from centralized management structure for network-based services. We hypothesize that when the advantage of more centralized management structure outweighs the benefit of many experiments, a centralized management structure may be justified. Both the first and second stages look at a single generation of a service; in stage three, the theory accounts for how services evolve from generation to generation. Our hypothesis is that at each generation of a service, service providers learn from the current generation about what will work better for the next generation.

Stage I of our theory starts with several assumptions, definitions, and a basic rule about the value of users having many choices.

Assumption 1

The market demand for network-based services has a degree of uncertainty. This means that service providers may not accurately predict the value they will receive for providing a service since the value of the service to its provider contains an element of randomness. This market uncertainty is denoted as MU.

MU is complex in that users' expectations evolve along with the technology. Users don't know what they want, or how their wants will change over time. The metric for MU should be independent of the market size, because a successful service can alter current markets and create new ones.

There are many examples illustrating market uncertainty. Just consider that the web was unpredicted, or that PBX vendors believed they would capture the LAN data market. For years pundits believed the X.400 suite of email protocols would be adopted by most users, but instead, the Internet architecture became the industry standard. These examples show how wrong vendors and industry experts can be.

Assumption 2

Experimentation with services is possible. The artifact produced by a service experiment performed by a service provider[3] is a service instance. We define a service experiment as the development and deployment of a service instance. There exists a way to gauge the market success of each service instance.

Definition 1

X is a random variable denoting the value to the service provider of a single instance of a service.

Definition 2

A service group is a set of service instances, with each instance available to the user as a service. Users have the option of picking the service instance within a service group that best meets their needs.

Definition 3

[3] The user may be the service provider for services with architectures such as the end-2-end principle.

X(i), i = 1 … n, are random variables denoting the value to the service provider of providing the i^{th} particular instance of a service within a service group of size *n*. With this simultaneous experimentation, each service instance does not benefit from the other instances of services within its service group because they occur at the same time. For the effects of sequential experimentation with services, see assumption 8.

Rule 1

E[Max(X(1) ,…, X(n))] >= E(X), that is, the expected value of the maximum of n simultaneous attempts at providing service instances by some service provider may be far above the expected value. As *n, or the market uncertainty* increases, the possibility of a truly outstanding market match grows.

The left side of this equation is the value obtained by the service provider's best matching service within the market. This particular service instance is the "winning" service. As the number of experiments increases, the expected value of the service with the best market match will grow at a decreasing rate. As MU increases, the value of the best service chosen from many increases at a linear rate.

There are many examples of how good the best of many experiments can be. Consider the web itself; it was the best of many attempts to unlock the potential of the Internet, and it was an astonishing success. Alternatively, consider web-based services; ebay is stunning in its success, but other ventures such as selling furniture online failed. The ability to pick the best of many experiments can have tremendous value.

One way to view Theorem 1 is in the context of options theory; having a choice is analogous to having an option. This theory follows a fundamental idea in options theory - choice and uncertainty increases value. To see this intuitive logic consider the following choice: would you rather own an option for a single stock, or own the option on many different securities (including the single stock) with the understanding that you can exercise any one option, (but only one) of many in the option portfolio? Being able to pick the stock in the group that has gained the most value is clearly the more valuable choice. As the uncertainty about all of the stock's prices grows, so does the value of users having choices.

Giving users too many choices may have the undesirable effect of fragmenting the market. The more services users have to pick from, the smaller the value of a poorly matching service, because of the number of better options the user has. More services within the market imply a greater range of outcomes as to how well any particular service instance will match the market. It is possible that many service providers will lose everything if their service is a poor market match and there are many better matches available for users to choose from. Another concern is that many parallel experiments are not an optimal solution in regards to society as a whole. The increased total cost of providing *n* services, while knowing that many of those services will not succeed (fortunately the world is not rational[4]), is not the lowest-cost solution. However, this is countered by the greater value of the best service; the winner does have the optimal solution, and will profit handsomely. In general, the expectation is that the market percentage captured by a service instance is proportional to how well the instance of this particular service matches the market.

Next we present a set of stronger assumptions, leading the way to a deeper theory about the type of service management structure that works best for a given degree of market uncertainty. The following helps to clarify what it means to allow easy experimentation in a network:

Assumption 3

The function representing the value to the service provider of providing a particular instance of a service that best matches a particular market is non-linear. More experimentation and greater uncertainty increase the expected value.

[4] Just look at the changing market value of beanie babies, pokemon cards, and .com companies.

That is, by undertaking more experiments when MU is high the expected value of the best of these experiments might far exceed the value of a single attempt at providing the service. The variability of the service's value determines the value of the option.

Assumption 4

Experimentation with providing service not requiring changes within the network infrastructure or permission from the network manager (for example - true end-2-end services) is in general, less disruptive to other users and less expensive than experimenting with services that require changes within the network, or permission from a central authority.

Assumption 4 is very important to innovation. Changes within the network infrastructure require permission from those controlling the network. New end-2-end services do not require permission. For example, one person can implement a new HTTP header without asking. Then, by proposing it to the IETF, the market has the chance to accept or reject the change[5] . If Tim Berners Lee, the Web's creator, required permission from a network authority to experiment with the Web, it is less likely that he would have been successful.

Assumption 5

If a real or potential market exists that is not being met, then the less disruptive and less expensive it is to experiment, the more experiments there will be.

One good example of this is the large amount of experimentation with web-based applications. Clearly, there is strong market demand for some web applications. It is also easy to experiment with different web-services because of the open nature of Internet and web standards, and the distributed management architecture of the Internet. Over the last several years,

[5] In this case the IETF is acting as the market and selecting the technology with the best market fit. One can also argue that the IETF can standardize technologies that have already been selected by the market (the original HTTP is such an example)

experimentation with web-based applications was very high. It seemed that if you could spell Internet, you could get VC money to develop a new web-based application. But, as the .com bust illustrates the market uncertainty was high because of the many failed ventures. As expected, some services such as information portals (CNN) are successful, but other ideas, such as on-line grocery shopping, have cost venture capitalists hundreds of millions of dollars, which illustrates the great experimentation and high market uncertainty.

The next assumptions discuss the conditions under which the advantage of experimentation and choice is not enough to outweigh the inefficiencies of distributed management structure. The case studies of voice and email network-based services show how there are different ways to provide each of these services, with different management structures. For these particular services, there are clear business and technical advantages to the more centralized architecture.

Assumption 6

For some services, business and technical advantages lead service providers to provide services that are more centrally managed. Let this advantage be represented by BTA as defined above. For these services if MU is zero, then centralized management structure makes sense.

Assumption 7

There are services for which market uncertainty is low relative to BTA, and this uncertainty will remain low with high confidence.

Some reasons for low market uncertainty are: regulation that may prohibit choice (such as the early history of voice services), service providers who have learned from previous attempts to provide the service, or technology that is mature, such as PBXs in the mid and late 1980s. It is important to understand that this high confidence of low market uncertainty does not include paradigm shifts (for example, the SPC PBX's - see Chapter 9). Paradigm shifts are generally not predictable.

Rule 2

If *(E[Max(X(1) ,…, X(n))] - E(X)) < BTA*, a service provider should consider providing a service with a more centrally managed architecture.

That is, if the advantage of market uncertainty combined with *n* simultaneous experiments is less than the business and technical advantages of central management, then a centralized management structure will work best. Furthermore, a single service choice with more efficient centralized management will meet market needs as well as several different choices with less efficient distributed management structure, because the low market uncertainty makes it easy to always meet the market.

This theory only looks at a single generation of a service. This is not realistic because services evolve over time. Below, we expand this theory by incorporating the evolution of services over time; in each generation, there will be *n* different attempts (experiments) to provide a service with a good market match. Thus, each service generation is composed of many service instances from simultaneous experimentation (that is, a service group), which are the efforts of one or many different contributors. This theory incorporates service providers learning from previous generations of experiments, thus reducing the market uncertainty from generation to generation.

Assumption 8

As a service evolves over many successive generations, each generation of the service consists of a group of service experiments, with each experiment producing a service instance. Services exist for which the market uncertainty decreases in a predictable manner as a function of the service generation.

Rule 3

Service providers are likely to succeed at providing a service with centralized management in the first generation of the service when the advantage of MU and parallel experimentation do not outweigh BTA. The service provider should wait no longer to provide the more centralized architecture than the generation of the service when the advantage of MU and parallel experimentation summed over all future generations will never overcome BTA.

This rule is used to decide the upper and lower bound of when to switch management structure of a network-based service. When to migrate depends on the number of generations a service is expected to evolve. Longer evolution implies that experimentation will still be of more value than central management, because over time the service will continue to come closer to meeting the changing market.

Assumption 9

Technology changes the range of possible services.

One example of a technology change that completely changed a market was the leap from a step-by-step PBX to SPC architecture.

Rule 4

If technology changes, market uncertainty may increase.

Another example of this is VoIP. This new paradigm to provide voice over data packet networks is creating large amounts of uncertainty about the future of voice services. It is very different from the current technology of switched circuits. For now, nobody is sure what features will have the most value to users as this new technology evolves.

This theory is fundamental in understanding how to design the management structure of network services. It provides a framework to analyze the management structure of a service with respect to market uncertainty, and the number of experimental attempts to provide the service compared to the potential advantage of centrally managing the service. It shows that when a centrally managed service has advantages from a business and/or technical perspective, the market for the service may still be better met with services that have distributed management structure, because such management structure allows more experimentation with features. When users have more choices that are more diverse, the winning service provider is able to reap huge profits because its service offering is a superior market match.

The next section provides a framework for a mathematical model showing Theorem 1 expressed in terms of a classic model in statistics known as maximum or extreme order statistics.

3.2 The Value of Many Experiments

This section explains how providing a user with choice creates value for the service providers, and how this value increases as market uncertainty grows. As shown above, it is difficult to match services to markets when market uncertainty is high. To a single service provider, providing a new and innovative service is a gamble: sometimes you win, sometimes you lose, and sometimes it takes a while to determine if you've won or lost. Service providers cannot predict how well a service will match the market. (see Assumption 1). However, many service providers can experiment creating *n* service instances. Then let the users pick the best outcome (as stated in Theory 1 above)[6]. The expected outcome is much higher. Picking the best of many experiments has the potential to greatly exceed the expected value of a single experiment.

[6] We are assuming that the parallel experiments have no correlation to simplify the mathematics, but the results still hold no matter what the correlation.

Assuming a normal distribution for the value of an experiment, Figure 3.1 shows what we expect to happen by attempting several parallel experiments for a particular service. It shows the probability of experiments being a particular distance from the mean. *V = E(X)* denotes the expected value of a particular experiment. Looking at the percentages in Figure 3.1, we expect that 34% of the experiments will fall between the mean and +1 standard deviation from it, 13.5% between 1 and 2 standard deviations, and 2% between 2 and 3 standard deviations from the mean. To find a superior service we expect to need over 769 experiments to find one that has a value greater than +3 standard deviations from the mean. This illustrates that finding great services may take on the order of 1000 attempts.

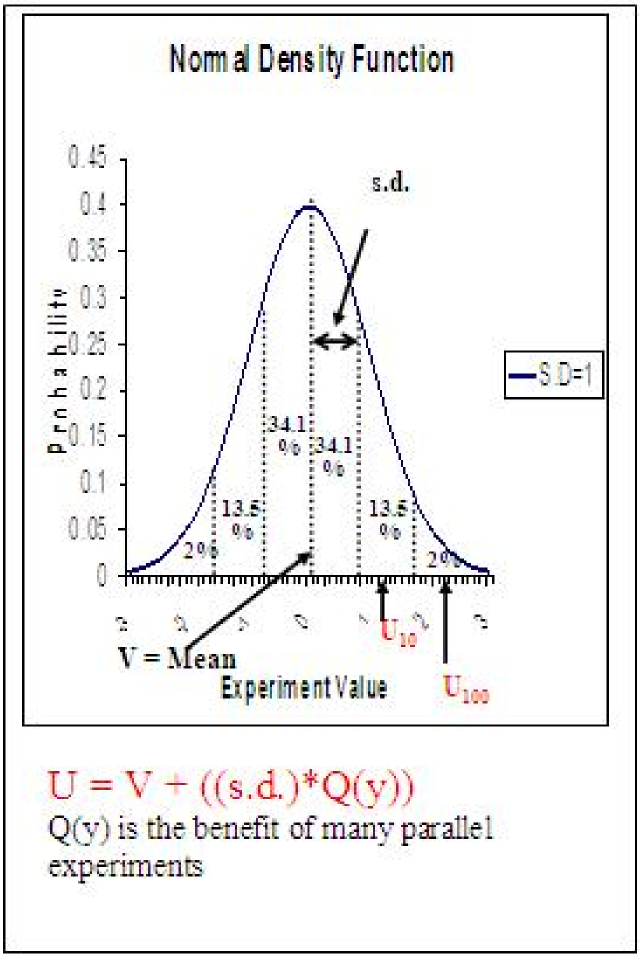

Fig 3.1 Best of many experiments (value of many experiments)

Figure 3.1 shows U(10) and U(100), the expected maximum of 10/100 experiments. That is, U(10) is the value of the best experiment from a sample of 10 experiments. This maximum is composed of two different components: first, the effect of the mean, and second, the offset from the mean. This offset from the mean (*V*) is itself composed of two parts: first, the effect of the standard deviation, and second, the effect of the parallel experimentation. Thus, I can express *U(n)* in terms of these parts: *U(n) = V + Q(n)*S.D*. That is, the maximum of *n* experiments equals the distribution mean plus the value of *n* experiments times the standard deviation of the normal distribution. *Q(n)* measures how many standard deviations from the mean *U(n)* is. Intuitively it makes sense that *U(n)* >= *V*, since to get an expected value for the mean, we do the *n* experiments, take the first one (expected value = *V*), and disregard the rest. It follows that the probability of *U(n)* greatly exceeding *V* increases as *n* or the variance grows.

Roughly, for *n* = 2, *Q(n)* = .85, for *n* = 10, *Q(n)* = 1.5, for *n* = 100, *Q(n)* = 2.5, and for *n* = 1000, *Q(n)* = 3. The intuition behind this is that, as you increase the number of experiments, the best of these experiments has a value that grows further from the mean, but at a decreasing rate. For example, with ten experiments you expect one of the outcomes to be between one and two standard deviations from the mean, but to expect an outcome greater than 3 standard deviations from the mean is likely to require 1000 experiments.

As uncertainty increases, so does the gain from experimentation and thus the potential for profit. To see how this works, consider the following example: let the *S.D*. = 1, and *n* = 10 with a mean of zero. With *n* = 10, *Q*(10) = 1.5, so *U* = 1 * 1.5 = 1.5. However, if we increase the standard deviation to 2, then *U* = 2 * 1.5 = 3. This example shows that *Q(n)* is a measure of how many standard deviations *U* is away from the mean.

This model, based on the best of many service experiments, is option-based because many service providers create several options for a particular service that users can pick from. When only a single choice for a service exists, the expected value is lower than if the user has many choices. The model illustrates how uncertainty increases the benefit of many choices.

Above, the methods of order statistics allow us to understand the benefit of many parallel experiments relative to a single experimental attempt at providing an instance of a service. We assume a normal distribution and experiments that are not correlated, but the basic idea holds for any distribution or correlation between experiments. The expected value of the best of many experiments may greatly exceed the mean, and is always at least as good the expected value of a single experiment. The next section uses these results to model the expected value a service provider receives by providing the best service, which users have selected from many choices.

3.3 Mathematical Model

This section quantifies the theory by presenting one possible mathematical model based on it, and the extreme order statistics discussed above. This model has two stages. First, from Rule 2, the model views services at a particular generation; next from Rule 3, expands my model to study how services evolve over many generations. At each evolutionary stage of a service, we model learning from the previous generation with a learning function. This multi-generation model allows one to predict at what generation of the service a more centralized management structure may start to make economic sense.

This model focuses on two main forces affecting the value that providers receive for their services. First is the benefit of many parallel experiments combined with market uncertainty that pushes services to a more distributed management structure; next is the efficiency of centralized management that pulls services to centralized architectures. The model is based on the premise that environments providing easy experimentation may not provide the optimal management structure, and environments optimized for efficient service management may not be conducive to numerous experiments.

3.3.1 Modeling a single generation of a service

As before, MU represents the market uncertainty as discussed above in Assumption 1; it is the random value to the service provider of providing a particular instance of a service. As Figure 3.1 shows, V is the expected value of X, that is, $E(X) = V$. By the definition of standard deviation (*S.D.*), $S.D.(X) = MU$, that is, the standard deviation of the random variable denoting the value of a service to its provider is equal to the market uncertainty. This is because MU is defined as the inability to predict the value service providers receive for a particular service instance, which is just a measure of the variability of the distribution of X.

In this model, the Business and Technical Advantage (BTA) of a centrally managed service, relative to a more distributed management style, is represented as a cost difference. BTA is the total advantage achieved by offering the centrally managed service. It may include both management and technical components. BTA is very general, as it must capture all the advantages of centralized management.

Let CP(L) be the cost to provide services with management structure L. E is for end-2-end type services (distributed management), C is for centralized management structure. This cost is comprehensive and includes both the internal and external components, including internal infrastructure, equipment (including software), and management.

Using this terminology, Assumption 6 can be restated as: $CP(E) > CP(C)$. It is more expensive to provide services with distributed management than with centralized management. Thus, the equation for BTA is:

Equation 1: $$BTA = CP(E) - CP(C)$$

VP(L) is the expected value to a service provider with a particular management structure *L*. This value is the total value the provider receives for providing the service minus the total cost of providing the service. For a service with central management structure that allows only one service instance, the value is:

Equation 2: **VP(C) = V - CP(C)**

For end-based services, we assume *n* service instances in a service group, and allow market selection to pick the best outcome as defined above in Theorem 1. Remember from above, Q(n) denotes the value of parallel experimentation; thus the value of the best service at the edge with the benefit of experimentation in uncertain markets factored in is:

Equation 3: **VP(E) = V - CP(E) + MU*Q(n)**

The main difference between Equation 2 and 3 is the additional term representing the marginal value of experimentation. When there are n experimental attempts at a service, and users are allowed to pick the best one of them, then this additional value is MU*Q(n). This extra value depends on both the market uncertainty (MU), and number of standard deviations away from the mean the best service will be.

Distributed management is better if **VP(E) - VP(C) > 0 => MUQ(n) > CP(E) - CP(C)**, which is equivalent to **MU*Q(n) > BTA**. It is better to provide the service with distributed management structure if:

Equation 4: **MU*Q(n) > BTA**

This equation states that the value of experimentation is greater than the business and technical advantages of centralized management. This indicates that central management structure will be too confining to allow the experimentation required to meet the uncertain market. When equation 4 is true, the benefit of giving users choices is too great to ignore. This is the saturation where the only way to figure out what users want is by giving them many different choices and seeing what they prefer.

This shows Rule 2: As market uncertainty increases, end-based services become more attractive due to the enhanced value of experimentation. If the cost differential between providing services with central management as compared to distributed management is less than the benefit gained from high market uncertainty and parallel experimentation, then the best service with distributed management has greater expected value than a single attempt to provide the service within the network.

This basic model is applied on two very simple cases: First, the case with only a single experiment, and second, when market uncertainty is zero. In both these cases, the advantage of environments allowing parallel experimentation is zero. Following these simple cases is a discussion of the more general case where experimentation is possible, and non-zero market uncertainty may make the effort of experimentation worthwhile.

These above cases are simple to analyze. With only a single experiment there is no extra benefit to architectures that allow easy experimentation. **Q(n)** as defined above becomes 0.[7] "No uncertainty" means hitting the market every time; having more experiments is of no value, since all experiments satisfy the market perfectly. In such cases, using the most efficient architecture makes sense, since experimentation does not help.

A state of no market uncertainty is common with mature technology, legacy technology, or when legal requirements dictate services. Several examples of regulation modifying uncertainty for services are: requirement of next generation

[7] It is more complex than this. The value is 0 if services with negative value must be kept, which may be the case with internal network-based services. However, keeping only positive outcomes, as end-2-end architecture tends to allow, raises this value to 0.39.

cell phones to support 911 location tracking, 911 location tracking behind PBXs, and hearing aid compatibility of phones in public locations or workplace.

The above cases are not interesting; the service provider does the obvious by providing the service in the most efficient way. Following is the more interesting case where the best management structure is not clear. On one hand, the advantage of market uncertainty and parallel experimentation tends to favor environments that promote experimentation; on the other hand, efficiencies of centralized management of services may outweigh these advantages.

Assume that market uncertainty exists and the environment allows parallel experimentation as discussed in Assumptions 1 and 2. Figure 3.2(a) shows the relationship between MU (the market uncertainty), BTA (the business and technical advantage transformed into a cost differential) and *n*, the number of experiments run in parallel. This surface shows the relationship for a range of *n* (# of simultaneous service experiments) between 1 and 20. Points on the surface show where market uncertainty equals BTA/Q(n); the points above the surface show where services work well with end-2-end architecture because of the advantage of parallel experiments and market uncertainty. Points below the surface have low enough market uncertainty relative to BTA that centralized architectures should meet market needs. The forward edge of the surface shows the amount of MU required to offset BTA for a single experiment.[8] From here, the surface slopes sharply down with regard to the number of experiments, showing the great value of experimentation. This is as expected since the range of services benefiting from end-2-end type architectures grows with more experimentation. In addition, as expected, this growth is at a decreasing rate. The rate of decrease levels out quickly, at around ten experiments, showing that the biggest gain from parallel experimentation is from relatively few experiments.

As expected from Theorem 1, the value of a service to its provider increases at a slower rate with respect to *n*, the number of experiments. It is increasing at a constant rate with respect to MU, the market uncertainty. The surface in Figure 3.2(b) illustrates this by showing the value (Z-axis) of running n (Y-axis)

[8] This is greater than the mean, since we reject experiments with outcomes less than zero.

experiments with regard to the MU (X-axis). The curved lines for increasing n show the decreasing rate of increase, while the straight lines for increasing MU show the linear increase with regard to MU. This simple model for a single generation of a service fits the theory well.

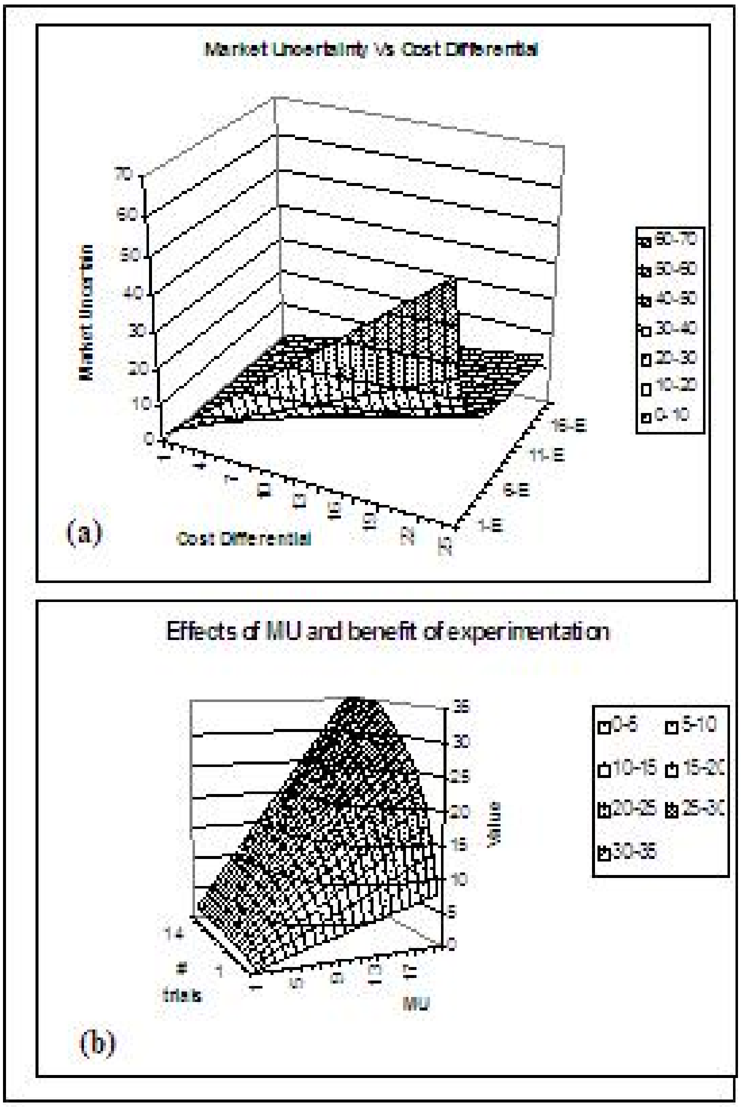

Fig 3.2 Simple model of the giving users choices

This model provides a framework to help understand the relationship between market uncertainties, many parallel experiments, and the advantages of a centrally managed service. The surfaces allow visualization of these tradeoffs that affect the choice of management structure. It helps the manager and investor understand that uncertain markets can still be of high value with the correct strategy.

Below, we expand this basic model to illustrate how services change from generation to generation as they search for a better match in uncertain markets. This section introduces learning - that is, service providers gain experience from the previous generation about the preferences in the market.

Learning may or may not occur between service generations; if it does, the learning rate may be different at each generation. We do expect that the effect of learning should decrease from generation to generation as the technology matures and market preferences become more focused. Figure 3.3 shows an example of how to represent learning for the normal distribution. The effect of learning is to squash the curve by decreasing the standard deviation (that is, market uncertainty). Learning has the effect of reducing the benefit of many experiments, because each experiment falls within an increasingly narrow range centered on the mean; thus, the value of many experiments decreases.

This model views services as evolving over multiple generations, where each generation learns from the past. Figure 3.3 shows this as a continued compression of the distribution. Using different equations, we define the value of a service at the n^{th} generation based on its value from the previous (n-1^{th} generation) plus the additional value gained in the n^{th} generation. A function dependent on the generation models the effect of learning by decreasing market uncertainty at each generation. Let *f*(generation) be this learning function that decreases learning by the correct amount at the i^{th} generation:

- **f(0) = 1** by definition, since there is no decrease in **MU** at the first generation.

Equation 5

$$f(x) \in [0, 1], x = 1, 2$$

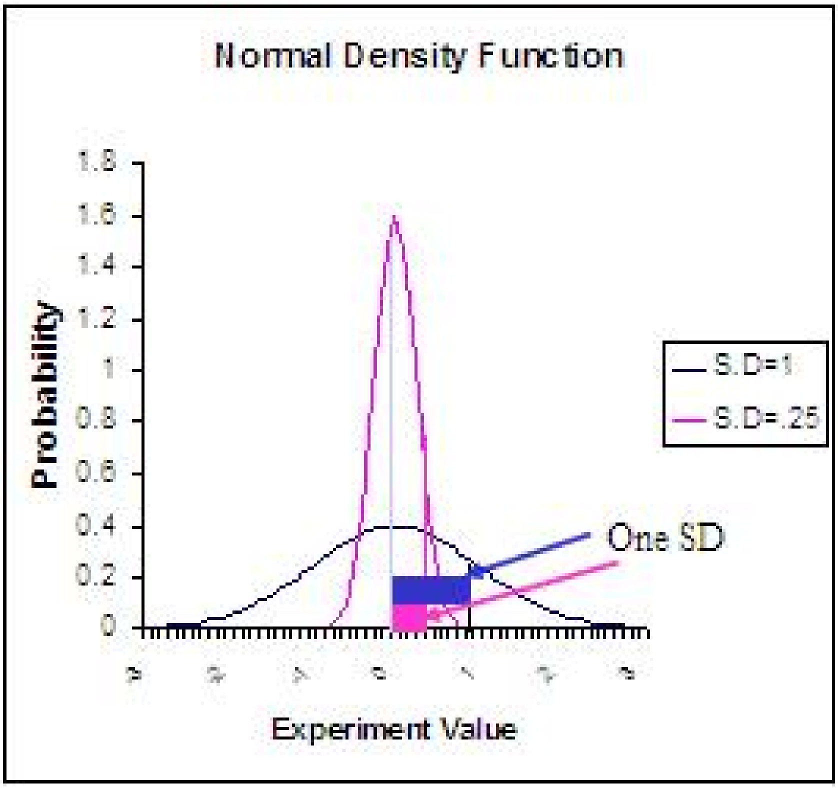

Fig 3.3 Learning with a normal distribution.

We assume this learning is symmetric, that is, all service providers learn the same for all experiments run by everybody.[9] Derived from the above single generation model (Equations 2 and 3) the following equations represent the value of the first generation of this multi-generation model:

Equation 6: $VS_1(C) = V_1 - CP\ (C)$

Equation 7: $VS_1(E) = V_1 - CP\ (E) + MU*Q(n)$

The value of the n^{th} generation is[10]:

[9] We know this is not true, some people just don't learn, but this assumption to makes problem tractable.
[10] To make a simple model we are folding in the cost from the previous generations.

Equation 8: $VS_n(C) = VS_{n-1}(C) + V_n$

Equation 9: $VS_n(E) = VS_{n-1}(E) + V_n + f(n) * Mu_n * Q(y_n)$

The value of the first generation of a service is identical to the previous single generation model. The value of the *n*th generation of a centrally-managed service is the value of the service at generation n-1, plus the new value gained from the current (*n*th)generation, assuming a single attempt to provide the service. Likewise, the value of a network-based service with distributed management structure is the same for the first generation as above. For the *n*th generation, the value of the service is the value at the n-1th generation, plus the additional benefit of picking the best experiment from the n attempts at this new generation (with learning factored in). Solving these difference equations gives:

Equation 10:

$$VP_n(E) = \sum_{i=1}^{n} V_i - CP(E)_n + MU * Q(y) \sum_{i=1}^{n} f(i)$$

Equation 11:

$$VP_n(C) = \sum_{i=1}^{n} V_i - CP(C)_n$$

This illustrates that the greater value of providing a service with distributed management is the sum of advantages gained from all previous generations. Thus, the benefit is dependent on the sum of f(i) over all generations (to infinity for the limit), times the gain from experimentation with market uncertainty. The major factor affecting this sum is the rate of decrease of f(i), the learning rate. Figure 3.4 shows several different types of learning functions, from the base case with no decrease, to a slowly decreasing harmonic series, and finally, in a rapidly converging geometric progression. This decrease in learning fits into two different groups: functions that sum to infinite, and functions that converge to a limit, as *n* approaches infinity. Figure 3.4 shows both types: First, no decrease or the harmonic decrease (specifically, market uncertainty at the i^{th} generation is reduced by 1/i) which sums to infinity; second, two converging geometric decreases (specifically, market uncertainty at the i^{th} generation is reduced by a^i, a < 0), for a=1/2 and 1/4.

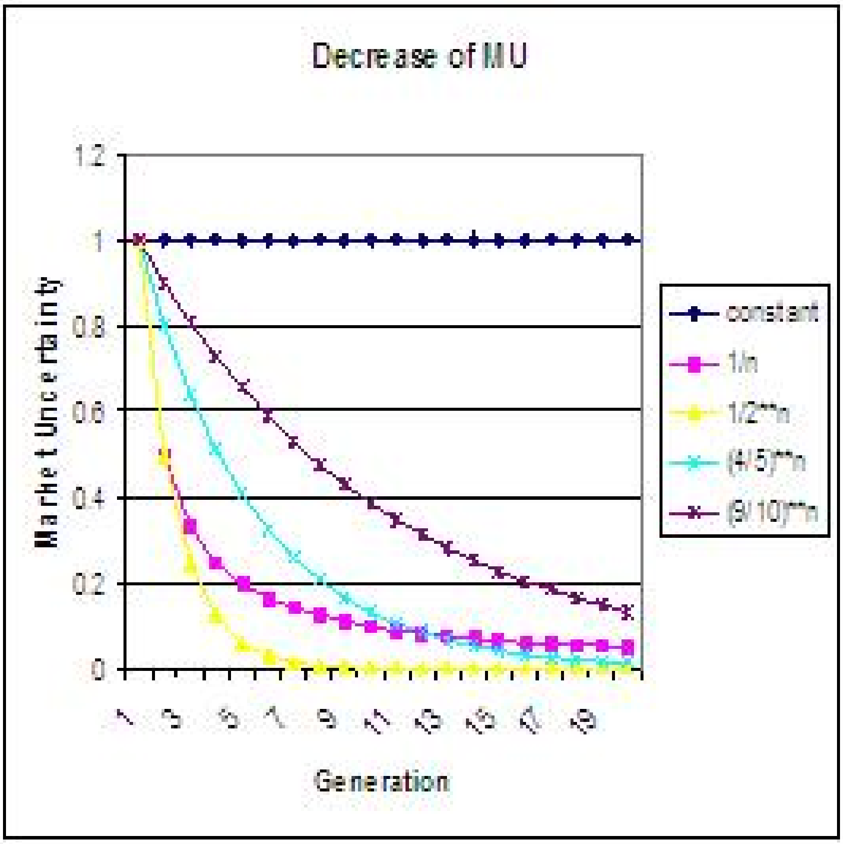

Fig 3.4 Different learning rates.

Different types of learning functions invoke dramatically different behavior. A learning function that diverges implies that a long evolution overcomes any advantage of a more centrally managed service. For example, Equation 12 shows what happens with the divergent harmonic series, since it sums to infinity; if the service provider is willing to keep evolving the service, any cost advantage will be overcome since experimentation keeps adding value.

Equation 12:

$$VP_n(E) = \sum_{i=1}^{n} V_i - CP(E) + MU * Q(y)\sum_{i=1}^{n}\frac{1}{i}$$

However, a convergent learning rate, such as any geometric progression, strictly limits the advantage gained from market uncertainty and many experiments. Below is an example of the convergent geometric series (specifically, it converges to 1/(1-a)). In this case a service provider never overcomes more than **MU*Q(n)*(1/(1-a))**, even if the service evolves forever.

Equation 13:

$$VP_n(E) = \sum_{i=1}^{n} V_i - CP(E) + MU * Q(y)\sum_{i=1}^{n} a^i, (a < 1)$$

The above equations allow one to compute the value of services at any generation, even an infinite amount. This allows a similar analysis to that shown in Figure 3.2, but with a fixed number of experiments (that is, 10). In the next four surfaces, the y-axis becomes the generation number, not the number of experiments as in Figure 3.2. Figure 3.5 and Figure 3.6 show examples of the resulting surface for different learning curves (the last y value is for n = infinity, showing the long-term effects of evolution). In Figure 3.5(a), there is no learning (f(i) = 1, for all i), showing a fast decrease in the amount of **MU** required to overpower **BTA** as the service evolves. As the service is allowed to evolve for more generations, the amount of **MU** required to justify distributed end-2-end management structure decreases. At each generation, the gain from experimentation is the same. Figure 3.5(b) shows a decrease in market uncertainty by 1/n at the nth generation. Overcoming any cost advantage (**BTA**) of centralized services is still possible as this figure shows, but it happens more slowly than with no learning. These surfaces show a very different situation than in Figure 3.6, where a convergent geometric series (as in Equation 13) represents the learning function. In both these figures, the limit to which the series converges bounds the **BTA** that experimentation will overcome. Figure A.6(b) has a series that converges faster than (a), which illustrates the limited value of experimentation because in later generations market uncertainty is very low.

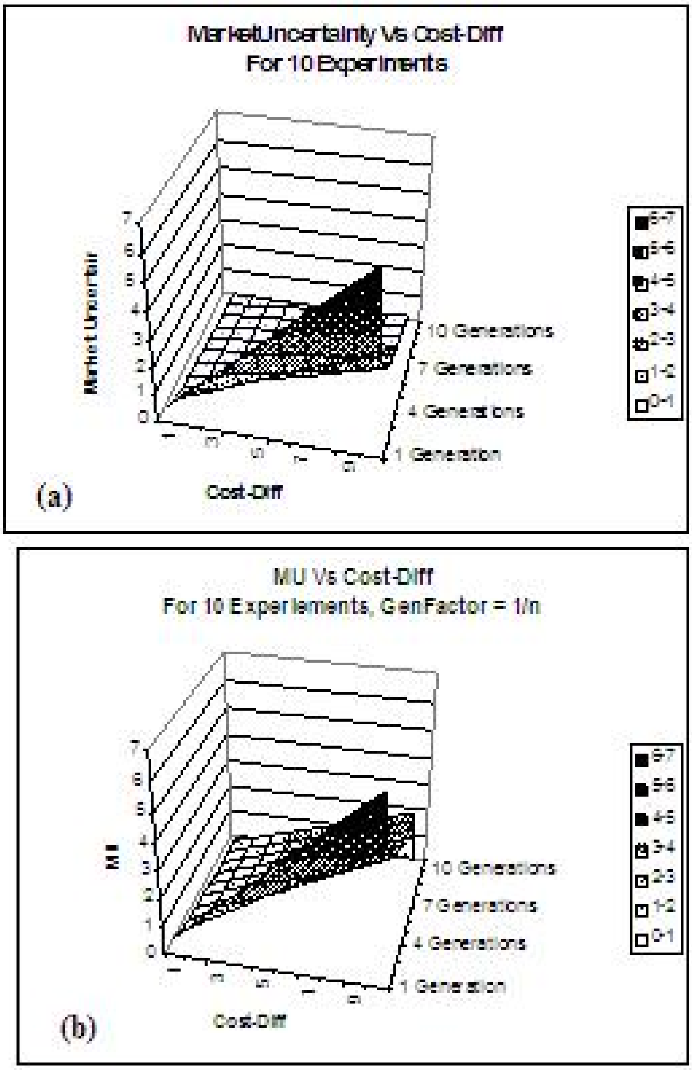

Fig 3.5 No learning compared to Harmonic learning (1/n).

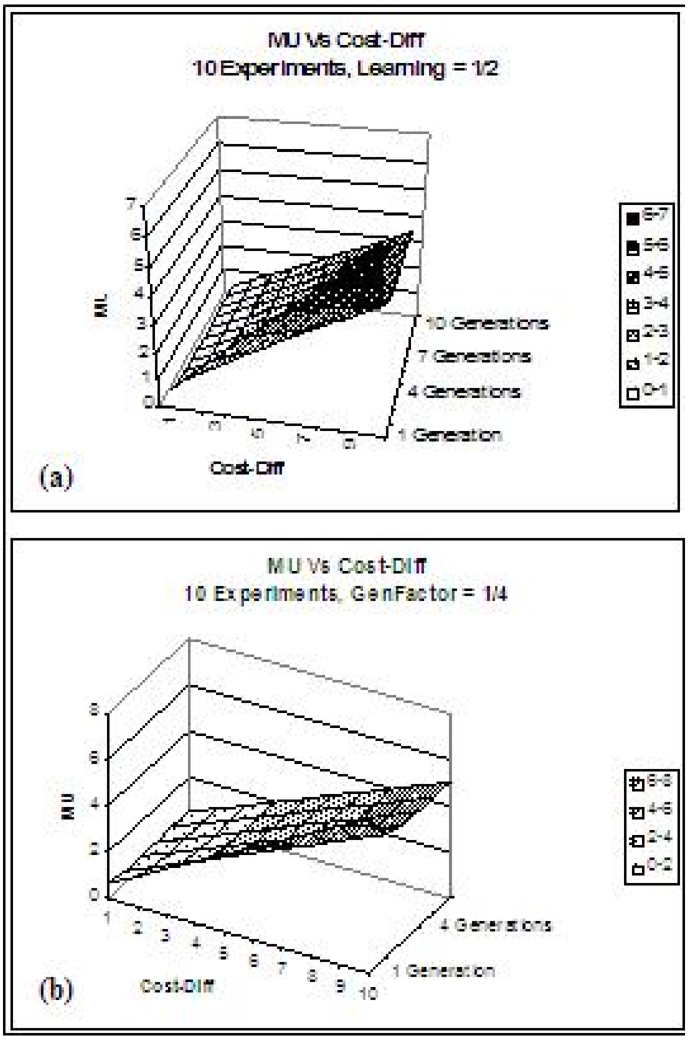

Fig 3.6 Geometric learning (1/*i*)n.

The previous graphs give a framework for examining the tradeoffs among market uncertainty, any advantages to a centrally managed service, and the number of generations the service is expected to evolve, given a fixed number of experiments. One important question is when, if ever, will the benefits of a centrally managed service overcome the advantage of experimentation to meet the market. It needs to be determined at what generation in the evolution of a service the advantages of experimentation is small compared to the efficiencies of centralized management structure, as discussed in Rule 3 above. From the equations above, it is possible to find both lower and upper boundaries for when centralized management structure is likely to be successful in meeting market demands.

The lower boundary is the generation at which a provider should first consider providing a more centrally managed service. This is the generation of the service when the advantage to a centralized service structure is greater than the advantage gained from experimentation. This is the first generation when a central management structure has advantage. That is, we expect a centralized service to succeed at the i^{th} generation when MU*Q(n)*f(i) < BTA. This is a lower boundary since if the service is in its last generation, then it pays to centrally manage it; however, continuing evolution of the service can still overcome greater BTA. The upper boundary is the longest amount of time to wait before shifting resources to services with centralized management structure. It is the i^{th} generation when the cost advantage of a centrally managed service can never be overcome with more experimentation. This is the generation when the advantage of central management will never be overcome by the benefits of experimentation. This is true when:

Equation 14:

$$Q(y) * MU \sum_{i=n+1}^{\infty} f(i) < BTA$$

that is, when the business and technical advantage of managing the service centrally is greater than the sum of benefits from experimentation from the current generation and future generations. This forms a bounded region when used in conjunction with the lower boundary. This shows at the point at which one should consider centralized management structure when designing network-based services.

Figure 3.7(a) illustrates this lower bound for several different learning functions, including one example of a divergent series (specifically, harmonic), and several different examples of geometric series that converge at different rates to a finite sum. It shows that the harmonic series initially may decrease market uncertainty faster, but in the end, any geometric series will decrease learning at a much faster rate because of its convergence. Figure 3.7(b) shows this upper bound.

As expected, there is no upper bound for any divergent series (specifically, harmonic) because any cost advantage of a more centralized managed service can be overcome as long as the service provider is willing to continue evolving the service forever.

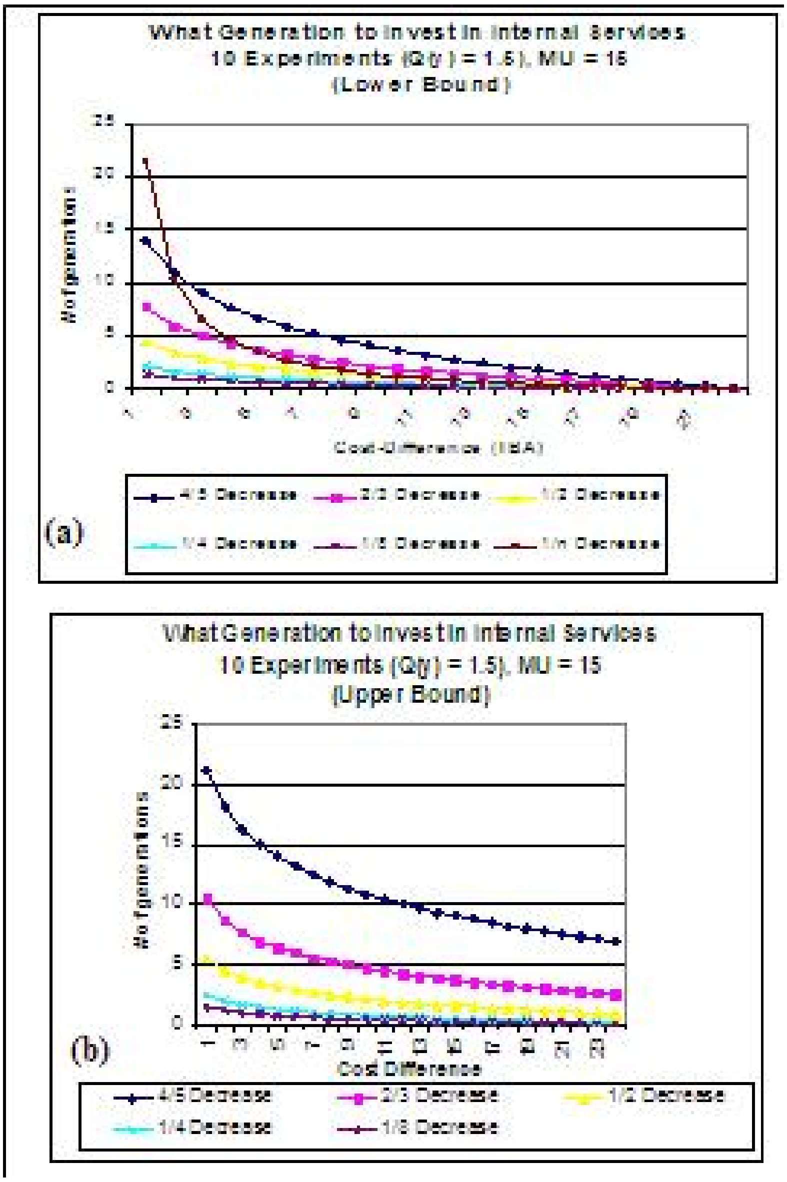

Fig 3.7 Lower and upper bound of switching point to centralized management.

One important question is whether it is better to have fewer generations of a service with more experimentation per generation, or more generations of the service, with less experimentation per generation. With constant **MU** (that is, no learning between generations) the slowing rate of increase of **Q(n)** implies that more generations with less experimentation is best. However, if **MU** does decrease, it limits the gain from experimentation, making the answer dependent on the rate of decrease. This is one area of future research.

The aforementioned theory and model provide a framework to better understand the choices a service provider must make when deciding how to design a management structure when providing a service. When the market is not predictable by a service provider, this model helps to clarify the tradeoffs among any possible advantage of a more centrally managed structure, the number of experiments all service providers undertake, and the number of evolutionary generations a service is expected to undergo. When you do not know what users want, single attempts to create services with centralized management schemes are unlikely to meet market demands. Instead, allowing the market to select the best service from many parallel experiments will be more successful at meeting the market. However, when user understanding of a technology has sufficiently evolved, then the end-2-end (distributed) architecture that allows easy experimentation will not meet market needs any better than more efficient centrally managed services. The close clustering of all experiments makes it easy to satisfy the user. While experimentation with services helps meet uncertain markets by giving users a wide range of service offerings from which to choose, this benefit is greatest in the first 10 to 20 experiments. Finally, we demonstrate the value of a service as it evolves from generation to generation and the effect of learning from previous generations.

This model illustrates that the ideal management structure for a network-based service changes as market uncertainty decreases (or increases with new technology). The model captures the chaotic behavior that occurs when the environment is dynamic. It allows visualization of the tradeoffs involved in deciding how to manage network-based services. Managers and investors who understand these tradeoffs have a competitive advantage over those who don't, because they can tailor management structure to maximize value.

3.3.2 Applying the model

To apply this model one must estimate the market uncertainty (**MU**), the business and technical advantage (**BTA**), and the rate at which learning reduces **MU**. These items are hard to measure precisely. While we used real numbers to produce the graphs that show the tradeoffs involved, it is not known how to get these numbers. These factors should be estimated in terms of being either: high, medium, or low. The measurement of **BTA** is a combination of technical advantage and business cost savings.

Many services such as email evolve in multiple generations. First, email was an inter-company service seldom used to communicate outside the organization. Standards-based systems such as the text-based Internet followed. Next, MIME allowed attachments to Internet email. Finally, we arrived at the centralized Web-based email systems that have become popular in the last five years. Similar to **MU** and **BTA,** estimates of the rate of decrease per generation of **MU** is hard to quantify, allowing only coarse-grained estimates at this time; the most important attribute is the divergent or convergent nature of the learning. As this theory shows, the way **MU** decreases may limit the benefit of parallel experiments.

One way to view the relative success of flexible decentralized services compared to efficient centralized services is the percent of the market captured by each group. This is what Figure 3.8 illustrates. Features incubate in the outer region where the market selects the successful features for inner migration. Selected services move from the outer edge, inwards towards the center; the closer a service is to the center, the more centralized it is. As new technologies come and go, we expect the inner core to grow and shrink according to the market uncertainty. If **MU** is increased because of new technology then services will shift from the core to the outer edges. However, after learning reduces **MU,** the successful features migrate into the core. This figure captures the success of a particular management structure, and its dynamic nature.

One example of a real situation mapped to Figure 3.8 is the PBX vs. Centrex market of the late 70's and early 80's. Before the PBX switched to SPC architecture in the mid-70's, it was a very stable technology. Centrex, the centralized version of PBX services, was a stable technology; both had pieces of the market based on attributes other than feature sets. However, with the introduction of the new SPC architecture, the feature set of PBXs exploded and market uncertainty increased. This caused the percentage of PBXs to grow at the expense of Centrex, because this new generation of PBXs matched users' needs better, which Figure A.8 illustrates this as a growing of the inner region with stable services.

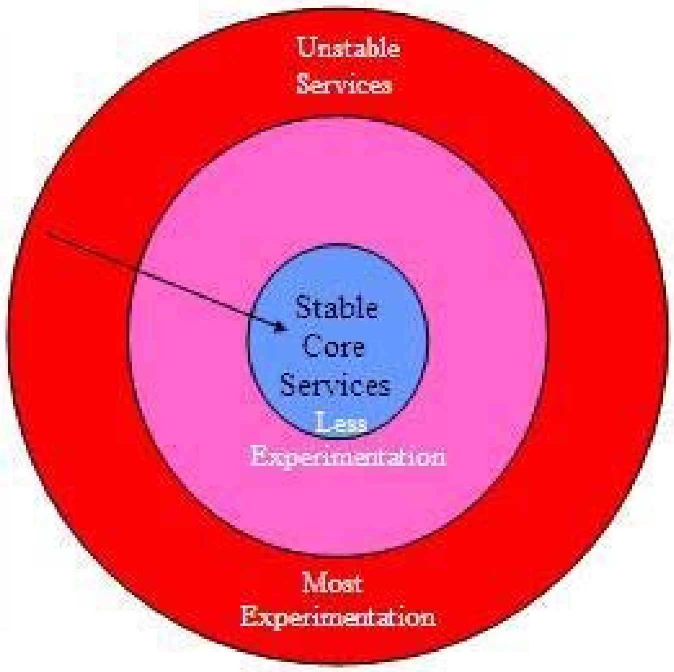

Fig 3.8 Model management diagram.

This model shows the importance of having both regions in Figure 3.8. On one hand, the ability to provide end-2-end services is necessary to meet user needs in uncertain markets. The ability to try out many different features for services when market uncertainty is high is the best way to understand the market. However, after understanding customer needs, the ability to migrate a feature into the network is necessary to capitalize on the business and technical advantages of centralized management. The outer region shows the power of innovation, while the inner region allows for efficient implementations of the best ideas.

Email and voice services are examples of services that have this two-layer structure. PBXs have provided a way to test and grow services that have become very successful in Centrex. Email maintains this ability to experiment with features (because of the underlying end-2-end architecture of Internet email) and also permits the centrally managed, core-based email services based on the same set of standards to adopt the successful features. Showing that these two different network-based services have a similar structure is strong evidence of the value of both regions in Figure 3.8

3.3 Conclusions

This theory and the model of the economic value of network services provides a framework to understand the advantages of experimentation and market uncertainty compared to the Business and Technology advantage of services with centralized management architectures. It shows that when users are confused (high market uncertainty), the value of experimentation is high. However, when service providers can predict what services and features will meet market demands, the management structure of the service becomes more important than the ability to innovate.

This work is one way to quantify the end-2-end argument, showing the value of end-2-end services due to their application independence of core network services. This work illustrates how end-2-end services will match markets best and produce the highest value to a service provider when high market uncertainty boosts the benefit of experimentation. However, it also shows that end-2-end architectures tend to lose some of their attraction as it becomes easier for service providers with more centralized structures to meet market needs as well, but at a lower cost and with other benefits.

This work helps link innovation in network design to architecture of service management. It does so with a model based on a real options framework that illustrates market uncertainty, ease of experimentation, and the number of generations the services is expected to evolve. It is important to understand how and why successful services have evolved in the PSTN and Internet, which is especially significant in the age of convergence of data and voice services.

IV. Real Options Approach to the Blue Ocean Strategy

This chapter describes an options based approach to optimize the “blue ocean” strategy – “the bluest ocean strategy”. By definition there is tremendous market uncertainty implied within blue ocean markets. However, the blue ocean methodology does not help charting a path to meet this uncertain market. How do service providers and vendors pick the services and products and their feature sets to extract the most value from their users? Framing a blue ocean market within a real options model does provide a methodology to maximize the potential of a blue ocean market. One example of this is the success of the i-mode wireless network in Japan. The basic idea is to build infrastructure enabling experimentation in areas of the greatest market uncertainty, which is why i-mode succeeded where others failed in similar blue ocean markets.

A blue ocean strategy tells how to find markets without competition because the fundamental attributes of competition have changed. However, because there is no competition, it is unknown what users really want and how much they will pay for services and products. Many vendors and service providers do not succeed in blue ocean markets because they fail to meet this uncertain market. A real options framework, however, provides a path to maximize value in such uncertain market. By building infrastructure that promotes experimentation and innovation along with a market selection process to pick the best of breed, vendors and services providers can discover services that meet uncertain markets. Combining a blue ocean market strategy with infrastructure based on a real-options framework provides a path to extract the most value from uncertain blue ocean markets.

The combined framework promotes building a platform enabling innovation in the areas that have the greatest expected value. Platforms enable innovation because they promote efficient experimentation, leading to innovation. The real-options framework focuses the platform to promote innovation in areas of greatest market uncertainty, thus maximizing value. According to the real-options framework, this is the area of greatest expected value. Because blue ocean market are big, and uncertain, its hard to figure how what the best bait is, however, the real options framework helps focus the experimentation in the areas most likely to be successful.

One example of how this merged theory explains the evolution of blue ocean markets is the wireless services market. Companies in the US such as Verizon and other RBOCs have been relativity un-successful in finding services that users are willing to pay enough to enable a viable business model. However, i-mode in Japan has successfully navigated in this blue ocean market, how did it achieve success where others have failed? It build infrastructure that promoted experimentation in the area of greatest uncertainty – what the services are, and what feature set they included. Unlike US vendors that promoted closed garden architecture, i-mode with its open garden service model encouraged third parties to experiment with new services. Unlikely candidates such as “hello kitty” proved very successful, which illustrates the uncertainty in these blue ocean markets.

The blue ocean strategy is a useful tool to help discover uncharted markets; the real option framework provides a path to maximize value in this uncertain new market. This combined theory is greater than the sum of its parts because of the synergy between these two theories. Greatest value in uncertain markets comes from providing the best market match to the users unknown needs. Only by combining a strategy that points to a blue ocean, and then a methodology to exploit this nascent market promotes the most value extraction.

In the following sections we will explore the real option framework of blue option strategy which can provide a path to maximize value in this uncertain emerging technology market.

4.1 VoIP Case Study

4.1.1 Vonage vs Skype: tradition vs future

Vonage

VoIP (Voice over Internet Protocol) technology uses packet switching technology instead of circuit switching technology to increase transmission efficiency of voice data. Basically, VoIP can do almost everything tradition telephony can do. “They include call waiting; caller ID; caller ID blocking (your number is invisible to those you call); call forwarding (incoming calls are automatically routed to, say, your cell phone when you're not home); call return (dial *69 to call back the last person who called you); call transfer ("You'll have to ask my dad in Denver about that; here, I'll transfer you"); automatic busy-line redial; Do Not Disturb (all calls go directly to voice mail during specified hours); Find Me (incoming calls try various phone numbers until you answer); multiple ring (incoming calls make all your various phone numbers ring at once); three-way calling, and more."[11]

Vonage is the leading company in VoIP market. Its strategy is to employ VoIP technology to provide cheaper telecommunication services, rather than to innovate with new features. Consequently, Vonage tries to offer customers an experience similar to that received using traditional telecommunication technology (digital switching). Thus, the company focuses mainly on the original phone users rather than PC users. Vonage may have a head start in Internet telephony, but the upstart is having a tough time holding its own against cable giants eyeing the nascent market for VoIP. Vonage reported 1.24 million subscriber lines at the end of 2005. Time Warner, meanwhile, said it had 1.1 million VoIP customers at the end of last year, up from 220,000 a year ago. Comcast, which only began its nationwide VoIP push last year, already claims 202,000 subscribers. "Despite Vonage pioneering the VoIP area, cable companies like Time Warner are reaping the benefits. The cable firms generally charge higher rates than Vonage, which costs $24.99 a month for unlimited calls to the U.S. and Canada, but are able to offer a bundle of services. Price wars promise to get even more intense as new players like America Online enter the scene and traditional phone firms like AT&T and Verizon fight back with their own VoIP offerings[4]."

Skype

Skype is similar to MSNmessenger or Yahoo!messender, but with superior quality, which makes it a hit among the PC users. In addition to talking with other Skype PC clients, users can also call traditional phone numbers by paying the destination carrier's connection fee. The rate of Skype only depends on "where you are calling to, not where you are calling from"[12]. Skype has been a wildly successful start-up (the software has been downloaded some 250 million times), and was acquired by Ebay in September 2005 for $2.6 billion, with

[11] David Pogue "Cut-Rate Calling, by Way of the Net", *The New York Times*, April 8,2004
[12] Skypeout rate http://www.skype.com/products/skypeout/rates/

another billion dollars or so of bonus if financial targets are reached.

Compared with other operators of VoIP services such as Vonage, Skype is a true disrupter of the old world of telecommunications. It provides free, software-oriented telecommunication services, along with high innovation potential. For example, you can use Skype in different operating systems, (ex: MS, Linux, Mac) as well as mobile devices such as the Pocket PC. As long as you can connect to the internet, you can always download the program and use Skype as the communication intermediary.

Because Skype is built on top of the open standards of the Internet, its users have devised new uses far beyond that of traditional phone services. For instance, Voxeo has teamed up with Skype to offer users access to its application platform. Users have already used the platform to create programs use voice recognition to create package tracking, translation, unified messaging, and call recording solutions, among many others[5].

Table 4.1 and Figure 4.1 show the VoIP subscriber growth in the US.

Table 4.1 U.S. VOIP providers' year-end subscriber levels

Company	2005	2004	Growth
Vonage	1.24 million*	390,000	218%
Time Warner	1.1 million	220,000	400%
Cablevision	734,000**	273,000	169%
Comcast	202,000	0	NA
8X8	113,000	40,000	183%

Notes: *Vonage reports "subscriber lines," but doesn't release figures for actual subscribers. Some subscribers may have more than one line. **Figure is estimate.

Source: TeleGeography Research

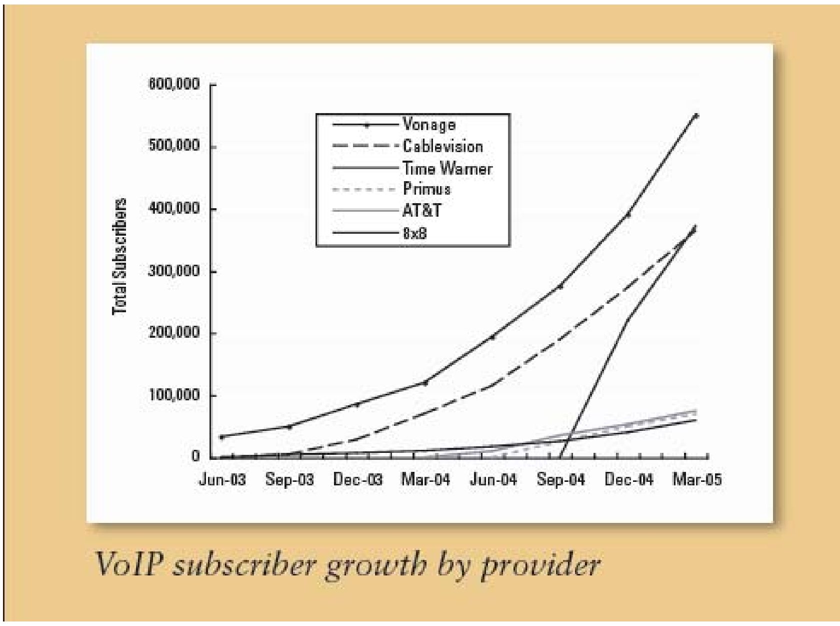

Fig 4.1 VoIP subscriber growth in the US

(source: TeleGeography Research).

Comparison

Vonage and Skype are both promising stars in the VoIP markets, but their strategy and advantages are totally different. Basically, Vonage uses the new VoIP technology to perform the same activities as the telecommunication carriers, while Skype uses the open standards of the internet to allow new activities to be developed. Free of the limitations of traditional telephones, Skype users can have unprecented control over their voice data and information. Even if we think Skype can outperform Vonage in the future, it doesn't necessarily mean Skype can generate much more profit. On the contrary, just like Linux, the more successful Skype are, harder for Skype to charge fee.

4.1.2 Strategy canvas

In *Blue Ocean Strategy*, the authors use strategy canvas to analyze the competitive environment of the market. Drawing a strategy canvas does three things. First, it shows the strategic profile of an industry by depicting very clearly the factors that affect competition among industry players. Second, it shows the strategic profile of current and potential competitors, identifying which factors they invest in strategically. Finally, it shows the company's strategic profile- or value curve-depicting how it invests in the factors of competition and how it might invest in them in the future. Before we draw the strategy canvas, we need to decide which factors/attributes are really crucial and needed to be compared. In the case of Vonage v.s. Skype, we analyze them from different perspectives and choose the following attributes: Intermediary Accessibility, Multiple Use, Technology Superiority, Price Model, Device Independence, Innovation Potential, and Converged Data.

The following table is the definition of each attribute:

Attribute	Description
Intermediary Accessibility	How accessible is the company and its products/services to the market? To what degree does the company have a support model and other customer relationship building features?
Multiple Use	To what extent can the company's technology be applied to different applications?
Technological Superiority	This value measures the relative and potential technological advantages of the current firm, compared with its competitors.
Price Model	Measures a company's price competitiveness.
Device Independence	To what extent is the technology offered, not restricted to proprietary hardware and closed specifications for compatibility. Are industry standards supported?
Innovation Potential	Does the nature of the company's technology support innovative use and further development?
Converged Data	How do the company and its technologies provide a capacity for collaboration across diverse data and access points?

According to the selected attributes, we analyze the competitive advantage of Vonage and Skype, and assign the value in each attribute.

Intermediary Accessibility: Since Vonage has structured customer service system, the clients can be easier to get the service when they have questions.

So Vonage gets a higher value in this attribute.

Multiple Use: Vonage tries to provide the traditional phone service by the VoIP technology, however, Skype wants to create a new service- phone on PC. Vonage limits the technology applications in the tradition phone, so Skype gets a higher value in this attribute.

Technology Superiority: Skype has a better analogism, and PC is a technologically superior platform than a physical phone.

Price Model: Vonage's package is competitive compared with other traditional carriers, but still more expensive compared with Skype, because Skype is basically free ("PC to PC" is free, "PC to traditional phone" charges you the transition fee).

Device Dependence: Both Vonage and Skype have certain degree of device dependence, but overall, Skype can apply to different operation systems in PC and it also has the potential to extend its application to other hardware. On the other hand, Vonage limits its service on the tradition phone.

Innovation Potential: The difference between Vonage's and Skype's strategy is that Vonage tries to capture the value of the existing market, but Skype tries to create value in the new market. So Vonage standardizes its service and provide the customers the similar services in traditional phone, but Skype plays a role of platform allowing a lot experiments. Therefore, Skype has a much higher innovation potential.

Converged Data: Using Skype, you not only can talk to your friends, you can also see their faces, or send them your new pictures. But in Vonage's service, you can only use it to call your friends. So Skype provides a better capacity to collaborate diverse data.

Figure 4.2 shows the strategy canvas for Vonage and Skype's VoIP business.

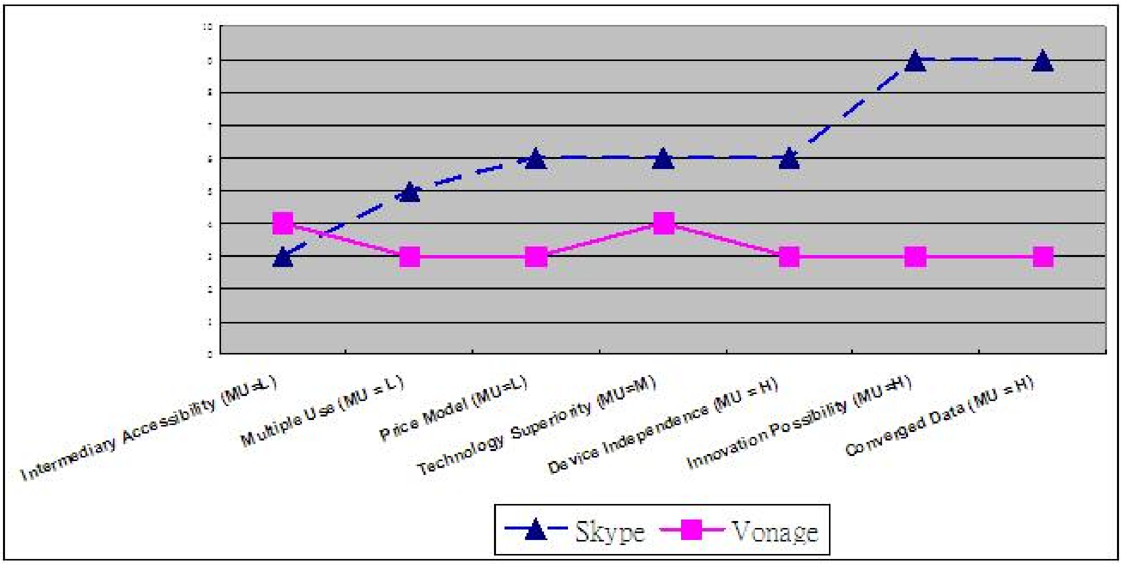

Fig 4.2 Strategy canvas for Vonage and Skype VoIP's business.

4.1.3 Strategy canvas with uncertainty consideration

The main theme of Blue Ocean Strategy is to each beyond existing demand or to find a new market. Because every company in the industry focuses on existing customers and drives for finer segmentation to accommodate buyer differences, conventional competitive strategy only leads to the red oceans of bloody competition. In the blue ocean, the companies need to take a reverse course, and find the new customers which didn't exist before. But the issue is how to get the blue ocean.

There are two types of competitive strategies: Low cost strategy or Differentiation strategy. It is not impossible to be both low cost competitor and market differentiator, but because the two strategies need different management mindsets, cost structure and price setting, so it is very difficult to manage both sides well. But in the *Blue Ocean Strategy*, it is believed that, although it is hard, it is the only way for the companies to get from red ocean to blue ocean. In the red ocean, the firms basically do value capture, but in the blue ocean, the firms do value innovation. But as what know, higher return always means higher risk. So the *Blue Ocean Strategy* pays most of the attention talking about the potential benefits to get from red ocean to blue ocean, but neglect the potential risk in the transition and innovation process might cause some misleading. In order to provide a more comprehensive and balance view of blue ocean strategy, we integrate the option theory to articulate the value of experiment in the market with different risk levels.

As companies seek to use value innovation to create new markets with little or no competition, they are faced with several questions: In which of their technologies is there the greatest benefit or value? Where should they focus their innovative energy? How can the companies balance the risk associated with implementing a new technology? The Multi-Dimensional Strategy Canvas provides a picture into how a company can address these questions and which steps it should take to enter markets with untapped potential. The following demonstration shows that a company with a proper balance of flexibility in experimentation and efficiency in implementing value innovation will be able to realize new, blue oceans, free from competition.

Basically, in our model, the horizontal axis is the uncertainty (risk), and the vertical axis is value. In the first step, we also need to find the important attributes, but we not only assign the value but also consider the uncertainty.

The Four-Quadrant Model

The multi-dimensional strategy canvas plots the same qualities and factors a company competes in, as the traditional strategy canvas. However, assessing the different competitive values of a company's products/services (e.g. "device interdependence" and "data collaboration") only shows a relative picture of which particular values are greater than those of a competitor. As a result, the traditional strategy canvas ties together several qualities in the form of a curve, but can only determine the better alternative with an evaluation of the one criterion: value. Adding more elements to its analysis of a product's features enables a company to avoid basing strategic decisions purely on calculations of the cost and benefit of their implementation. Therefore, to differentiate between the competitive qualities with the greatest value and those with the highest probability for implementation and success, the multi-dimensional canvas uses both the perceived value and the uncertainty associated with realizing that value, as axes.

With two axes, the new model appears as a four-quadrant canvas, with each of the sections illustrating a different analytical interpretation. The upper and lower quadrants are distinguished by high and low ratings of competitive value. At the same time, the two left and right quadrants are easily distinguishable by the uncertainty involved in a company implementing value innovation with that characteristic. The following sections of this document further clarify how competitive elements should be approached, given where they stand with their value and uncertainty, as plotted on the multi-dimensional strategy canvas.

Finally, it should be noted that the multi-dimensional strategy canvas is a dynamic model in that as a company implements value innovations based on the qualities mapped on the strategy canvas, the uncertainty diminishes and the data points shift into different quadrants. In addition, to promote a company's value innovation in certain strategy factor, the layout of this new strategy canvas encourages experimentation where the value is high. On the other hand, the quadrants where uncertainty is high increase the likelihood that undiscovered (competition-free) markets would be created through such experimentation.

Figure 4.3 shows a four-quadrant model for Vonage and Skype's VoIP strategy canvas.

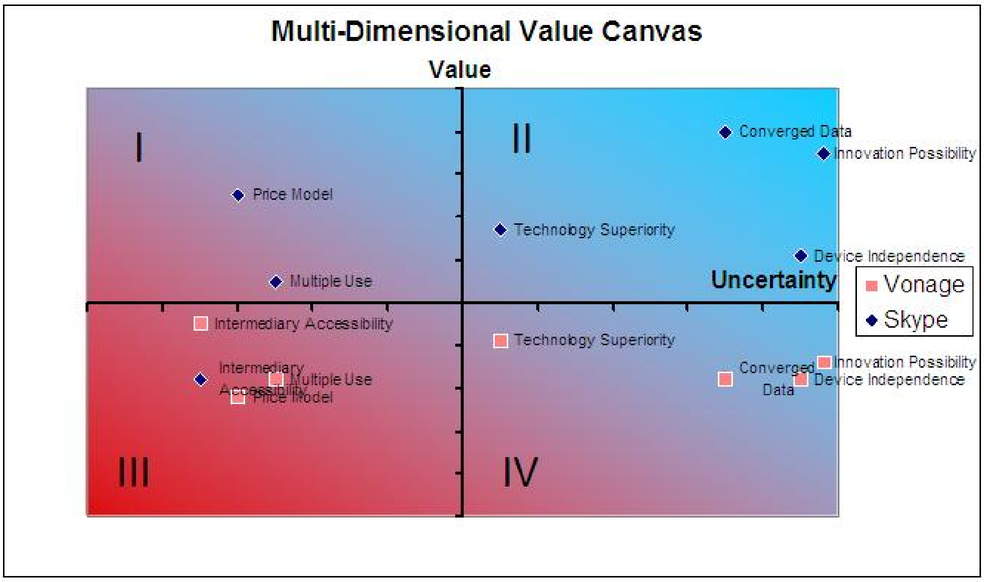

Fig 4.3 Four-quadrant model for Vonage and Skype's strategy canvas.

The top-right segment of the multi-dimensional strategy canvas (quadrant II) presents a company with the greatest potential value among its technologies, but also highlights the uncertainty and risk present in bringing them to market. The company must therefore facilitate and encourage experimentation to increase its chances of capturing value from these uncertainties, but highly valuable innovations. However, it is understandably difficult for risk-averse businesses to take this bold step towards its shifting its existing policies.

To help offset concern in adopting a flexible policy for encouraging experimentation, managers should not only consider the benefits realized from ultimately implementing these strategy factors, but also consider the likelihood that an environment open to internal and external trials will result in discovering additional strategy factors. For example, the amount of uncertainty in adopting and seeing value from a technology, as well as the amount of value that can be realized both depend on the technology's introduction. However, the degree to which a company facilitates experimentation increases the chances that these new ideas will be successful with consumers and clients. Using a slightly different perspective (as demonstrated in Figure 4.4), the ideas and technologies that comprise the data points in quadrant II have a considerably higher standard deviation of experimentation and therefore a much larger chance of realizing their potential value.

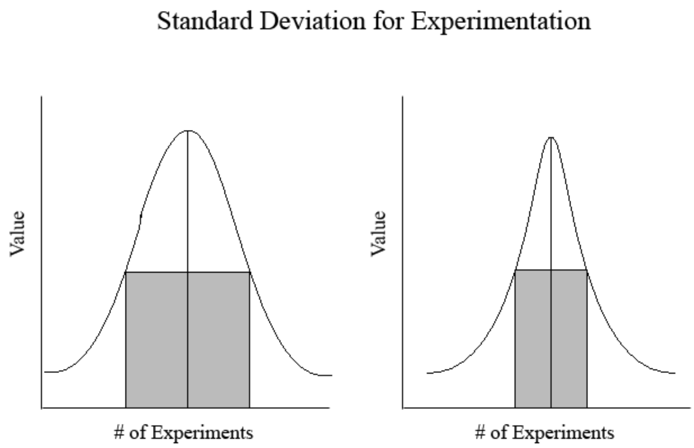

Fig 4.4 Standard deviation of experimentation

In the top-left quadrant (I), we find value innovations that can be implemented into existing or new products/services with little financial or technological risk; they offer great value to the company, while their introduction inherently involves less uncertainty. As a result of this decreased risk, the amount of value may still be high, but the likelihood of creating a blue ocean is significantly reduced, as other companies will also be able to realize this value. Furthermore, as experimentation with technologies in quadrant II result in less uncertainty in bringing them to market, their respective data points will shift into quadrant I. Therefore, quadrant I plays a critical role in the company's ability to enter blue oceans of competition. By establishing an efficient infrastructure that takes innovations with high levels of value and implements them in existing or upcoming product releases, the company will be able to quickly take advantage of the competitive items in quadrant I before its competitors. This infrastructure will be an advantage that enables the company to break into the blue ocean first and establish barriers to entry such as pricing strategies and marketing campaigns.

In the lower half the multi-dimensional strategy (quadrants III and IV), the data points lying here represent technologies and innovations that do not have relatively high value compared to items in the upper two quadrants. Unlike in the discussion above, where increased experimentation could help realize the value of items in quadrant II, the lower level of value here indicates a company's risk when investing resources, implementing an innovation with low value. At best, the experimentation will only result in introducing a product/service with mediocre return on the company's investment, assuming that particular data point were close to the uncertainty axis (i.e. value = neutral).

Value of multi-dimensional strategy canvas model

The value of the multi-dimensional strategy canvas is in helping companies identify a platform that enables the data points in quadrant II, through flexible experimentation, to shift to quadrant I, where they can be implemented into existing or new products/services as value innovations. As value is captured from experimentation in the high uncertainty, the company creates blue pools in the red ocean of competition, which eventually transforms into blue oceans as the technology becomes more mature. Therefore, this new strategy canvas stresses the need for a company to have both a flexible policy, encouraging experimentation both internally and externally and to efficiently transform new innovations and technologies into marketable products/services.

4.2 RFID/USN Case Study

4.2.1 Current status of RFID/USN

RFID (Radio Frequency Identification) is a subset of the Automatic Identification and Data Capture (AIDC) technologies, which include the barcode. Compare to the conventional barcode, however, RFID has numerous advantages due to its information transfer characteristics via radio wave.

RFID system consists of three principal components. The first is the transponder, which is usually called tag. This is a device that identifies the item to which they are attached. The second is the interrogator or reader which communicates wirelessly to the tag. The final component is the application system that controls the communications between the reader and the tag, and utilizes the collected information for specific applications.

The most important functional factor is the operating frequency of an RFID system which is used to enable the reader to communicate with the tags. There are several available frequency bands for the operation of an RFID system: low-frequency (125-134KHz and 13.56MHz) and high-frequency (433MHz, UHF, MW).

Over the several years there has been an explosion of interest in RFID due to their rapidly expanding adoption to track items through the supply chain such as retails (Wal-Mart), Pharmaceuticals (FDA), and military (DoD).

RFID is one of a variety of ubiquitous sensor network (USN) technologies. USN system is the much more broad sense of AIDC system. The USN tag, which is usually called nod, not only getter data intelligently but pass the information data proactively. Active tag with embedded sensors is one of the present forms of the USN nods. USN nod can communicate each other and open the new M2M (Machine to Machine) applications.

Figure 4.5 shows the RFID value chain and major industry players for conventional dummy tags applications. Figure 4.6 shows the forecasts for the RFID market growth.

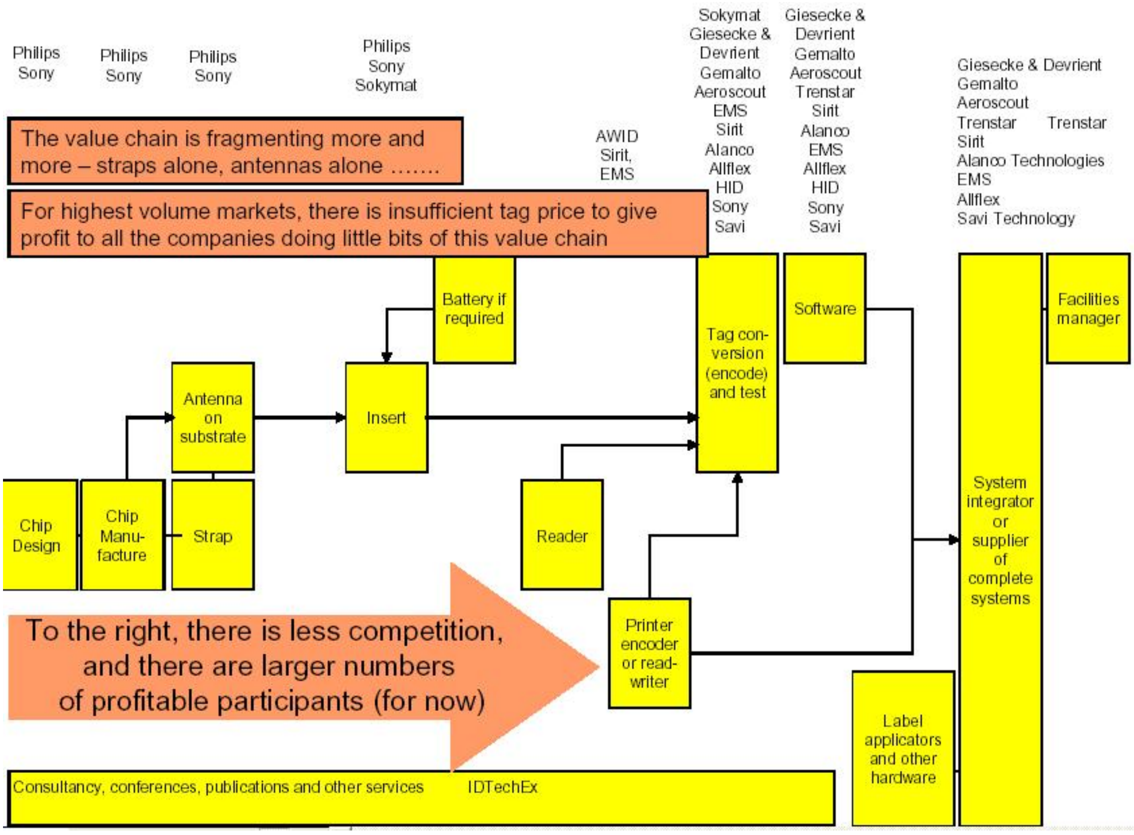

Fig 4.5 RFID value chain and major industry players (source: IDTechEx)

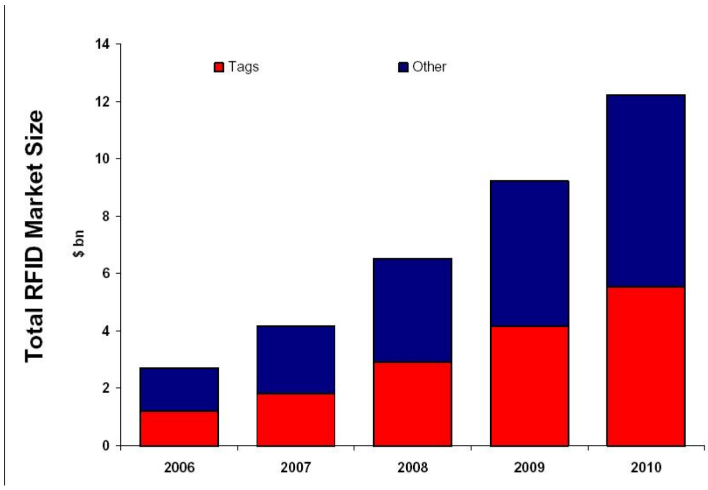

Fig 4.6 Forecasts for the RFID market growth (source: IDTechEx)

4.2.2 Constructing RFID/USN blue ocean strategy

The RFID/USN market is highly fragmented, and many players are competing on small niches. Up to now there was only small numbers of cases open a RFID/USN blue ocean market. One example is the Savi technology which had a $424.5 million contract with the US Department of Defense. The contract includes the range of active RFID products and services, from tags and readers to software systems.

Savi has more than fifteen years experience implementing solutions that have been proven to enhance operational efficiency, deliver substantial cost savings, reduce capital investment in supply chain assets and optimize inventory levels. Through investments in R&D and technology acquisitions, Savi has designed and developed software solutions which can be integrated with other AIDC technologies including barcode and passive RFID technologies. Savi's hardware offering includes a broad range of high performance active RFID tags with sensors that monitor security and environmental conditions. Savi is the leader in RFID solutions that deliver value through real-time visibility, asset management, inventory optimization, and security.

Based on Savi’s business cases, the factors that affect competition among RFID industry players are as follows:

Attribute	Description
Vertical Integration	How the company and its products/services support specific applications/industry?
Standard Compliances	To what extent can the company's technology be complying with different industry standards?
Technological Stability	This value measures the technological stability of the current firm, compared with its competitors.
Price Model	Measures a company's price competitiveness.
Consistency	To what extent is the technology offered can be integrated with legacy systems?
Innovation Potential	Does the nature of the company's technology support innovative use and further development?

Right Offerings	How do the company and its technologies provide end-user values across diverse needs?

Figure 4.7 shows the strategy canvas for Savi and others in Read Ocean business.

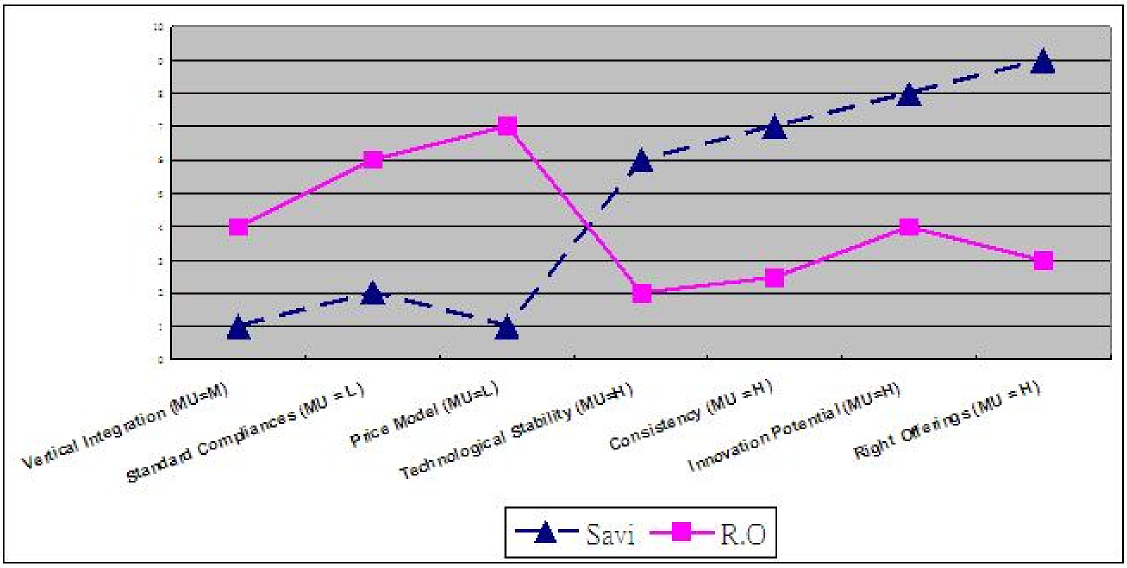

Fig 4.7 Strategy canvas for Savi and others in Read Ocean business.

As can be seen in the figure, Savi's strategy canvas shows three characteristics of a good strategy usually found in Blue Ocean cases studies[[1]:

1. Focus on factors such as consistency with the legacy system and innovation potential by developing various platforms (multi-band, active and passive, sensor tags, wireless networks).
2. Divergence from conventional competition factors such as Gen2 standard compliances and low price devices development sacrificing the technological stability in operation.
3. Compelling Tagline in right offerings for end-user values across diverse needs.

Figure 4.8 shows the multi-dimensional strategy canvas for Savi and others in Read Ocean business.

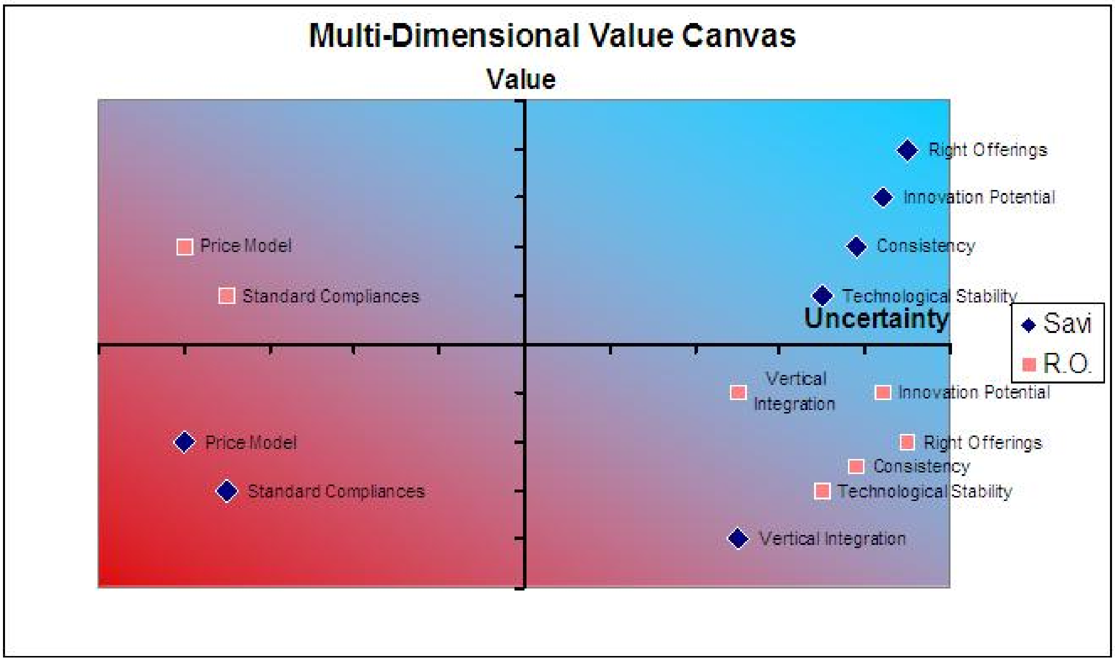

Fig 4.8 Multi-dimensional strategy canvas for Savi and others in Read Ocean business.

As can be seen in the figure, Savi facilitates the uncertainty and does experimentation to increase its chances of capturing valuable innovations dealing with factors in the top-right segment of the multi-dimensional strategy canvas.

Factors such as prices and standard in the top-left quadrant offer great value to the company, while their introduction inherently involves less uncertainty. As a result of this low risk, the amount of returned value may be high, but the likelihood of creating a blue ocean is significantly reduced, as other companies will also be able to realize this value.

V. Conclusions

In this research we discussed how we extend the Blue Ocean Strategy Theory to include a Real-Options framework dealing with market uncertainty. Blue Ocean Strategy instructs firms on how to create a wide open market – called a Blue Ocean – by changing the factors they compete on. The current theory does not manage the uncertainty inherent in Blue Oceans, because one cannot know market preferences. The Real-Options framework illustrates how this uncertainty can be managed to create the greatest expected value in these new, uncharted Blue Ocean markets. This research started with a tutorial on both Blue Oceans and Real Options. Next it discussed how these two theories fit together and complement each other. It then examined emerging technology busienss such as VoIP, and RFID/Sensors to show how the combined Blue Ocean/Real Options theory can help organizations capture the most value from Blue Ocean markets.

As companies seek to use value innovation to create new markets with little or no competition, they are faced with several questions: In which of their technologies is there the greatest benefit or value? Where should they focus their innovative energy? How can the companies balance the risk associated with implementing a new technology? To provide answers for theses questions, we developed the “Multi-Dimensional Strategy Canvas” which can provide a picture into how a company can address these questions and which steps it should take to enter markets with untapped potential.

We found that a company facilitates the uncertainty and thus does experimentation to increase its chances of capturing valuable innovations dealing with factors in high market uncertainty (factors in top-right segment of the multi-dimensional strategy canvas).

Our analysis could be a valuable tool for a company which would like to formulate a good blue ocean strategy by the “Eliminate-Reduce-Raise-Create” framework, and thus to be a market leader in emerging ICT markets.

REFERENCES

[1] Kim, W. & Mauborgne, R., “Blue Ocean Strategy”, HBU Press, 2005.
[2] Amram, M. & Kulatilaka, N., “Real Options”, HBU Press, 1999.
[3] Gaynor, M., “Network Services Investment Guide”, Wiley, 2003.
[4] WallStreet Journal, February 19, 2006.
[5] http://community.voxeo.com/skype/home.jsp.

APPENDIX: Market Uncertainty

Understanding what market uncertainty is, and how best to manage it to maximize gain, is essential to success when investing or managing in today's world. Even before the Sept 11th tragedy, uncertainty in the area of network-based services was high; now, smaller budgets and heightened concern for security make it even higher. Thus far, it has been very hard to predict the services and applications that users would embrace. Ideas such as on-line grocery shopping (WebVan, PeaPod, and so on) attracted over a billion dollars from investors, and are now worth very little -- what seemed like a good idea was not. Yet, other ventures such as on-line auctions (ebay), have proven valuable to investors and users. Still other services such as on-line map/direction services (MapQuest) have proven valuable to users, but have not found a business model to ensure their continued existence. Market uncertainty is high in regards to network-based services. Investors and managers who understand how to use uncertainty to their advantage will have a strategic competitive advantage over their peers.

This appendix defines market uncertainty, how to measure it, and its link to the value of experimentation. It starts with a discussion about market uncertainty in a general sense by looking back in time at what others have discovered. Then, it discusses several methods to measure market uncertainty. These measurement techniques include both established methodologies and ideas presented in Gaynor's thesis. The chapter ends by linking market uncertainty to the value of experimentation.

What is Market Uncertainty?

Market uncertainty is the inability of vendors and service providers to predict what users will like. Market uncertainty is not new; it has existed for many years. However, with today's fast-changing telecommunication and computer technology it has reached new heights. The uncertainty exists partly because sometimes users do not know what they want until they see it. This means service providers cannot ask users what they want, because the users don't know. The only way to meet uncertain markets is through trying different ideas and hoping to find at least one that will meet the market.

Users often do not know what they want from new technologies because they don't know enough about them to understand the possibilities. When users are first introduced to new technology they tend to view it in the context of the older technology being replaced. Users' expectations evolve along with the technology as they become more educated about the technology and what it enables. When the first automobiles were built, users viewed them in the context of a horse-drawn carriage (hence the name horse-less carriage). Only later, as users began to understand the range of possibilities, did attributes such as reliability, comfort, and safety become important.

Market uncertainty is hierarchical in nature. Consider the migration from horse-drawn carriages to automobiles. At first, the uncertainty existed with high-level design questions such as what type of power plant is best to replace the horse. Next, decisions such as the best steering, brakes, and tires became important. It became obvious that the tiller design used with the previous technology did not meet the needs of the new technology. In today's car, there is little uncertainty about the power plant[13], steering, or braking. Consumers today are more concerned with safety, efficiency, or performance, and not with the basics of how the car works. It is this combination of new technology and users' perceptions of their evolving needs that creates market uncertainty.

A similar phenomenon is occurring with the Internet and the Web. The diversity of Web-based applications is beyond what pundits ever imagined. Nobody predicted in the early 90s what the Web is today, or the impact it has had on society. In ten years the Web has emerged as a requirement for modern commerce. The Web is the standard way to share information both within a company (intranets), and to the outside world (extranets). Web-based services from banking, to shopping, to travel, and even sex have become the norm for many. The Web has enabled customers to help themselves to services and information without having to depend on customer help lines. The Internet today is far different from the predictions of early 1990. This shows the high level of

[13] This is changing now because of environmental concerns. The efficiency and environmental friendliness of the combustion engine is being questioned, but it has been a stable, dominant technology for over 50 years.

market uncertainty that exists in network-based services, and the way users' preferences evolve with the technology.

Understanding market uncertainty is important for product design and development. The Internet has changed how applications are designed and built because of the high uncertainty of the Internet environment. Think about development of the first breed of web browsers. When Netscape started its development process there was extreme uncertainty. Users had no idea what they would do with browsers, and vendors had no idea what services would become popular. Understanding the high market uncertainty, Netscape altered the traditional software development process to allow for extraordinary levels of early feedback from users. It also changed its software development processes to be able to incorporate this feedback into the product design at advanced stages in the development process, when traditional software engineering methodologies would not allow changes. Netscape succeeded in its browser development because it understood how to take advantage of the extreme market uncertainty.

How to Measure Market Uncertainty

It is important to be able to measure what you try to manage; thus, measuring market uncertainty is important to managing this uncertainty. Knowing if market uncertainty is high, medium, or low is important to shaping management policy of network-based services. While the ability to measure is critical, the precision of the measurement is not. In fact, precise measurements of market uncertainty are not possible. Fortunately, it is possible and sufficient to estimate market uncertainty as low, medium, or high.

We try to use techniques for estimating market uncertainty that are independent of the changes to market uncertainty. This means the metric used should not be a factor causing changes in market uncertainty. One good example described below is the ability to forecast the market. When industry experts try and predict the future markets, they are not changing the market uncertainty. One example of a poor metric is technological change because it is one of the factors that causes market uncertainty.

When the architecture of Private Branch Exchanges (PBXs) used to provide voice services to business users changed in the 1970's to a programmed controlled design that increased the vendor's ability to experiment with new features, this created market uncertainty. Suddenly customers had a tremendous choice among innovative features that were brand new, and because of the learning curve with new technology the market uncertainty became high.

While difficult, estimating market uncertainty is important for showing relationship to management structure. Using a combination of existing and new techniques to estimate market uncertainty adds confidence to its measurements. Below are the techniques used in the case studies to estimate market uncertainty:

Ability to forecast the market: The ability to predict market trends and behavior implies low market uncertainty because it shows a basic understanding of the market.   This metric is independent of market uncertainty.

Emergence of a dominant design: As the dominant design is being determined, market uncertainty is decreasing as more users pick this design. However, once the dominant design is established, its existence shows an independent measure illustrating a decrease in market uncertainty.

Agreement among industry experts: Another indication of lower market uncertainty is agreement among experts about a technology and its direction. When market uncertainty is high, such as in the early email period, there was little agreement as to industry's direction, and what features would turn out to be important to users.

Feature convergence and commodity nature of a product: This convergence of features demonstrates a metric similar to that of the dominant design. Initially, as features converged there is linkage between the metric and the changing market uncertainty. However, after the convergence of features, and once the product has become more like a commodity, this metric is independent of changing market uncertainty.

Changes in standards activity: Stable standards mean vendors have a fixed target on which to base products. Email is a good example of low market uncertainty after the standards stabilized. In 1996 the major Internet email standards (Mail, SMTP, POP/IMAP, and MIME) were established. Once standards for a particular technology are stable, then this stability is a good indication of low market uncertainty that is independent of market uncertainty.

The above methodologies for measuring market uncertainty provide a reliable way to gauge market uncertainty at coarse granularity, indicating whether market uncertainty is low, medium, or high. These estimates provide a way to see significant shifts in market uncertainty. This is particularly true if several of the above methods agree.

Effect of Market Uncertainty on the Value of Experimentation

The economic value of experimentation links to market uncertainty by definition of market uncertainty - market uncertainty is the inability of the experimenter to predict the value of the experiment. When market uncertainty is zero, the outcome of any experiment is known with perfect accuracy. As market uncertainty increases, the predictability of the success of any experiment's outcome is lower, because outcomes are more widely distributed. This link between experimentation and market uncertainty is intuitive as long as the definition of market uncertainty is consistent with the variance of results from a set of experiments.

When market uncertainty is low or zero, the experimenter has a good idea of the market. This means that each experiment is expected to match the market well and meet the needs of most users. However, if market uncertainty is large, then the experimenter is unable to predict how the market will value the experiment. It may be a wild success (such as the Web), or a dismal failure, such as the attempt of PBX vendors to capture the business data LAN market in the 80's As market uncertainty increases, so does the possibility of performing an experiment that is a superior match to the market as indicated by a value far above the mean of the distribution. When market uncertainty is low, even the best experiment is not far from the mean, but high market uncertainty disperses the outcomes over a greater distance from the mean.

The difference between the mean of the distribution and the best experimental result grows as the standard deviation increases. As you get more experiments, or as the variance increases, then the difference between the average of the distribution and the best of many experiments increases. It explains how high market uncertainty implies greater value.