

# Competitiveness and Management of Technology

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## Abstract

This paper delves into competition and technology management as a means of economic development. Expanding from Porter's framework on competitiveness and using a novel framework of PTGE (People, Technology, Government and Environment), this paper argues that three types of competitive advantage could be created. These competitive advantages range from passive to active advantages, i.e. natural advantage, duplicated advantage and niche advantage. Technology and effective management of technology become the key differentiating factors in determining one's competitiveness. This paper discusses key aspects of technology management, namely R&D management, new product development and technology strategy in enhancing competitiveness that may lead to the creation of one of the competitive advantage mentioned.

**Key Words:** competition, competitive advantage, technology, management of technology

## Introduction

Competition is one of the major forces shaping today's economy. The success of a company, industry, country or even an individual is largely attributed to the competitive advantage possessed and utilized. Competition explains why some countries are rich and why some companies are making sustained profits whereas others have failed to move on the same paths. Competition is a popular word with many interpretations associated with it. What does competition or competitiveness really mean? And, how could it be created? There are many drivers of competition. In this paper, we focus on technology and the management of technology, as technological change is among the most prominent factors explaining the dynamism of the current economy. The structure of this paper is based on a lecture delivered to MBA students at Josai University, Japan. The main goals of the paper are to shed light on some of the issues related to competition, competitiveness and technology as well as to highlight critical issues involved in the management of technology, in order to provide a basis for further discussion.

## On Competition

Many people are fearful of competition. To them competition means warfare which will result in the identification of winners and losers. With competition, they have to strive to be the best player in order to beat their rivals to survive. Magretta (2012) pointed to a different view of competition based on an argument provided by Michael Porter. Instead of "beating

down competitors to be the best player”, Porter sees competition as a process of “creating value through differentiation”. Competition with the goal of being the best will lead to competitive convergence where the strategic distances between players will diminish over time (Langohr, 2004). It will lead to a zero-sum game where everyone ends up doing almost similar things, exhausting the capability to create value through the activities performed.

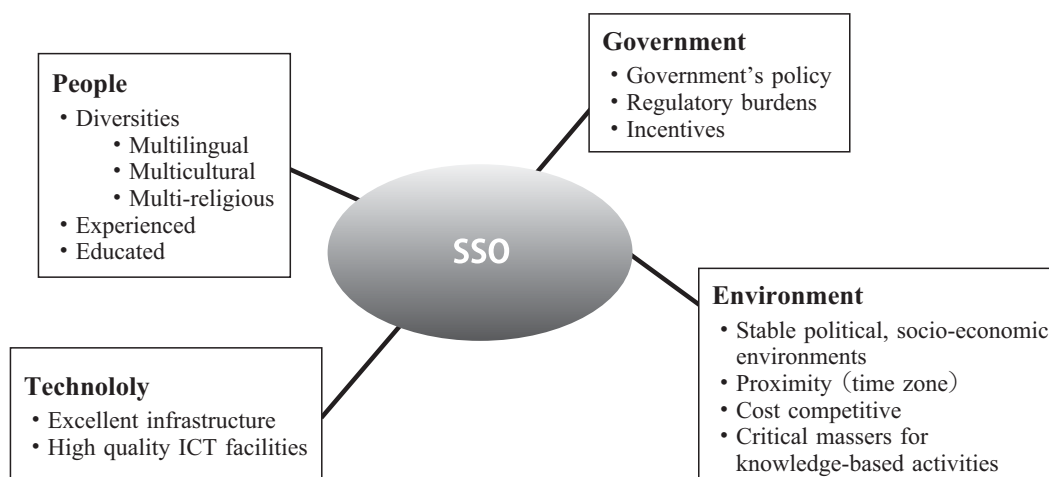
On the other hand, Porter argues that competition is more than doing better than others or to be the best at one extreme, it is about doing things differently. That is how competition is seen as “the only path to growth and prosperity” as postulated by Porter (1990). As there is no single way of performing or achieving a particular objective, competition that aims to be unique rather than to be the best will allow many “bests” in the competition, which will enhance value creation in general. For instance, in business, there are many ways to meet customer demand or satisfaction. In fact, there are just too many different customers with different needs to entertain in the market. It is impossible to find the best way to compete or to be the best. Instead, firms who understand the different needs and are creative in offering their products or services differently will get a share in the market. It can be done through unique product packaging, quality services, or product innovation, just to name a few, which allows firms to generate profits, sustain growth, explore new markets or meet other objectives of the firm. Competition entices a relentless effort to stretch one’s ability to identify and sustain an advantage, which is called a competitive advantage.

Defined simply, competitive advantage means the ability to create superior values from the activities performed. Basically it is created through the understanding of the roles of anticipation and the application of it in decision making, which will eventually lead to cost reduction or unique offerings. At the industry level, it means the ability to predict what customers want, who the new players are, what new products have been introduced and how these products may affect firms’ current position in the market, and other related questions that may determine how a decision is made. Porter’s Five Forces Framework provides a framework to understand the essential relationships in businesses (Porter, 1985). The five forces which consist of forces from rivals, buyers, suppliers, new entrants and substitutes explain the relationships between sellers and buyers, between sellers and suppliers, between potential entrants and rivals and between demand and supply, all of which are critical in forming anticipation about how the industry works or how the values are created and shared among players in the industry.

In explaining the factors affecting the competitiveness of a nation or industry, Porter (1990) developed the Diamond Model, which looks at four interrelated dimensions, namely firms’ strategies, factor conditions, demand conditions, and related and supporting industries as determinants of the “attractiveness” or competitiveness of a nation or industry. According to Porter, “if you have a real competitive advantage, it means that compared with rivals, you operate at a lower cost, command a premium price, or both” (Magretta, 2012).

Cheng (2005) proposes a different framework to explain the competitiveness concept. Important elements of competitiveness are People (P), Technology (T), Government (G) and Environment (E) of a nation. The PTGE Framework is explained by referring to the competitive position of the shared services and outsourcing (SSO) industry in Malaysia. Malaysia has been ranked as the third most attractive country by A. T. Kearney in its Global Services Location Index for many years, since A. T. Kearney started its Global Service Location Index (A. T. Kearney, 2011; 2014). Figure 1 illustrates how the PTGE Framework is used to explain Malaysia’s competitive advantage in the shared services and outsourcing industry.

## Shared Services and Outsourcing in Malaysia



**Figure 1 Malaysia's Competitive Advantage in the Shared Services and Outsourcing Industry**

Based on the PTGE Framework, Cheng (2010) further suggests that there are three different types of competitive advantage possesses by a nation, an industry, or a firm. As competitive advantage is both a relative and a dynamic concept, when the economy moves up the value chain or transforms its structure from primary industry to services, the type of competitive advantage created or enjoyed may change over time. These competitive advantages range from passive to active advantages.

**(a) *Natural Advantage***

This is a “given” advantage enjoyed by a country or industry due to natural resources endowment. This advantage, which is also called “supply advantage” “inherited advantage” or “passive advantage”, will deplete over time, if the resources are not utilized or maintained in a sustainable manner. Some of the important measures to sustain natural advantages include R&D and advanced technology management to better integrate various industries to form backward as well as forward linkages in order to benefit from the complete value-chain created by the industries.

**(b) *Duplicated Advantage***

This is the competitive advantage enjoyed by first-movers who react swiftly in response to the market needs. At the country level, this advantage is created by offering attractive incentives, particularly financial incentives, such as tax exemptions or subsidies. Increasingly, a duplicated advantage is derived from the availability of talented workers and trained personnel, or from a cost advantage and favorable infrastructure which allows it to compete in a progressively innovative economy. This advantage is considered as the least sustained advantage because the attractiveness offered can be “imitated” by rivals over time. In order to sustain this advantage, there is a need to continuously innovate to provide attractive packages for competition.

**(c) *Niche Advantage***

This is an “active” advantage that would be sustained over time once a reputation is gained and the niche activity is developed. This advantage is created through differentiation strategy, innovation, formation of social capital and branding. This advantage is not easily

copied or imitated due to the unique value created. It can be sustained if continuous innovation and differentiation effort is carried out. The key ingredient to create and sustain this advantage is the availability of a skilled and professional workforce to provide reliable and consistent management of innovation, availability of advanced technology, management of technology practices, efficient market processes, and a conducive as well as stable macro environment for the development of professional services in the country.

The above discussion has highlighted the importance of innovation, technology and management of technology. Indeed, as industries are becoming more technology-driven and advanced technologies are becoming pervasive, an effective management of technology is often seen as a strategic tool in determining one's competitiveness. The next section will discuss technology and management of technology in association with competitiveness.

## **On Technology**

The development of the current economy is largely attributed to the advancement of technology. Technology is inevitable and affects people from all walks of life. The Internet, 3D printing, robotics and many more innovations are changing the way we communicate, consume, produce, and affect essentially every aspect of our life. For instance, the creation of the 3D printer is changing the entire supply chain and affecting the traditional production structure. Rapid prototyping, desktop manufacturing, and "all together production" are some of the trends gradually replacing the outsourcing model. The production chain will become shorter, city-based and customized. Initial capital costs will reduce significantly and conventional economic principles such as economies of scale may not be as popular as before. The new technologies move producers closer to the users, enabling massive customization and lower initial production costs.

Generally speaking, technology is embedded in every activity conducted. It is not limited to equipment or product per se. Besides physical devices such as tools, instruments and machines, technology encapsulates knowledge, functional actions, processes, systems and other undertakings conducted either to solve problems or improve existing conditions. In fact, technology is relevant to everyone and every business. It involves processes, production, distribution, packaging and services. Since technology is literally embodied in every value activity, any change in technology will have an impact on competition, especially if the change enhances differentiation or the relative cost position of a firm or industry (Porter, 1985). In his book *Competitive Advantage: Creating and Sustaining Superior Performance*, Porter (1985) emphasizes the importance of technological change as the key driver of competition.

Technological change affects competition in a number of ways. For instance it shifts the bargaining relationship between different players in the market (i.e. buyers and sellers, between suppliers, etc), alters the nature of competition, changes industry attractiveness and industry structure, redefines industry boundaries and changes the relative value of a product or service. Although not all technologies produce significant and positive impacts on competition as some technologies may destroy an industry's attractiveness, some may affect a company's competitive position and others may reduce the profitability of a firm or industry, generally technological change is highly desired. As a result of technological innovation, customers are able to enjoy more new, better and cheaper products; firms are able to venture into new markets, offer new products and enhance productivity and efficiency in production, and the nation is able to enhance its standard of living.

However, not all technologies invented are meaningful. Unless the technology is effectively managed to create an impact on industry structure and/or competitive advantage, it may not be helpful in creating a superior performance as stated above. Basically, the value of technology lies in its ability to produce better products and services at lower costs. In other words, technology can be helpful in enhancing differentiation, generating price premium and cost advantage if we know how to use the existing and new technologies effectually. This leads us to the discussion on an important topic, i.e. Management of Technology (MOT).

## On Management of Technology

Management of technology (MOT) is not a new concept or practice. In 1986, a special task force was formed in the United States to look at technology and the role of MOT in defining competitiveness (National Research Council, 1987). As a result of the rapid advancement in technology development and technological changes, the importance of MOT is gaining increasing attention nowadays. One of the key factors to explain sustainable competitive advantage is the effective development, management and implementation of technology rather than the existence of technology in and of itself.

Defined simply, MOT is the application of the principles of management to the invention-innovation process of technological change. It involves cross-disciplinary co-ordination, particularly engineering, sciences and management to enhance the capability of technology in achieving the strategic objectives of an organization. Specifically, MOT is related to the planning, development and implementation of technology and the integration of people, financial resources and other organizational resources to achieve the objectives of an organization such as how to profit from new markets, how to respond to increasingly sophisticated customer demands or to develop an industry's leadership position.

MOT involves many interrelated operations. Important management aspects of MOT include but are not limited to the followings (Dodgson, 2000):

- Research and development
- New product development
- Management of operation and production
- Technology strategy
- Technological collaboration
- Commercialization
- Technology forecast and foresight
- Patent management

This paper discusses some of the important practices of MOT and highlights critical issues in respective fields in enhancing competitiveness.

### (a) *Management of Research and Development (R&D)*

R&D is an important activity of MOT as it plays a strategic role in the identification of the use of appropriate and feasible technology in order to enhance competitiveness through differentiation or cost advantage. However, managing R&D is a challenging task. The challenges are always associated with how much to spend for basic versus applied research; whether to focus on immediate business needs or long-term research; and whether the organization should adopt a centralized or decentralized R&D management. Obviously, no definite answer can be given for each of the issues mentioned above as different organizations operating in different industries would have different approaches to address the challenges,

depending on the purposes of conducting the R&D activities and skills and resources possessed by the organization. However, organizations need to realize the importance of R&D management and be aware of the complicated process in managing R&D so that they can benefit as much as possible from the investment they put into the R&D activities.

**(b) *New Product Development***

One of the elements of competitiveness is the ability to produce new, better and cheaper products and services. Hence, management of new product development is considered a key activity of MOT. Basically, we can categorize products into three big groups, namely products that customers want; products that customers do not want; and lastly products that customers do not know they want (Dodgson, 2000). The major but most rewarding challenge is to manage the third type of product where the customers are not aware of what they want. Therefore the major risk involved in new product development is the market risk. Besides, organizations also have to manage other risks, particularly competitors risks, technology risks, organizational risks, and financial and production risks. In order to increase the success rate of new product development and mitigate various risks associated with new product development, it is crucial for organizations to develop effective technology strategies including technology forecasting and foresight.

**(c) *Technology Strategy***

Rapid developments in technological change, increasing globalization activities as well as the need for organizational transformation have caused potential disruptive outcomes. Unless organizations are guided by strategies that build synergies and grow expertise continuously, the competitive advantage of organizations may be depleted over time. Technology strategy is the organization's approach to the development and use of technological competencies to develop the organization's competitive advantage. Key issues to be addressed include: what technologies to develop; whether to collaborate with others; whether to purchase the technology or internally develop it. Technology strategy is guided by the organization's resources such as people, equipment, financial capital and networks as well as the organization's innovative capabilities, particularly the searching, acquiring, implementation, and coordinating capabilities as well as a range of other activities activating the resources of the organization.

## **Conclusions**

This paper highlights a few key issues in technology, management of technology and their implications for competitiveness. The discussion on competitiveness and technology as well as technology management is not new. However, there has been a renewed interest in this topic due to the dynamism of the current economy in which technology and effective management of technology are playing an increasing role in determining one's competitiveness. Hence, there is a need to take a closer look at the role of technology and management of technology in competitiveness. According to Michael Porter, competition is not about competing to be the best; rather it is about aiming to be a unique player in the marketplace. Based on the PTGE framework developed by Cheng (2010), three types of competitive advantage ranging from passive to active advantages are proposed. These competitive advantages, namely natural advantage, duplicated advantage and niche advantage, are closely associated with technology and the management of technology.

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