Standardized Strategic Assessment Framework for Small and Medium Enterprises in High-Tech Manufacturing Industry

by

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A Thesis Presented in Partial Fulfillment
Of the Requirements for the Degree
Master of Science in Technology

Approved November 2012 by the
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ARIZONA STATE UNIVERSITY

December 2012

ABSTRACT

A fundamental question in the field of strategic management is how companies achieve sustainable competitive advantage. The Market-Oriented Theory (MOT), the Resource-Based Model and their complementary perspective try to answer this fundamental question. The primary goal of this study is to lay the groundwork for Standardized Strategic Assessment Framework (SSAF). The SSAF, which consists of a set of six models, aids in the evaluation and assessment of current and future strategic positioning of Small and Medium Enterprises (SMEs). The SSAF was visualized by IDEF0, a systems engineering tool. In addition, a secondary goal is the development of models to explain relationships between a company's resources, capabilities, and competitive strategy within the SSAF.

Six models are considered within the SSAF, including R&D activities model, product innovation model, process innovation model, operational excellence model, and export performance model. Only one of them, R&D activities model was explained in-debt and developed a model by transformational system.

In the R&D activities model, the following question drives the investigation.

Do company R&D inputs (tangible, intangible and human resources) affect R&D activities (basic research, applied research, and experimental development)?

Based on this research question, eight hypotheses were extrapolated regarding R&D activities model. In order to analyze these hypotheses, survey questions were developed for the R&D model. A survey was sent to academic staff and industry experts for a survey instrument validation. Based on the survey instrument validation, content validity has been established and questions, format, and scales have been improved for future research application.

ACKNOWLEDGEMENTS

I would like to thank my mentor, Professor Gary Waissi, for masterfully guiding me through the various phases of this thesis program. His support, guidance, encouragement, detail-oriented critique, and expertise sustained me through the completion of my thesis. I would also like to express my sincere gratitude to Professor Jane Humble and Professor Gerald Polesky, for their constructive evaluation and encouragement throughout this process. To all professors and teachers I have encountered along the way, I appreciate your unique insights and belief in my abilities.

I would also like to thank my family and friends for their encouragement - without their patience, understanding, support, and, most of all, love, the completion of this study would not have been possible.

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ABBREVIATIONS

A&D: Aerospace and Defense

AMT: Advanced Manufacturing Technology

IDEF: Integration Definition Function

IDEF0: Integration Definition for Function Modeling

IOE: Industrial Organization Economics

MOT: Market-Oriented Theory

NAICS: North American Industry Classification System

R&D: Research and Development

RBM: Resource-Based Model

SCP: Structure Conduct Performance

SMEs: Small and Medium Enterprises

SSAF: Standardized Strategic Assessment Framework

CHAPTER 1

INTRODUCTION

The most fundamental question in the field of strategic management is how a company is able to achieve a sustainable competitive advantage. Strategic management is a highly complex field because it involves analyzing an entire organization and its largely uncontrollable environment (Herrmann, 2005). Thus, strategic management can be defined as:

> The process of identifying, choosing and implementing activities that will enhance the long-term performance of an organization by setting direction and by creating ongoing compatibility between the internal skills and resources of the organization, and the changing external environment within which it operates (Smith, Jackson, & Wyatt, 1998, p. 6).

Accordingly, strategic management focuses on the compatibility between a company's resources, capabilities and its external environment.

In the strategic management field there are two major influential contributions, including Market-Oriented Theory (MOT), which was postulated by Michael Porter (1980), and Resource-Based Model (RBM), which was first introduced by Penrose (1959). Michael Porter (1980) built a framework of generic strategies and industry analysis (Herrmann, 2005). According to his model, company performance is determined by industry attractiveness, which depends on five competitive forces, including: threat of entry, intensity of rivalry among existing competitors, pressure from substitute products, bargaining power of

buyers, and bargaining power of suppliers. The interaction of these forces relates to a company's profit potential.

Another influential framework for understanding strategic management is the Resource-Based Model (RBM) of the company. The basic idea of the RBM is that a company will achieve a sustainable competitive advantage by developing and applying distinctive company resources. When company-specific resources are costly, rare and non-replicable by other companies, these resources become the basis of sustainable competitive advantage; unique company resources (e.g. company knowledge: know-how) are valuable because social complexity cannot be imitated (Herrmann, 2005). In order to understand sustainable competitive advantage, a combination of both the Market-Oriented Theory (MOT) and the Resource-Based Model (RBM) has been considered by recent strategic management studies (Conner, 1991; Mahoney & Pandian, 1992; Amit & Schoemaker, 1993; Peteraf, 1993; Henderson & Mitchell, 1997; Spanos & Lioukas, 2001; Rivard, Raymond, & Verreault, 2006).

Statement of Research Problem

This study examines the performance implications of strategic models in the high-tech manufacturing industry. High-tech manufacturing industries can be defined as those "engaged in the design, development, and introduction of new products and/or innovative manufacturing processes through the systematic application of scientific and technical chance" (Hecker, 2005, p.57). The high-tech manufacturing industries (e.g. electronics, aerospace and defense, etc.) are highly dynamic industries in respect to their continual technological advances.

These continuous changes in technology induce company managers to update their technology in order to increase their company's competitive strength. Therefore, a complete understanding of company technology is necessary to be able to determine its optimal structure (Caves, 1980). In order to properly identify high-tech manufacturing industries, several requirements were confirmed by the Census Bureau in 2004, including "high proportion of scientists, engineers, and technicians", "high proportion of R&D employment", "production of high-tech products", and "use of high-tech production methods" (use of high tech capital goods and services in the production process) (Hecker, 2005, p. 58).

This study investigates the parallelism of competitive environment, resources, and capability for any company endeavoring to achieve sustainable competitive advantage. For this purpose, a Strategic Assessment Framework (SSAF) and, within it, related models were developed. The SSAF and its developed models attempt to close the gap between the Market-Oriented Theory (MOT) and the Resource-Based Models (RBM). The SSAF and its related models build on, and extend from, the underlying theories and concepts of the Market-Oriented Theory (MOT), the Resource-Based Model (RBM) and their respective extensions.

Here, it is important to note that there are some differences between a framework and a model:

- A framework (Porter, 1991)
    - "Encompasses many variables and seeks to capture much of the complexity of actual competition" (Porter, 1991, p. 98).

- "Identifies relevant variables and questions which the user must consider in order to develop conclusions tailored to a particular company or industry" (Porter, 1991, p. 98).
- "Seeks to help the analyst think through a problem by understanding the company and its environment and then identifying and selecting an available strategic alternative" (Porter, 1991, p. 98).

➢ A model (Porter, 1991):

- Depends on the fit between assumptions and reality.
- "[Is almost inevitably applicable] to small subgroups of companies or industries whose characteristics fit the model's assumptions" (p. 98).

Due to their complementary goals, a framework and a model are not mutually exclusive, and when used in conjunction with each other, they can form a theory, which is more all-encompassing. While models are very useful in ensuring logical contingency and exploring the subtle interactions involving a limited number of variables, frameworks balance models by highlighting omitted variables (Porter, 1991, p. 98).

The Standardized Strategic Assessment Framework (SSAF) approach has been identified as a possible method in capturing as much of the actual complexity of competition as possible. The SSAF can aid with assessment of current strengths and needs, as well as help with future strategic competitive positioning. The SSAF is composed of six interconnected strategic theoretical models, including a model for each of the following: R&D activities, process innovation, product innovation, technology adoption, operational excellence, and

global engagement, and two support models - including qualified workforce, and machines & equipment. The SSAF and its theoretical models are, in part, based on a systematic literature review.

In the context of an organization, knowledge of industry forces and company resources are necessary to achieve sustainable competitive advantage. A company has a sustainable competitive advantage when "it is implementing value creating strategy not simultaneously being implemented by any current or potential competitors and when these other companies are unable to duplicate the benefits of the strategy" (Barney, 1991, p. 103).

Strong environmental uncertainty within the high-tech manufacturing industry, ever-changing technology, and increasing complexity of company resources all combine to force companies to constantly analyze the industry in which they operate. These variables urge companies to change their strategies to be the leading competitors in their markets. By structuring a company's portfolio, bundling resources, and leveraging capabilities, enterprises can maintain value for customers (Sirmon, Hitt, & Ireland, 2007). Therefore, industrial forces (external factors) and company resources (internal factors) significantly affect a company's sustained competitive advantage. However, in very few studies do researchers explain the complementary link between external and internal factors to the sustained competitive advantage. Even if such literature exists, there has been little investigation into a strategic framework development using the Integration Definition for Functional Modeling (IDEF0) approach of systems engineering. Essentially understood:

> Systems engineering is an interdisciplinary field of engineering focusing on how complex engineering projects should be designed and managed over their life cycles. Issues such as logistics, the coordination of different teams, and automatic control of machinery become more difficult when dealing with large, complex projects. Systems engineering deals with work-processes and tools to manage risks on such projects, and it overlaps with both technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies, and project management (Hribik, 2012, p. 252).

Integration Definition (IDEF), which is like a systems engineering toolbox, can be used to describe operations in an organization. IDEF0 is a common modeling technique for analysis, development, re-engineering, and integration of business processes (DOD, 2001).

Due to its recent introduction into the business world, the theoretical perspective of strategic management (e.g. organizational knowledge creation: a link between knowledge and company capabilities, and a link between knowledge and competitive advantage) is not yet mature enough to allow for empirical testing (Spanos & Lioukas, 2001). Therefore, a specific framework for how to achieve and sustain a competitive advantage needs to be identified.

Goal of the Study

The primary goal of this study is to lay the groundwork for Standardized Strategic Assessment Framework (SSAF). The SSAF, which consists of a set of six models, aids in the evaluation and assessment of current and future strategic

positioning of Small and Medium Enterprises (SMEs). The second goal is the development of models to explain relationships between a company's resources, capabilities, and competitive strategy.

The contribution of this study is therefore focused on the development of the SSAF, which will enable SMEs to improve their strategic focus. Causality of the relationships is claimed only within the models and not between the models within the SSAF. Six theoretical models were developed as follows:

(1) Research Development (R&D) Activities Model: R&D activities model will attempt to explain the relationship between inputs (tangible resources, intangible resources and human resources) and outputs (e.g. product and process innovation, and process improvement);

(2) Product Innovation Model: the product innovation model will attempt to explain the relationship between inputs (e.g. R&D activities, qualified workforce, etc.) and outputs (e.g. export performance) with a focus on what is produced;

(3) Process Innovation Model: the process innovation model will attempt to explain the relationship between inputs (e.g. R&D activities, qualified workforce, etc.) and outputs (e.g. export performance) with a focus on how things are produced;

(4) Technology Adoption Model: the technology adoption model will attempt to explain the relationship between inputs (environmental influences, tangible, intangible and human resources) and outputs (company performance);

(5) Operational Excellence Model (process improvement): the operational excellence model will attempt to explain the relationship between inputs (e.g. qualified workforce, technical information, etc.) and outputs (critical success factors) with a focus on operational systems;

(6) Global Engagement Model: the global engagement model will attempt to explain the relationship between inputs (e.g. product and process innovation, process improvement, etc.) and outputs (company performance) with a focus on connection to other global enterprises.

Rationale

This study is based on a theoretical context of the MOT, the RBM and their extensions. Its purpose is to reveal a link between specific activities and a sustained competitive advantage. The resulting SSAF and its models could assist companies in evaluating their competitiveness in the market. The goal is that the SSAF and its models will help SMEs improve their strategic focus through the six model dimensions.

Significance of the Study

Companies are still searching for new and better ways to achieve and sustain a competitive advantage. The solution is not easy to find due to the uniqueness of companies and their environments. Further, the complexity of company resources adds even more factors that can affect a strategy (Teece, Pisano, & Shuen, 1997). “Rapidly shifting environmental contingencies provide a premium for companies capable of quickly identifying and understanding the

contingencies and then making decisions about how to leverage their capabilities without undue delay" (Sirmon, Hitt, & Ireland, 2007, p. 287). Therefore, in order to achieve and sustain competitive advantage, a company requires continual change and engagement in developing their methods. Understanding the relationship between a company's environment, resources, and effectiveness of its capabilities would provide necessary opportunities for analyzing the empirical implications.

Research Method

The following research techniques were used in this study:

- Review of fundamental competitive advantage models, including the MOT, the RBM, and complementary perspectives that comprise both the MOT and the RBM.
- Identify theoretical models related to the proposed SSAF derived from fundamental competitive advantage models.
- Develop the SSAF in a systematic way to demonstrate a relationship between various theoretical models discussed in literature, which relate to competitive advantage.
- Identify R&D activities model's inputs, based on literature reviews.
- Develop hypotheses regarding each input of R&D activities models.
- Validate survey instrument of SMEs in the A&D industry in the Arizona area.
- Analyze the data with appropriate statistical analysis tools.

This investigation seeks also to aggregate results from studies which investigate different focus areas in the manufacturing industry. It will develop a method by which companies can evaluate themselves with respect to competitive advantage in a given industry.

Scope

In this study, two fundamental competitive advantage models, the MOT and the RBM, were considered in the development of the SSAF:

- The MOT can be achieved by offering low priced products or differentiated products for which customers are willing to pay a price (Porter, 1980; Barney, 1991; O'Shannassy, 2008).
- The RBM is inspired by neo-classical microeconomics. Essentially, neo-classical microeconomics shows that sustainable competitive advantage occurs when a company implements a value creating strategy that is not already being implemented simultaneously by rivals - and the benefits of which other companies are unable to duplicate (Porter, 1980; Barney, 1991; O'Shannassy, 2008).

After reviewing these two fundamental advantage models (the RBM and the MOT), six models within the SSAF were developed, including: R&D activities, Product Innovation, Process Innovation, Technology Adoption, Operational Excellence, and Global Engagement. Additionally, one model, R&D activities, shed new light on the SSAF models in this study. Finally, hypotheses

were developed for each input of only one model (R&D activities) in order to test their relationships in future studies.

Assumptions. The following assumptions are considered in this study:

1. There are two supporting factors in the SSAF, including: qualified workforce, and machines & equipment.
    - *Qualified workforce* is necessary for sustainable competitive advantage. Therefore, development and management of a workforce is vital. (Dahms, 2001).
    - *Machines & equipment* are classified as physical capital resources (other physical capital resources can include: a company factory/plant, geographic location, and access to raw materials), which are used by companies in their operations (Barney, 1991).
2. Through literature reviews, positive and negative relationships between each model's inputs and outputs were determined within the SSAF and its variables. The effects of these relationships on a company's competitive advantage are different for each industry.
3. There are positive and negative areas which affect a company's sustainable competitive advantage.
4. To ensure validity, all stated hypothesis should be tested.

Limitations. The study has the following limitations:

1. This study is limited to the development of only six models: R&D activities, product innovation, process innovation, technology adoption,

operational excellence and global engagement. Only one of them is expounded upon in detail: *R&D activities model* will attempt to explain the relationship between inputs (tangible resources, intangible resources and human resources) and outputs (product and process innovation, and process improvement). R&D activities, which carry out internal company innovative activities, are a precursor to new products or new processes for a company.

2. This study is limited to only two supporting factors, including: qualified workforce and machine & equipment. Qualified workforce and machine & equipment are expounded upon within each model.
3. In the technology adoption model, the study is limited to only Advanced Manufacturing Technology (AMT) adoption. AMT can be defined as "a family of manufacturing process technologies whose common element is the use of computers to store and manipulate data" (Sohal, Sarros, Schroder, & O'neill, 2007, p.5226).
4. In the global engagement model, the study is limited to only export performance for global engagement model. Export performance can be defined as the "outcome of a company's activities in export markets" (p.497).
5. This study is limited to only a survey instrument validation, because of time constraints.

Summary

As indicated, the purpose of this study is to develop the SSAF and identify its theoretical models. The study focuses on investigating the relationships between a company's environment in which it competes, a company's distinctive resources, and a company's capability for achieving sustainable competitive advantage. The SSAF builds on the underlying theories and concepts of the MOT, and the RBM and its dynamic extensions. These theories and concepts are discussed further in Chapter 2.

Relevant literature relating to the problem statement will be reviewed in Chapter 2. Key topics in Chapter 2 include the Market-Oriented Theory (MOT), the Resource-Based Model (RBM), and the complementary perspective of the MOT and the RBM. In Chapter 3, the design and methodology of the study, as well as the choice of tools, are identified. Chapter 4 includes discussion of the concept of the SSAF and the development of the hypotheses. In Chapter 5, the SSAF concept is summarized, including implications for current theory and practice, the limitations of the study, and recommendations for future study.

CHAPTER 2

LITERATURE REVIEW

In order to achieve and sustain competitive advantage within industry, a company should identify its competitive strategy based on its internal factors (e.g. company resources, company capabilities, etc.) and analysis of externalities (e.g. customers, suppliers, e.g.). Many recent contributions place emphasis on company level competitive advantage under the banner of a resource-based view of the company (Hart, 1995; Dhanaraj & Beamish, 2003). The Resource-Based Model (RBM) focuses on "how sustained competitive advantage is generated by the unique bundle of resources at the core of the company" (Dhanaraj & Beamish, 2003, p.244). In this chapter, review of relevant literature is assessed in the following order: first, some basic terms in the literature, including competition, competitive advantage, competitive strategy, and economic development and company growth at company level, are defined; and second, some of the core concepts of competitive advantage at the company level are described in detail. The discussion of the core concepts sets precedence for the specific concepts and techniques in this study.

Understanding Competition, Competitive Advantage and Competitive Strategy

Competition in the market. In a company, finance and ability are crucial for competition. In a continual effort to affirm progressive financial status and technological capabilities, companies introduce new products and processes

which can alleviate people's sensitivity to price changes. New product and process development results in a greater emphasis by companies to satisfy customers' reduced economic needs (Burke, Genn-Bash, & Haines, 1991). Armstrong (1982) stresses several elements of real-world competition, including: innovation and imitation; offering the best choice in a market; adopting a stance of independent assertiveness by managers; acquiring and using power as essential ingredients of competition; acquisition of expertise; involving the acceptance of fair and equitable rules in the competitive environment; and competing with a large society in which members produce modern complex products and services (p. 24-25).[1] Porter (1985) explains that competition is the source of success or failure of companies, and he emphasizes that a company's characteristics (e.g. innovations, a cohesive culture, or product implementation, etc.) can be determined by competition (p.1).

In a nutshell, company strategy comprises internal and external data and, based on this data, it determines the position of the company in the market by performing R&D activities and innovation, investing in new technology, process improvement, and marketing.

Competitive strategy. In order to identify the right competitive position in an industry, a company defines its competitive strategy, which "aims to establish a profitable and sustainable position against the forces that determine industry competition" (Porter, 1985, p.1). In this case, the company pursues a

[1] For more detail about nature of competition based on real-world company perspective see Armstrong (1982).

strategy that is not being executed by rival companies. Implementation of a strategy provides opportunity for reduction in costs and dominance in the marketplace. To help managers analyze industry, with respect to competition level and profit potential, Porter (1980) lists five competitive forces: threat of new entrants, bargaining power of suppliers, bargaining power of buyers, threat of substitute products or services and rivalry among existing competitors (Porter, 1991; Nilsson & Rapp, 2005).

Company strategy makes a company unique; it gives a distinct competitive advantage, provides direction, builds brand reputation, sets the right goals, adds superior performance, defines a market position, and creates unique value proposition (Porter, 2005). Company strategy seeks to answer questions such as what a company should do or not do, what customers to serve, what is the technology level of the industry, how to develop new product and processes, how to create a unique value proposition, and how to expand in the market. (Porter, 2005).

The focus area of company strategy is "matching a company's resources and capabilities to the opportunities that arise in the external environment" (Grant, 1995, p.114). Based on this, the roles of company and industry environment are depicted in Figure 1. As is detailed in the figure, both company resource analysis and industry analysis are vital in proper utilization of company competitive strategy. In order to analyze resources, the interface between strategy (company goals and values), and resources and capabilities must be included. At industry-level analysis, company focus is on the interface between strategy and the

industry environment. Since the 1970s and 1980s, industry environment dominance reflects the strategy literature of that time (especially Michael Porter's work). However, strategic analysis of the company's internal environment still remains underdeveloped (Grant, 1995).

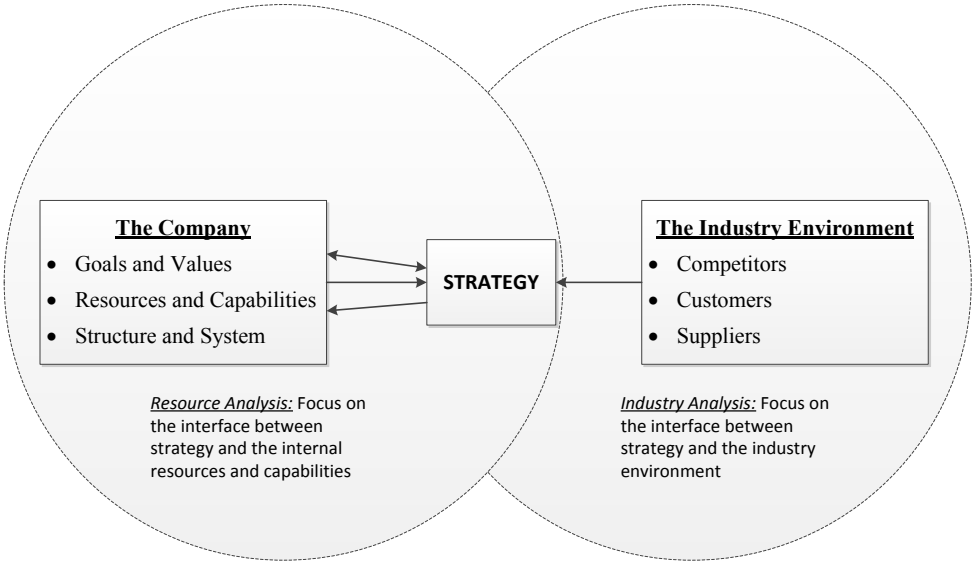

Figure 1. The role of company and industry environment in strategy formulation. *Note.* Adapted from "*Contemporary Strategy Analysis: Concepts, Techniques, Analysis*," by R. M. Grant, 1995, Cambridge, MA: Basil Blackwell Inc., p. 114.

Competitive advantage. If a company can successfully identify its unique competitive strategy, then it can achieve and sustain a competitive advantage in the industry. Barney (1991) agrees that "a company has a sustainable competitive advantage when "it is implementing value creating strategy not simultaneously being implemented by any current or potential competitors and when these other companies are unable to duplicate the benefits of the strategy" (Barney, 1991, p. 103).

According to Porter (1985), "competitive advantage grows fundamentally out of [the] value [that] a firm is able to create for its buyers that exceeds the firm's cost of creating it" (p. 3). Thus, a company "experiences competitive advantages when its actions in an industry or market create economic value and when competing companies are engaging in similar actions" (Barney, 2002, p.9). Based on the RBM perspective, competitive advantage is created when a company applies a value created strategy which is not being applied at the same time by current or potential competitors, and the competitors are unable to duplicate the benefits of this strategy (Barney, 1991; Sirmon, Hitt, & Ireland, 2007; O'Shannassy, 2008).

Porter (1985) highlights that there are two basic types of competitive advantage, including cost leadership and differentiation (p. 3).[2] While cost leadership can be viewed as "a firm that sets out to become the low-cost producer in its industry", differentiation is explained as "a firm that seeks to be unique in its industry along some dimensions that are widely valued by buyers" (Porter, 1985, p. 12, 14). In these two types of competitive advantage, technological change is one of the most important resources for competitive advantage (Porter, 1985; Nilsson & Rapp, 2005). Also, Porter's (1985) study elaborates on the strong alliance among companies in order to enhance competitive advantage in one industry (p. 3). Basically, "interrelationships among business units are the

[2] According to types of competitive advantage, Porter (1985) defines four generic strategies, including cost leadership, differentiation, and focus which is divided into cost focus and differentiation focus (p.11-16).

principal means by which a diversified firm creates value, and thus provides underpinning for corporate strategy" (Porter, 1985, p.3).

An Economist's Perspective on Sustainable Competitive Advantage

To further understand sustainable competitive advantage, a differentiation between economic growth and economic development has been examined in many studies (e.g. Schumpeter, 1975; Porter, 1980; Porter, 1985; Solow 1956; Romer, 1986). While "economic growth refers to the increasing production of goods and services", economic development "combines the meaning of economic growth with a number of desired criteria associated with the goals of the development" (Sudaryanto, 2003, pp.24-25). Therefore, economic growth is an important component of economic development (Sudaryanto, 2003).

Economic development at company level. Economic development "requires sustainable and shared increases in per capita income accompanied by changes in the structural composition of an economy towards higher value added goods and more efficient production methods" (Szirmai, Naude, & Goedhuys, 2011, p. 3). Even early in these studies, Schumpeter (1934) asserts cooperation between economic development and company internal factors, especially in terms of technological progress (Moran & Ghoshal, 1999). According to his evaluation, competitive markets and multiple companies are indications of organizational economics. Within this changing environment, there is anticipated creative tension. In fact, this economic structure of competition between multiple companies was declared to be the process of creative destruction by Schumpeter

(1942) (Moran & Ghoshal, 1999). Creative destruction, which is an evolutionary process, requires continued interaction between companies; on the one hand "creating and realizing new value, and markets, while, on the other hand, forcing these same firms to surrender, over time, most of [their] value to others" (Moran & Ghoshal, 1999, p.390). In the Schumpeterian model (creative destruction), "entrepreneurship was the key motive force in the capitalist process, generating innovations, often radical in nature, that may alter the rules by which an industry or economy operates" (Galunic & Rodan, 1998, p. 1193). Therefore, economic development achieved through innovative entrepreneurship challenges incumbent companies by new product innovation or process innovation which then makes current technologies and products obsolete (Carree, Stel, Thurik, & Wennekers, 2002). Companies that are not able to measure up to these innovations thus become obsolete. Rivalry to develop new products or processes - or to improve existing ones - is critical to the Schumpeterian model. New product and new process developments (technological innovation) are relatively transitory. This means that teams are continuously working to develop the next new product or process. Also, in the Schumpeterian model, a technological change, in terms of product and process development, impacts company productivity and economic growth.

Economic growth at company level. Economic growth at a company level refers to the increasing volume of products or services produced or provided by a company. Since the industrial revolution, companies have employed many

methods to increase their production volume in order to meet with ever-increasing market demand. In the context of an organization, technological innovation is the engine of economic growth and thus, productivity. From a basic economic perspective, technology is considered a means of transforming available resource inputs into marketable, value-added products.[3] Productivity is the measurable worth of those value-added products. In order to increase productivity, companies attempt to minimize the cost of resources and maximize customer perceived value of outputs. This type of productivity improvement is a foundational pillar of sustainable competitive advantage (Smith & Sharif, 2007).

Consequently, many economists have focused solely on economic development and economic growth at a company level in order to understand overall sustainable competitive advantage. They have observed that internal (e.g. human capital, technological capital, management, etc.) and external (e.g. export performance, industrial movement, competition, etc.) factors are driving forces of companies' economic development and economic growth as well as their sustainable competitive advantage (Sudaryanto, 2003).[4]

The Evaluation of Strategic Management Models

Since the Schumpeterian model (also called creative destruction) was applied, many models utilize both internal (Andrews, 1971; Ansoff, 1988) and

[3] A more detailed definition of technology is "the process that any company uses to convert inputs of labor, materials, capital, energy, and information into outputs of greater value" (Smith & Sharif, 2007).

[4] Economic development (new product or new process = productivity), economic growth (increasing value of value added products = productivity) and competitive advantage (Productivity = Y_i/EM_i, Y_i refers to production level and EM_i represents the number of people employed in the respective sector) are related to each other in terms of productivity (Sudaryanto, 2003).

external (Hannan & Freeman, 1977; Pfeffer & Salancik, 2003; Porter, 1980) factors to show how a company can achieve sustainable competitive advantage (Barney, 1991; Hart, 1995). Recently, many contributions (e.g. Barney, 1991; Hart, 1995) have attempted an integration of the internal and external factors under the banner of the Resource-Based Model (RBM) (Barney, 1991; Wernerfelt, 1984; Hart, 1995). There are three extensions of the strategic management models, including: the competitive strategy perspective (Industrial-Organization Economics – IOE), the RBM perspective (microeconomics) and the complementary perspective (includes both MOT and RBM) (Spanos & Lioukas, 2001). On the one hand, the IOE originates from traditional economic analysis, and it considers industry structure as the primary motivator of strategy and performance. On the other hand, the RBM is derived more directly from strategy research, and underlines the importance of company capabilities and competencies (Rivard, Raymond, & Verreault, 2006). "While the roots of the IOE go back to Harvard School Industrial-Organization, roots of the RBM introduce Penrose's (1959) famous study 'The Theory of the Growth of the Firm'" (Bogner, Mahoney, & Thomas, 1998, p. 66). The IOE focuses on industry level concepts, and Penrose's (1959) study focuses on the company level (Bogner, Mahoney, & Thomas, 1998). Figure 2 shows the evaluation of the fundamental concepts of strategic management models.

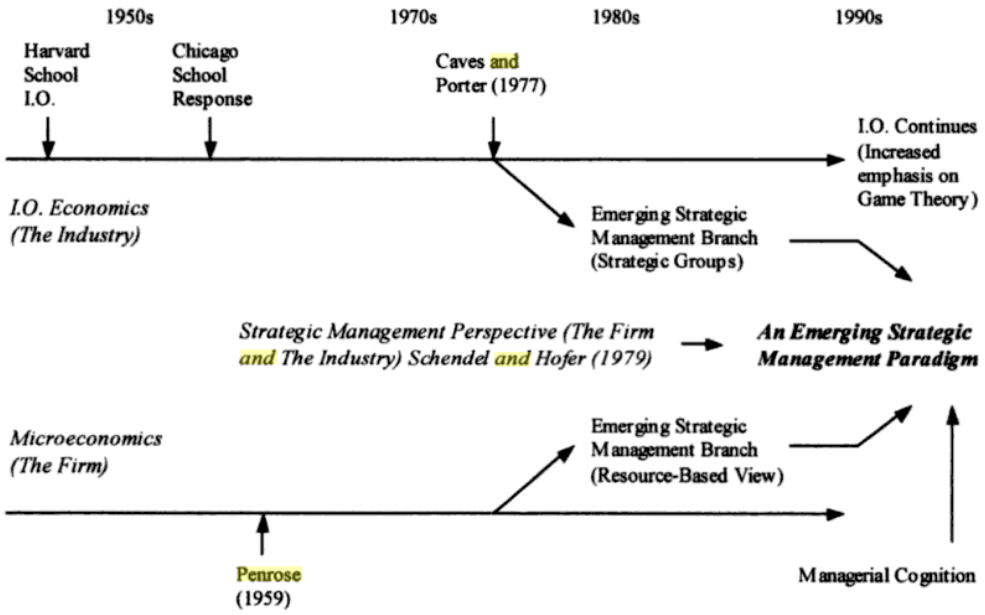

Figure 2. The evaluation and integration of the concepts.

Note. Adapted from "Paradigm Shift: The Parallel Origin, Evolution, and Function of Strategic Group Analysis with the Resource-Based Theory of the Firm," by W.C. Bogner, J. T. Mahoney, and H. Thomas, 1998, *Advances in Strategic Management*, 15, p. 67.

The industrial organization model focuses externally on the industry and product markets, and the RBM focuses internally on the company and its resources (Mahoney & Pandian, 1992). In an evaluation of the concepts, the Chicago school response was that Porter's (1980) Market Oriented Theory (MOT) and game theory are considered to be at an industrial level, while Penrose's (1959) study and RBM ought to be used at a company level. Wernerfelt (1984) speculates that these two models are like "two sides of the same coin" (p.171), because IOE's "constrained maximization problem of maximizing production given resource constraints and the constrained minimization problem of

minimizing resource costs given a desired production level" (Mahoney & Pandian, 1992).

Industrial organization economics. The origin of IOE is: industry -structure, -conduct, -performance (SCP), which originated in the Harvard School of Industrial Economics. Wirth & Bloch (1995) define 'structure' as market structure, 'conduct' as the behavior of the companies in a market, and 'performance' as market performance (p. 17). Figure 3 shows the basic approach of the SCB approach.

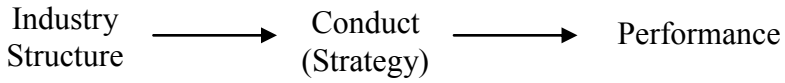

Figure 3. The SCB approach.

Note. Adapted from "The Contributions of Industrial Organization to Strategic Management," by M. E. Porter, 1981, *The Academy of Management Review*, 6, p. 611.

The SCB approach was first formulated by Mason (1939), and then applied to a large sample of cross-sectional studies by Bain (1951) (Mason, 1939; Bain, 1951; Wirth & Bloch, 1995).[5] The basic idea of the SCP was to analyze the relationship between industry structure and industry performance. According to the SCB, "a company's performance in the marketplace depends critically on the

[5] Mason (1939)'s study analysis price and production policies, and responses of market structure as well as large scale companies. Bain (1951)'s study considers American manufacturing industries from 1936 through 1940, and it is a statistical application of the SCP which emphasizes relationships between seller concentration, buyer concentration, condition of entry, and degree of product differentiation to profits, selling costs, and relative efficiency of scale an capacity (Mason, 1939; Bain, 1951).

characteristics of the industry environment in which it competes" (Porter, 1981, p. 610).

In the context of industrial organization analysis, industry (or market) performance is determined by the conduct of the companies within it, which is determined by various market structure variables (Wirth & Bloch, 1995). In the SCB, while structure variables are considered as exogenous to the market, conduct and performance variables are considered as endogenous (Wirth & Bloch, 1995).[6] Exogenous and endogenous variables, and their examples, are shown in Table 1.

[6] The reason of exogenous to the market is that "most SCB analysis is static, and basic conditions such as technology, which affect market structure, are assumed to remain constant" (Wirth & Bloch, 1995, p.16).

Table 1

The SCB Variables

SCB	Variables	Examples
Structure (Exogenous Variables)	The number of sellers and buyers in a market	Market concentration
	The degree of product differentiation present in a market	A brand preference which has been created by the companies, either real or imagined, among customers.
	The level of barriers to enter an industry	Absolute barriers such as patents and licenses, and cost-related barriers such as economies of scale and economies of scope.
	The level of barriers to exit from an industry	The expected costs of companies' exits.
	The extent to which market firms are vertically integrated	The extent that companies can control more than one stage of production.
	Conglomerates	The extent by which large economic conglomerates own market competitors.
Conduct (Endogenous Variables)	The number of sellers and buyers in a market	How prices are set independently or in collusion.
	Product and advertising strategies	How companies decide on their advertising, and the actual level of expenditure in advertising.
	Research and Innovation	How companies decide on their research budgets and the actual level of expenditure in research budgets.
	Investment in production facilities	How companies decide on the budget of this investment and the actual level of expenditure here.
	Legal tactics	Company market position is enforced by the legal system.
Performance (Endogenous Variables)	Company profitability	How market companies earn normal returns in the long run.
	Production and allocative efficiency	How companies avoid wasting scarce resources and how companies can produce the right quantity, quality, and mix of goods to maximize customer welfare.
	Full employment	How market companies contribute to stable full employment.
	Distribution of income	How market companies contribute to an equitable distribution of income.

Note. Adapted from "Industrial Organization Theory and Media Industry Analysis," M. O. Wirth and H. Bloch, 1995, *The Journal of Media Economics,* 8, pp. 16-17.

New industrial organization economists have criticized the SCP approach. Some of the major criticisms include (Wirth & Bloch, 1995):

- Market structure is not exogenous, because conduct and performance affect market structure. For example, innovation and advertising may increase entry barriers, and predatory pricing could pressure competitors out of the market, etc. (Ferguson & Ferguson, 1994).
- Market performance is a multidimensional concept, proof of which can be seen in Figure 4. According to Figure 4, the performance influences the structure and the conduct, and is, in turn, influenced by the conduct. Therefore, it is very difficult to define and measure market performance as a dependent variable. [7]

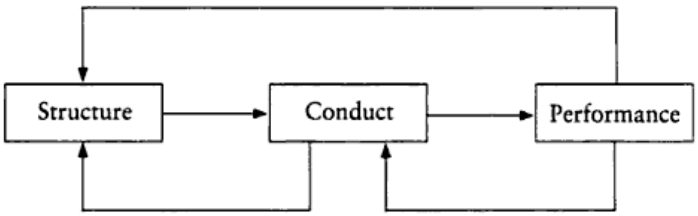

Figure 4. Detail of relationship between structure, conduct and performance. *Note.* Adopted from "*Industrial Economics: Issues and Perspectives*," by P. R. Ferguson and G. J. Ferguson, 1994, NY: New York University Press, p. 18.

- The SCP does not provide stable general relationships (Wirth & Bloch, 1995; Cable, 1994), which can be definitively tested. After testing the SCP approach in several empirical studies, it was determined that the level of

[7] In this study, multidimensional concept is also accepted for the SSAF's core models and their variables. Generally, in order to determine dimension of each model, and their inputs and outputs, thesis statements were exposed based on the literature review. However, the exact dimensions for any given industry can be determined, after testing the hypotheses in future study.

theoretical abstraction of the SCP is not sufficiently informative in order to make empirical analysis useful. Additionally, the testing stated that particular aspects of market structure may provide results which are not robust (Bothwell, Cooley, & Hall, 1984; Donsimoni, Geroski, & Jacquemin, 1984).

Porter (1981) brings further constructive criticisms to previous IOE works under 'The New Promise of Industrial Organization' (Porter, 1981, p.614-617):

- *Translation*: At this point, the IOE paradigm is not limited to simply a theoretical understanding, but the "extensions of the IOE paradigm to the perspective of strategy formulation are now in the literature" (p.614).
- *Unit of analysis*: Empirical researchers started to analyze not only the industry as a whole, but also a company as a unit.
- *Free-standing entity*: Some studies research "the interrelationship between business units and their corporate siblings in modeling industry outcomes" (p. 615). Previous work done on the IOE assumed it to be a free-standing entity, but new studies rejected this assumption in order to better reflect reality.
- *Static tradition*: New IOE models focus on a changing model of industry evaluation.
- *Determinism*: The SCB classical model does not have an influence on industry structure. However, company conduct does affect market structure, as depicted in Figure 5.

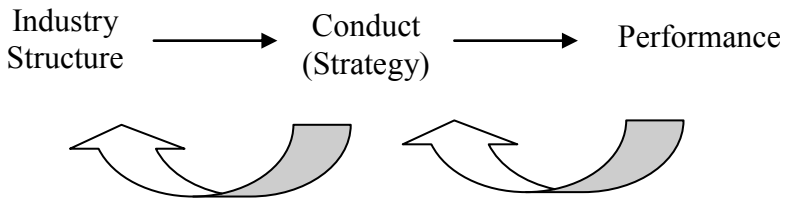

Figure 5. The updated version of the SCB**.**

Note. Adapted from "The Contributions of Industrial Organization to Strategic Management," by M. E. Porter, 1981, *The Academy of Management Review*, 6, p. 616.

- *Completeness*: IOE researchers are introducing an increasingly vast set of elements within industry structure, which are important for achieving competitive advantage.
- *Loss function*: Researchers are working to develop new models which recognize inter-firm and inter-industry differences.
- *Oligopoly theory*: In order to catch the real market condition, some strides are being made in applying oligopoly and game theory.

Even though Porter (1981) suggested some constructive critiques, he still acknowledged the SCP framework as the origin of market oriented theory. The SCP framework under IOE ideas was used by Porter in order to analyze industry competition and to remedy problems through a strategic methodology including mobility and entry barrier extensions. [8]

[8] Mobility barriers can be defined as "a structural attribute of a strategic group that makes it difficult for firms not already in the group to move in" (Enders, 2004, p.9). According to Porter's (1981) definition, "the strategic group concept is that firms within industries can be clustered according to their strategies, and that their reactions to disturbances and the model of rivalry will

Market oriented theory. In the late 1970s, the world gained an interest in Market-Oriented Theory (MOT). In MOT, Porter (1981) equally integrated both company level ideas and the IOE ideas (industry level ideas). According to his approach, there can be a theory which simultaneously deals with both an individual company (as well as its industry) and the broader environment in which it operates (Porter, 1981). Basically, Porter's MOT takes into consideration two factors (Porter, 1985):

- The attractiveness of industries that companies seek to enter.
- Improvement of the relative competitive position.

In order to explain these two factors, Porter (1985) developed a well-known Five Competitive Forces model, which includes: the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry among existing competitors (p.5). However, in this model, he did not include internal resources and capabilities. He assumes that "the relevance of capabilities and resources is reduced by stating that they are generally homogeneous (due to resource mobility) across companies" (Enders, 2004, p.10). In essence, the Five Competitive Forces model is a list of competition rules. In order to achieve a competitive advantage, a company's competitive strategy is to change the competition rules. The Five Competitive Forces affect the prices, costs and required investment of companies in an

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be determined by the configuration of groups" (p. 615). Caves and Porter (1977)'s illustrative list of group-defining traits includes bases of entry barriers: some companies differentiate their products through advertising and sales promotion, while others do not (p. 252). (Caves & Porter, From entery barriers to mobility barriers: conjectural decisions and contrived deterrence to new competition, 1977)

industry. As a result, they drive industry profitability and competition (Porter, 1985). Knowledge of an industry's structure is important in determining whether the Five Competitive Forces are favorable or not favorable. For example, the Five Competitive Forces can be helpful for pharmaceuticals, soft drinks, and database publishing industries (because of attractive returns). However, the Forces are more challenging to incorporate for airlines, textiles, and hotels (there are no attractive returns on investment). Porter (2008) believes that the Five Competitive Forces - which are the underlying determinants of industry structure - are more important than being a high technology or low technology industry, or being a manufacturing or service industry (p.24). Therefore, the function of the framework is to explain "the sustainability of profits against bargaining and against direct and indirect competition" (Porter, 1991, p.100). The Five Competitive Forces model is depicted in Figure 6.

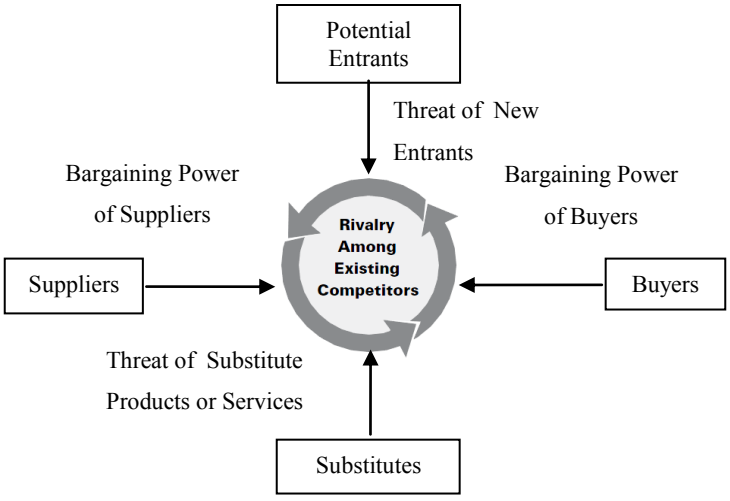

Figure 6. The five competitive forces framework.

Note. Adapted from "*Competitive Advantage*," by M. E. Porter, 1985, New York: The Free Press, p. 5.

Porter (1985) defines the strength of the Five Competitive Forces as a function of industry structure, which is an underlying economic and technical characteristic of industry (p.5). Even if an industry structure is stable, in due course, the structure inevitably changes due to industrial evolution (Porter, 1985). Particular aspects of industry structure can drive competition in the broader industry. Elements of each competitive force are shown in Table 2.

Table 2

Elements of Industry Structure

	Entry Barriers	**Determinants of Supplier Power**	**Determinants of Substitution Threat**	**Determinants of Buyer Power**	**Rivalry Determinants**
Elements of Industry Structure	Economics of Scale	Differentiation of inputs	Relative price performance of substitutes	**Bargaining Leverage**	Industry growth
	Proprietary product differences	Switching costs of suppliers and firms in the industry	Switching costs	Buyer concentration versus firm concentration	Fixed costs(or storage)/ value added
	Brand identity	Presence of substitute inputs	Buyer propensity to substitute	Buyer volume	Intermittent overcapacity
	Switching costs	Supplier concentration		Buyer switching costs relative to firm switching costs	Product differences
	Capital requirements	Importance of volume to supplier		Buyer information	Brand identity
	Access to distribution	Cost relative to total purchases in the industry		Ability to backward integrate	Switching costs
	Absolute cost advantages	Impact of inputs on cost or differentiation		Substitute products Pull-through	Concentration and balance

Table 2 (Continued)

	Entry Barriers	Determinants of Supplier Power	Determinants of Substitution Threat	Determinants of Buyer Power	Rivalry Determinants
Elements of Industry Structure	Government policy	Threat of forward integration relative to threat of backward integration by firms in the industry		**Price Sensitivity**	Informational complexity
	Expected retaliation			Price/ total purchases	Diversity of competitors
				Product differences	Corporate stakes
				Brand identity	Exit barriers
				Impact on quality	
				Buyer profits	
				Decision maker's incentives	

Note. Adapted and modified from "*Competitive Advantage*," by M. E. Porter, 1985, New York: The Free Press, p. 6.

Porter (2008) explains each force and some of its characteristics in the general framework of industry structure (pp.26-33):

- Threat of entry: the threat of entry puts a limit on the profit potential of an industry. This is because new entrants in an industry bring new production capacity and a desire to increase market share, which, consequently, puts pressure on prices, costs, and the rate of investment necessary for other established companies to compete. There is a negative correlation between the threat of entry and entry barriers. If entry barriers are low (meaning new entrants expect minimal competitive reaction), then threat

of entry is high and industry profitability is moderated. For instance, when the threat is high, then current companies in the industry decrease their prices or increase their investment costs to deter new entrants (e.g. low entry barriers resulted in Starbucks needing to invest aggressively in modernization of stores and menus – which means high threat of entry). Entry barriers are an advantage for current companies in the industry. There are seven major sources of entry barriers (Porter, 2008, p. 26-28):

(1) *Supply-side economies of scale*: "[D]eter entry by forcing the aspiring entrant either to come into the industry on a large scale, which requires dislodging entrenched competitors, or to accept a cost disadvantage" (p.26).

(2) *Demand-side benefits of scale (also known as network effects)*: "[D]iscourage entry by limiting the willingness of customers to buy from a newcomer and by reducing the price the newcomer can command until it builds up a large base of customers" (p.27).

(3) *Customer switching costs* (also known as fixed costs): Put a cap on the number of customers that new entrants can gain.

(4) *Capital investments:* Deter new entrants by requiring investments of large financial resources in order to compete.

(5) *Incumbency advantages independent of size*: "[I]ncumbents have quality or cost advantages not available to potential rivals" (p.27). The sources of these advantages are "proprietary technology, preferential access to the best raw material sources, preemption of the most

favorable geographic locations, established brand identities, or cumulative experience that has allowed incumbents to learn how to produce more efficiently" (p.27).

(6) *Unequal access to distribution channels:* Deter new entrants by limiting wholesale or retail channels, which already have pre-established collaboration with incumbents.

(7) *Restrictive government policy:* Limits or even forecloses entry into industries through licensing requirements or restrictions on foreign investment.

- Monopoly of suppliers: Powerful suppliers capture more value for themselves by increasing prices, limiting quality or services, or shifting costs to industry participants. They can also generate profitability out of an industry that increases cost in its own prices. Companies depend on different supplier groups for inputs. The following factors show that a supplier group is very powerful, because (Porter, 2008, p.29-30):
  - A supplier group is more concentrated than an industry. This means it can have monopoly power, e.g. Microsoft is considered to have a monopoly in providing operating systems.
  - In terms of revenue, a supplier group does not depend solely on an industry.
  - There are switching costs in changing suppliers. If switching costs are high, then companies (incumbents) find it hard to play suppliers off against one another.

- There is no substitute for a supplier group's product(s) or service(s).
- If an industry is gaining profitability relative to suppliers, companies in the industry unintentionally cause a supplier group to increase its competitive strategy, at the expense of the industry.

- The power of buyers: Powerful buyers - which are the flip side of powerful suppliers - can capture more value by forcing down prices and demanding better quality. If customers are price sensitive and can demand price reduction, then buyers are more powerful. In the following conditions, a customer group can have negotiating leverage (Porter, 2008, p.30):
  - "Large-volume buyers are powerful in industries with high fixed costs" (p.30).
  - "If buyers can always find another equivalent product, they can play one vendor against another" (p.30).
  - "Buyers face few switching costs in charging vendors" (p.30).
  - "Buyers can credibly threaten to integrate backward and produce the industry's product themselves, if vendors are too profitable" (p.30).
- The threat of substitutes: "A substitute performs the same or a similar function as an industry's product by a different means" (e.g. video conferencing instead of travel, plastic instead of aluminum, email instead of express mail) (Porter, 2008, p.31). When the threat of substitute is high,

industry profitability suffers, because substitute products bring limitations to industry profitability by placing a ceiling on prices. The threat of a substitute depends on the attractive price performance trade-off as well as low switching cost to the substitute (Porter, 2008).

- Rivalry among existing competitors: Price discounting, new product introductions, advertising campaigns, and service improvements all constitute opportunities for rivalry between competitors. A high level of rivalry puts a cap on overall industrial profitability. The intensity of rivalry is primarily based on: numerous competitors, slow industrial growth (which creates fights for more market share), high exit barriers, strategic goals, and invisibility of company strategy (Porter, 2008).

The five competitive forces framework can be applied at the level of industry, a strategic group, or an individual company (Porter, 1991).

Resource-based model. A resource-based model is a parallel structure of the IOE. Mahoney and Pandian (1992) emphasize that the RBM is complementary to the SCP (Bain, 1968) and the MOT (Porter, 1985, p.371). The origin of the RBM is neoclassical microeconomics (Penrose, 1959; Mahoney & Pandian, 1992; Bogner, Mahoney, & Thomas, 1998; Barney, 2001).[9] However, there is controversy between some studies in terms of the reasons of the development of the RBM. In one opinion, the RBM was developed from dissatisfaction with neoclassical economics (Mahoney & Pandian, 1992; Bogner,

[9] Neo-classical economics (micro economics – neo-classical price theory) "focuses on how market forces determine the quantity, quality, and price of goods and service sold in a market" (Barney, 2001,p. 644).

Mahoney, & Thomas, 1998). Further explained, Mahoney and Pandian (1992) claim that the paradox of neoclassical microeconomic theory is that "[a] company need not exist" (p.369). Neoclassical economics disregards transaction costs, limits on rationality, technological uncertainty, consumer or producer learning, and prices as signals of quality. Pricing alone is not sufficient material to generate accurate statistics, and the static equilibrium approach does not address the competitive advantage process (Mahoney & Pandian, 1992). In an opposing opinion, Barney (2001) asserts that "the advantages of positioning the RBM relative to neo-classical microeconomics are so significant" (p.645). In the context of his perspective, neo-classical theory and the RBM have many of the same assumptions, such as: economic factors are limited rational utility maximizers; markets can vary in their competitiveness; information can vary in how it is diffused across a market, etc. (Barney, 2001). In other words, while one interpretation argues that the RBM was developed because of dissatisfaction of neoclassical microeconomics, the other side alleges that the RBM and neoclassical microeconomics have similar components. No doubt, the controversy between these two theories will continue with new insights and arguments. However, despite the controversy, it is universally agreed upon that – at least the origin - of the RBM depends on neo-classical microeconomics.

The RBM demonstrates how competitive advantage can occur if a company applies a value creating strategy which is not being used by current or potential competitors; and, furthermore, competitors are unable to duplicate the benefits of the strategy (O'Shannassy, 2008, Barney, 1991). Companies are

fundamentally diversified in terms of their resources and internal capabilities (Barney, 1991). According to Barney (1991), company resources must have at least four common attributes, which were previously shown in Figure 5 (Barney, 1991). Resources:

- must be *valuable* – meaning that they illuminate opportunities in a company's environment;
- must be *rare* - among a firm's current and potential competition;
- must be *imperfectly* imitable; and
- must not have strategically equivalent *substitutes* for this resource.

The RBM requires that a company's internal strengths take advantage of opportunities in an external environment. There are two assumptions in the theoretical model of the RBM: first, companies in a given industry can be heterogeneous in terms of resources, and secondly these resources cannot be mobile across companies (O'Shannassy, 2008). Figure 7 shows the basic structure of the RBM.

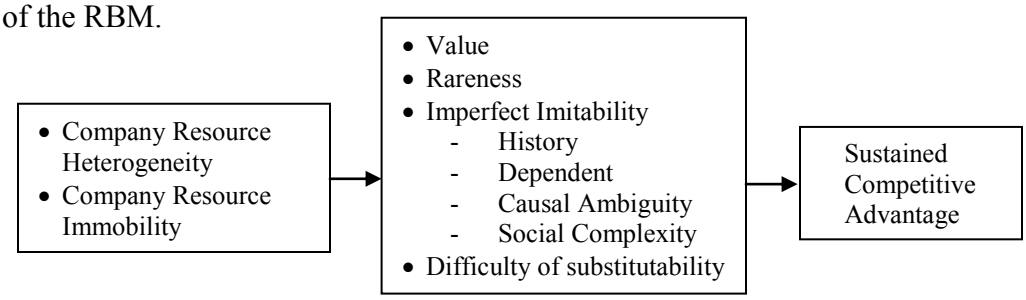

Figure 7. The relationship between company resources and competitive advantage.

Note. Adapted and modified from "Firm Resources and Sustained Competitive Advantage," J. Barney, 1991, *Journal of Management*, 17, p. 112.

According to the RBM, a company is a collection of resources and capabilities, which facilitate product/market competition (Amit & Schoemaker, 1993). Company capabilities "refer to a company's capacity to deploy resources, usually in combination, using organizational process, to affect a desired end" (Amit & Schoemaker, 1993, p.35). Company resources are "a stock of available factors that are owned or controlled by the company" (Amit & Schoemaker, 1993). Also, "company resources at a given time could be defined as tangible and intangible assets which are tied semi-permanently to the company" (Wernerfelt, 1984). In this regard, a company's resources include brand names, in-house knowledge of technology, employment of skilled personnel, trade contracts, machinery, efficient procedures, capital, etc. (Wernerfelt, 1984). According to Barney (1991), company resources can be classified into three categories:

(1) *Physical capital resources* - include the physical technology used in a company, the company's plant and equipment, its geographic location, and its access to raw materials.

(2) *Human capital resou*rces - include the training, experience, judgment, knowledge, intelligence, relationships, and insight of individual managers and workers in a company.

(3) *Organizational capital resources* - include a company's formal reporting structure, its formal and informal planning, controlling, and coordinating systems, as well as informal relations among groups within a company and between a company and those in its environment.

Another company resource classification method was outlined by Grant (1995). According to Grant (1995), there are three types of company resources in a company environment (which are illustrated in Figure 8):

(1) Tangible resources - the resources which are easiest to identify and valued in the company's financial statements. These include both financial and physical resources (Grant, 1995).

(2) Intangible resources - defined as "a company's image or its scientific and technological knowledge" (Del Canto & Gonzales, 1999). These are difficult resources to detect and evaluate for competitors because they are invisible assets, and not on printed reports (Barney, 1991). Intangible resources determine two capacities, including the *absorptive capacity*, which is "the ability to recognize and exploit technological opportunities from outside," as well as the *transformative capacity,* which is "the ability to continually redefine a product portfolio based on technological opportunities created within a company" (Del Canto & Gonzales, 1999). Intangible resources include technology and commercial resources (Del Canto & Gonzales, 1999).

(3) Human resources - classified as resources which "offer to the company their skills, knowledge, and reasoning and decision-making abilities" (Grant, 1995, p.125). A talented, quality workforce is a more important source of competitive advantage for companies. The importance of quality employees as a key to a company's competitive advantage, because the key to company success is now associated with a company's ability to

create manage, and to transfer "knowledge" (Greening & Turban, 2000). However, achieving some competitive advantage through the workforce takes time to accomplish, when we compare workforce with a new equipment or new technology. When the competitive advantage is achieved by workforce, if obtained through employment practices is likely to be substantially more enduring and more difficult to duplicate (Pfeffer, 1995). However, assessing stock of human capital is complex and difficult. Individuals' skills and capabilities can be assessed based on their job performance, experinece, and qualifications (Grant, 1995).

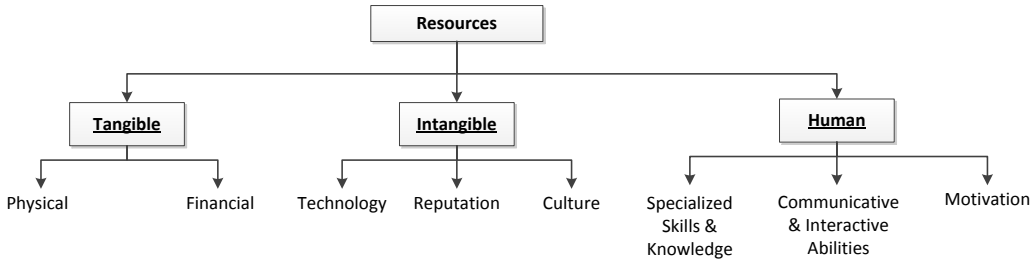

Figure 8. Company resources.

Note. Adapted from "*Contemporary Strategy Analysis: Concepts, Techniques, Analysis*," by R. M. Grant, 1995, Cambridge, MA: Basil Blackwell Inc., p. 121.

Drawing up an inventory of a company's resources is very difficult, and most companies' accounting or management systems do not have comprehensive data of all significant resources. Therefore, dividing types of resource into tangible, intangible, and human resources can be a useful starting point to measure a company's assets. The principal types of resources and their assessments are depicted in Table 3.

Table 3

Classifying and Assessing the Company's Resources

Resource	Main Characteristics	Key Indicators
Tangible Resources		
Financial Resources	The company's borrowing capacity and its internal funds generation determine its investment capacity and its cyclical resilience.	• Debt/ equity ratio. • Ratio of net cash to capital expenditure. • Credit rating.
Physical Resources	- The size, location, technical sophistication, and flexibility of plant and equipment; - Location and alternative uses for land and buildings; - Reserves of raw materials constrain the company's set of production possibilities and determine the potential for cost and quality advantage.	• Resale values of fixed assets. • Vintage of capital equipment. • Scale of plants. • Alternative uses of fixed assets.
Intangible Resources		
Technological Resources	- Stock of technology including proprietary technology (patents, copyrights, trade, secrets) and expertise in its application of know-how. - Resources for innovation: research facilities, technical and scientific employees.	• Number and significance of patents. • Revenue from patent licenses. • R&D staff as a percentage total employment.
Reputation	- Reputation with customers through the ownership of brands, - Established relationships with customers, the association of the company's products with quality, reliability, etc. - The reputation of the company with the suppliers of components, finance, labor services, and other inputs.	• Brand recognition. • Price-premium over competing brands. • Percentage of repeat buying. • Objective measures of product performance. • Level and consistency of company performance.

Table 3 (Continued)

Human Resources		
	- The training and expertise of employees determine the skills available to the company. - The adaptability of employees determines the strategic flexibility of the company. - The commitment and loyalty of employees determines the company's ability to maintain competitive advantage.	• Educational, technical, professional qualifications of employees. • Pays rates relative to industry average.

Sources: *Note.* Adapted from "*Contemporary Strategy Analysis: Concepts, Techniques, Analysis*," by R. M. Grant, 1995, Cambridge, MA: Basil Blackwell Inc., p. 122.

For a company to turn resources into a new product requires many contributions from a variety of sources, such as technology, management information systems, incentive systems, "knowhow", financial or physical assets, human capital, etc. (Amit & Schoemaker, 1993). The RBM specializes in utilizing similar components in a company, including assets, knowledge, information, capabilities, processes, and "company attributes that enable the organization to formulate and implement their strategies effectively and efficiently" (O'Shannassy, 2008, p.172). Figure 9 shows a basic framework of the RBM. This framework is particularly helpful for showing the relationship between company resources, capabilities and competencies, and some of the key authors associated with core ideas (Hart, 1995). According to basic requirements of company competitive advantage, resources must be valuable and non-substitutable (Hart, 1995). Additionally, resources ought to be tacit, socially complex and company

specific. A company using the RBM would assess its *capabilities* of competitive advantage in terms of distinctive competencies, or, core competencies. Therefore, company competence can be defined as "a higher order managerial capacity of the firm or corporate management to mobilize, harmonize and develop resources and capabilities to create value and competitive advantage" (Christensen, 1996, p.1). According to the figure, *competitive advantage* depends on Porter's model, which places a strong emphasis on the value of cost leadership and differentiated products.

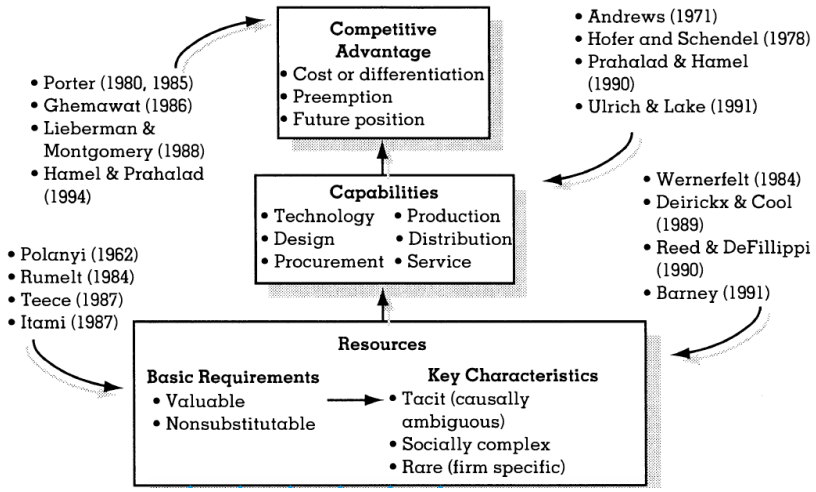

Figure 9. A framework of industrial model and RBM in terms of sustainable competitive advantage.

Note. Adapted from "A Natural-Resource-Based View of the Firm," by S. L. Hart, 1995, *The Academy of Management Review*, 20, p. 988.

Complementary perspective. Although their premises are different, the similarities between the market-driven perspective and the RBM perspective have been recognized (Conner, 1991; Mahoney & Pandian, 1992; Amit &

Schoemaker, 1993; Peteraf, 1993; Henderson & Mitchell, 1997; Spanos & Lioukas, 2001; Rivard, Raymond, & Verreault, 2006). The fundamental compatibility of the RBM and the OMT are (Spanos & Spyros, 2001, p.912):

- They are complementary in terms of explanation of company performance, "in the sense that by drawing insights from both, one can gain a more balanced view on the sources of competitive advantage (internal and external determinants)" (p.912).
- Both of them try to find a way to explain the same phenomenon of interest such as sustained competitive advantage.
- Their unit of analysis is identical, as they both use the company as subject of examination.

Two perspectives can be taken into account under traditional SWOT analysis. Study of strengths and weaknesses is done by internal analysis (Penrose, 1959), whereas opportunities and threats are viewed through a lens of external analysis (Porter, 1980). These two studies are then compared side by side (Andrews, 1971; Ansoff, 1988). Figure 10 shows the relationship between these analyses.

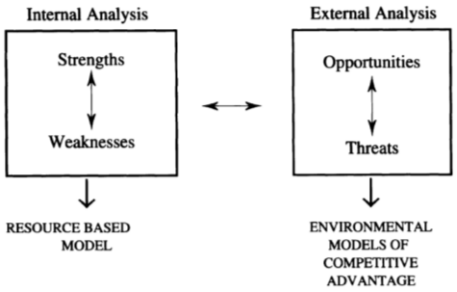

Figure 10. Strengths, weaknesses, opportunities, threats analysis.

Note. Adapted and modified from "Firm Resources and Sustained Competitive Advantage," J. Barney, 1991, *Journal of Management*, 17, p. 100.

Figure 10 shows the details of Penrose's (1959) study of organizational strengths and weaknesses. By highlighting companies' reliable and dominant strengths and weaknesses, it was found that each company had strengths and weaknesses, which correlated to its resources (Penrose, 1959). Porter's (1980) study (MOT) offers an example of external analysis. His study describes the conditions of environment within a company that favor high levels of overall performance (Barney, 1991; Porter, 1980).

Preceding studies of IOE have, to varying degrees, considered factors of environment in which companies compete. Nevertheless, they have also succumbed to accepting company level assumptions, which produced inconclusive results. Conner (1991) compared five IOE models in terms of company level, including neoclassical perfect competition theory, Bain-type industrial organization, Schumpeter's response (a focus on dynamics), the Chicago response (a Renaissance of price theory), and Coase/ Williams transaction cost economics (p. 123-132). In this regard, he showed five IO related

predecessors as having a relationship to the RBM. Table 4 shows these five studies and their relationship with the RBM (Conner, 1991):

Table 4

Comparison of the RBM to Five Industrial Organization Related Predecessors

IOE Studies	Similarities with the RBM
Neoclassical	• Company as input combiner: emphasizes physical production of goods or services.
Bain Type	• Company's environment (Other Companies/ Public Policy) poses critical constraints on strategy. • Persistent above-normal returns are possible.
Schumpeter	• Spectacular above-normal returns can result from new ways of competing. • Entrepreneurial vision is at the heart of the company. • Potential imitators always exist.
Chicago	• Companies are production and distribution efficiency-seekers. • Size and scope of the company reflect extent to which production and distribution efficiencies are achieved.
Coase/ Williamson Transaction Costs	• Asset specificity and small numbers are critical concepts constraining the company's strategic options.

Note. Adapted and modified from "A Historical Comparison of Resource-Based Theory and Five Schools of Thought Industrial Organization Economics: Do We Have a New Theory of the Firm?," K. R. Conner, 1991, *Journal of Management*, 17, p. 133.

Spanos and Lioukas (2001) and Rivard (2004) focused on a composed model, which was first developed by Spanos and Lioukas. The aim of this model is to "identify the relative impact of industry vs. company specific factors on company performance" (Spanos & Lioukas, 2001, p. 912). Basically, the model,

which is depicted Figure 11, describes the relationship of the RBM and the MOT for the purpose of market performance and profitability.

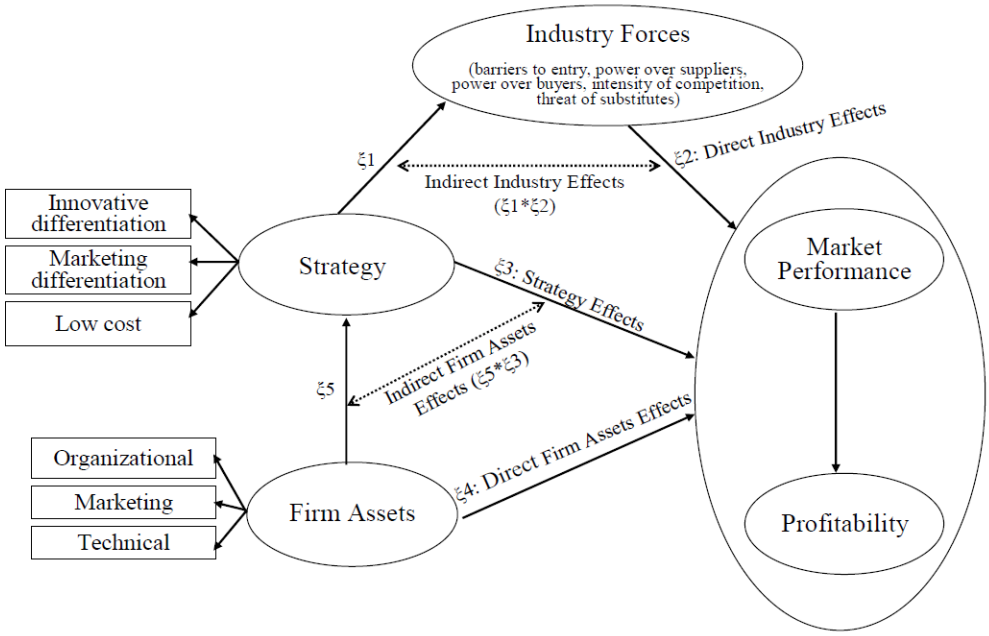

Figure 11. Integrated model of the RBM and the OMT.

Note. Adapted from "Resource-Based View and Competitive Strategy: An Integrated model of the Contribution of Information Technology to Firm Performance," by S. Rivard, L. Raymond, and D. Verreault, 2006, *Journal of Strategic Information Systems*, 15, p. 34.

According to the model, there are three types of relationships (Rivard, Raymond, & Verreault, 2006):

(1) Strategy effects (ξ3 on the figure): if a company creates value for buyers though either product differentiation or cost leadership, then the strategy will create a ripple effect, influencing the company's overall performance.

(2) Industry effects (ξ1 and ξ2 on the figure): Industry effects encompass the competitive strategy perspective components of the model. It includes direct (ξ1) and indirect (ξ2) effects on market performance and profitability. ξ2 is the result of strategic positioning in the industry in order to protect the company against competitive forces. The company's offensive strategy (ξ1) "influences the relative balance of the competitive forces that the company confronts" (Spanos & Lioukas, 2001, p.913).

(3) Assets effects (ξ4 and ξ5): assets effects have two extensions, which include first, an efficiency effect (ξ4), which is " the impact on performance that results from the possession of a superior stock of available resources" (Rivard, Raymond, & Verreault, 2006, p.34). A second effect (ξ5) of company assets pertains to the impact of assets on a strategy. Company assets enhance a company's ability to have competitive strategy in terms of product differentiation and cost leadership (Rivard, Raymond, & Verreault, 2006).

Also in this model, is a combined effect (ξ3 ξ5) resulting in modification and/or development of available resources (Rivard, Raymond, & Verreault, 2006).

Although the RBM and the MOT strategies can be complementary, they are distinct in their motive goals: the MOT's principal aim is to identify relative impact on industry, while the RBM's is to identify relative impact on a company (Spanos & Lioukas, 2001).

Summary

In considering the strategic management concept, the most fundamental question asks how can companies achieve and sustain competitive advantage. Until now, the answers have been vague in methodology and lacking in practical applications. Generally speaking, competitive advantage is achieved when a company applies a value created strategy which is not already being applied at the same time by current or potential competitors, and the competitors are unable to duplicate the benefits of this exact strategy (Barney, 1991; Sirmon, Hitt, & Ireland, 2007; O'Shannassy, 2008). In order to gain a better understanding of how to achieve a sustainable competitive advantage based on empirical investigation, researchers take internal company resources and external competitive environment into consideration.

The external environment in which companies compete is continuously changing, due to factors such as the actions of its customers, partnerships with suppliers, and marketing of competitors. In order to determine how companies successfully achieve sustainable competitive advantage, company internal and external components are isolated and studied by a strategic management field. Accordingly, two major frameworks are taken into account, the MOT, which focuses on a company's external environment and the RBM, which focuses on company internal resources and capabilities. Although these two perspectives originated from different perspectives and focus on different factors, they are coordinating ideas and they share the same ultimate goal. Hence, some of the studies recognize that these two perspectives are complementary, and each of the

components of these perspectives affects each other. In this study, the SSAF focuses on company environment, internal resources, and capabilities in order to identify how these factors, along with their related models (RBM and OMT) influence competitive advantage.

CHAPTER 3

METHODOLOGY

As noted in Chapter 1 and Chapter 2, strategic management has been studied since its inception. Strategic management seeks to answer the fundamental question of how a company can achieve sustainable competitive advantage (Herrmann, 2005). There are two main applications that have been drawn from strategic management, both of which lead to a competitive advantage: The Market-Oriented Theory (MOT) highlights the importance of competitive strategy, and internalizes the industry structure and attractiveness of a company's competitive position, and the Resource-Based Model (RBM) emphasizes that company resources drive value creation. These two approaches are like two sides of the same medallion. However, even a complementary perspective of these two approaches still leaves a void in terms of explaining how a company uses resources and capabilities, and how it can determine the best competitive strategy in order to create a competitive advantage. There has been little research done on the complementary perspective of the MOT and the RBM in the form of a cooperative modeling framework.

The primary purpose of this study is to lay the groundwork for the SSAF. The SSAF, which consists of a set of six models, aids in the evaluation and assessment of current and future strategic positioning of Small and Medium Enterprises (SMEs). The study investigates the relationships among a company's resources, capabilities, and performance. In correlation, a secondary purpose of this study includes a refined focus on the models. To this end, of the six

theoretical models that are considered, only one is investigated in depth (R&D activities model). Causality of the relationships is claimed only within the models and not between the models within the SSAF. The models are:

(1) *R&D activities model*: attempts to explain the relationships between (1) company inputs and company capabilities, and (2) company capabilities and company outputs. For the purposes of this study, the inputs consist of company tangible resources (company equity, debt, size, and capital intensity), company intangible resources (R&D collaboration, process improvement, marketing orientation, and commercial), and human resources (R&D workforce and learning orientation). The capabilities consist of basic research, applied research, and experimental research. The outputs consist of product innovation, process innovation, process improvement and technology adoption. R&D activities, which carry out internal company innovative activities, are precursors to new product or new process development for a company.

(2) *Product innovation model*: attempts to explain the relationship between inputs and outputs. For the purposes of this study, inputs include tangible resources (e.g. R&D expenses -company equity and/or debt, company equipment, and company size); intangible resources (e.g. R&D activities, company/brand reputation, communication channel(s), distribution and sales channel(s), knowledge of customer needs, and process improvement); human resources (e.g. qualified workforce). The outputs include anything related to company export sales. This model is included

for consideration in this study, but its effects should be further evaluated in future research. Product innovation is the adoption of technologically new or significantly improved "product whose technological characteristics or intended uses differ significantly from those of previously produced products" (OECD, 2005, p. 32).

(3) *Process innovation model*: attempts to explain the relationship between inputs and outputs. For the purposes of this study, the inputs include tangible resources (e.g. R&D expenses – company equity/or debt, and company size); intangible resources (e.g. R&D activities and process improvement); and human resources (e.g. qualified workforce). The outputs include company export sales. Process innovation "is the adoption of technologically new or significantly improved production methods, including methods of product delivery" (OECD, 2005, p. 32).

(4) *Technology adoption model*: attempts to explain the relationship between (1) company inputs and technology adoption, (2) environmental influences and technology adoption, and (3) technology adoption and the outputs. For the purposes of this study, the inputs include tangible resources (e.g. company equity, cost of capital, debt, size, age, and manufacturing technology uncertainty); intangible resources (e.g. R&D intensity, process improvement, product innovation, and process innovation); and human resources (e.g. top management commitments, soft integration, technical skills, and worker empowerment). The environmental influences include demand uncertainty, supplier uncertainty, cost competitive, export

orientation, other organizations' information, and supply chain information. The outputs include company performance (e.g. reduction of cost of reworks, reduction cost of direct man power, R&D intensity, and export). Technology adoption is a process to establish a new or different production process. Technology adoption affects a company's production and knowledge absorptive capacity. Small and medium companies, especially, tend to adopt new technology, rather than pursue new development by themselves, due to a high risk and high cost (Farzin, Huisman, & Kort, 1998).

(5) *Operational excellence model (process improvement)*: attempts to explain the relationship between inputs and outputs. For the purposes of this study, the inputs include tangible resources (e.g. company size); intangible resources (e.g. technical information and communication); and human resources (e.g. qualified workforce). The outputs include critical success factors (e.g. reduction of cycle time and reduction of cost). "Operational excellence is the goal of conducting business in a manner that improves quality obtains higher yields, faster through put, and less waste" (Adkins, 2007, p.52).

(6) *Global engagement model*: attempts to explain the relationship between inputs and outputs. For the purposes of this study, the inputs include tangible resources (e.g. company size and original equipment manufacturer(s) or supplier(s)); intangible resources (e.g. competition and export experience); and human resources (e.g. dedicated export staff). The

outputs include export sales. The global engagement "involves creating a business advantage through people, partnership and systems that can open doors to global markets, talent and resources" (Urbain, 2011, p. 28).

Should conclusions of the study show that some strategic actions are highly related to competitive performance, the chasm between academic research and practice will be narrowed due to their cooperative effect. This chapter describes the methodology, design, and procedures used in answering the following key research question for the R&D activities model development within the SSAF:

Do company R&D inputs (tangible, intangible and human resources) affect R&D activities (basic research, applied research, and experimental development)?

Research Design

This study uses quantitative research instead of qualitative research (because this study does not need to investigate in what way something occurs) in order to identify the source of relationship between certain variables and the strength of their relationship. In this study, the basic research strategy is as follows:

- *Formal theory (literature review):* In order to conceptualize models in the SSAF for empirical testing, related research literature is summarized.

- *Framework development:* Based on literature review and a systems engineering approach, a basic framework of standardized strategic assessment is developed.
- *Model development:* Founded on literature review, one model (R&D activities model) out of six models is further developed.
- *Sample surveys:* Survey methods are used in order to maximize the representative sampling of the population units studied.
- *Survey instrument validation:* After collecting survey results, appropriate statistical analysis is used.
- *Conclusion:* In this study, a conclusion is drawn based on statistical evidence.

Due to time constraints, a survey (non-experimental design) was designed for only R&D activities model within the SSAF. Surveys are most appropriate when participants are uniquely qualified to provide the required information (Creswell, 2009). In this study, to collect the most accurate data possible, individual companies are interviewed.

Survey Instrument Validation

The purpose of the survey instrument validation in this study is to test the survey questions and their formulation. For the survey instrument validation, experts from academia and four local key executives from Small and Medium Enterprises (SMEs) in the Aerospace and Defense (A&D) industry are

interviewed. The survey has been evaluated in terms of phrasing, clarity, adequacy of construction, and instructions about the survey instrument given.

One executive from each company will be chosen to respond to the survey, followed by a detailed interview with the respondents to shed further light on the relevance of the survey questions. Based on academic staff, the survey sent to several departments in Arizona State University, including department of Technological Entrepreneurship and Innovation Management, Department of Engineering Technology, Department of Economics, and Learning Sciences Institute. Only three members of academic staff of these departments, Technological Entrepreneurship and Innovation Management, Department of Engineering Technology, and Learning Sciences Institute responded. Also, the survey was sent to Kinetx Inc., Nichols Precision Inc., Spirit Electronics and Airborne Systems Group. Only get response from Kinetx Inc. and Nichols Precision Inc. Therefore, this survey instrument validation has, in total, five responses. Based on the survey instrument validation, content validity is established and questions, format, and scales are improved.

Sample

This study focuses on how a company can achieve a sustainable competitive advantage based on company resources, capabilities and competitive strategy. The population for this study will consist of all known Arizona based SMEs in the Aerospace and Defense (A&D) industry. A sample of the population will be used to draw conclusions about the entire population, because surveying a

large number of companies would be costly and lengthy. The sample will be chosen from Arizona the A&D supply chain interactive database, which was developed in 2011 by the Systems Research Group, Department of Technological Entrepreneurship and Innovation Management in the College of Technology and Innovation at Arizona State University (TEIM, 2012).

Data Analysis

The survey questions used, and related variables, are identified in Appendix A. Table 5 shows a summary of the relationships between the initial key research question, the hypotheses, and the data techniques which are used.

Table 5

List of Hypotheses

Research Question	Hypotheses	Statistical Test
Do company inputs (resources) affect R&D activities (capabilities)?	**H1:** There is a positive relationship between company equity and the level of R&D activities.	TBD
	H2: There is a negative relationship between company debt and level of R&D activities.	
	H3: There is a positive relationship between company size (number of employees) and the level of R&D activities.	
	H4: There is a positive relationship between capital intensity and the level of R&D activities.	
	H5: There is a positive relationship between company outsourcing and the level of R&D activities.	
	H7: There is a positive relationship between marketing orientation and the level R&D activities.	
	H9: There is a positive relationship between a high stock of qualified human resources and the level of R&D activities.	
	H10: There is a positive relationship between learning orientation and the level of R&D activities.	

Summary

This chapter describes the methodology, design, and procedures used in answering initial key research question for the development of SSAF.

This study involves literature review conducted to further understand the sustainable competitive advantage at a company level, how it occurs, what the internal and external sources of sustainable competitive advantage are, and how they affect each other. This study uses quantitative research in order to identify whether there is a correlation between certain variables and, if so, create a way to measure the strength of their relationship. However, because of lack of the responses only content validity is established and questions, format, and scales are improved in this study. Companies that fulfill the necessary requirements of resources needs, size, etc. are interviewed as a way to collect the data for a survey instrument validation.

CHAPTER 4

STANDARDIZED STRATEGIC ASSESSMENT FRAMEWORK

In this study the Standardized Strategic Assessment Framework (SSAF) and its models are developed for investigating the relationships between the environment in which a company competes, company resources, and company capability for achieving sustainable competitive advantage. The SSAF aids assessment of current strengths and needs, as well as helps with future strategic competitive positioning. A general view of the SSAF is depicted in Figure 12. The figure shows the SSAF's six models, company strategy, and environmental influences (e.g. government, economic, industry, culture, etc.). Also, the figure shows that, hypothetically, all models are related to each other.

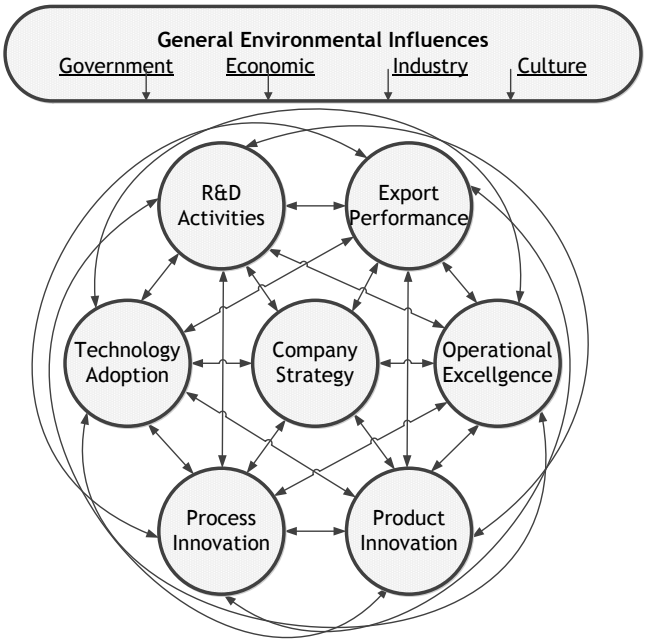

Figure 12. Interaction of models between each other within the SSAF.

The SSAF was designed using a systems engineering approach. There are many definitions for a system. One of the most applicable meanings for this case defines a system as "an integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective" (DOD, 2001, p. 3). A system can also be defined as a set or group of interacting, interrelated or interdependent elements or parts that are organized and integrated to form a collective unity or a unified whole to achieve a common objective (Kossiakoff, Sweet, Seymour, & Biemer, 2003; Wasson, 2006).

From these detailed definitions, it can be deduced that a system includes every essential part of a company. Systems engineering can be viewed through several different lenses. According to DOD (2001), systems engineering is "an interdiciplinary engineering management process that evolves and verifies an integrated, life-cycle balanced set of system solutions that satisfy customer needs" (p. 3). Sage (1992) defines systems engineering based on two perspectives (Sage, 1992):

(1) Based on functional perspective (Sage, 1992):

> Systems engineering is a combination of theories and tools, carried out through use of suitable methodology and set of systems management procedures, in a useful setting approprate for the resolution of real-world problems that are often of large scale and scope (p.10).

(2) Based on purposeful perspective (Sage, 1992):

> The purpose of systems engineering is information and knowledge organization that will assist clients who desire to develop policies for management, direction, control and regulation activities relative to forecasting planning, development, production and operation of total systems to maintain overall integrity and integration as related to performance and reliability (p.10).

Also systems engineering can be defined as (Hribik, 2012):

> An interdisciplinary field of engineering focusing on how complex engineering projects should be designed and managed over their life cycles. Issues such as logistics, the coordination of different teams, and automatic control of machinery become more difficult when dealing with large, complex projects. Systems engineering deals with work-processes and tools to manage risks on such projects, and it overlaps with both technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies, and project management (p. 252).

In order to develop a general framework for the standardized strategic assessment, two major fundamental concepts are used. These include Integration Definition for Function Modeling (IDEF0) and transformational (or functional) system.

Integration Definition for Function Modeling

IDEF0 is a functional modeling technique commonly used for the analysis, development, re-engineering, and integration of business processes. The IDEF0 includes two primary modeling components: functions, which are represented by boxes; and data flow, which are represented by arrows. Data, dataflow and objects interrelating these functions, are represented by arrows (DOD, 2001). The following example function, which is depicted in Figure 13, shows four different types of arrows and their meanings (DOD, 2001):

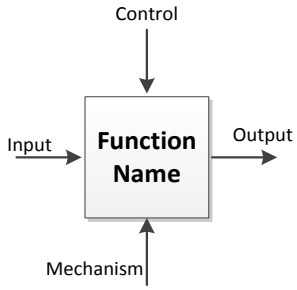

Figure 13. Integration Definition for Function Modeling (IDEF0) box format. *Note.* Adapted from "*Systems Engineering Fundamentals*," by Department of Defense, 2001, Fort Belvoir, VA: Defense Acquisition University Press, p. 51.

The position at which the arrow attaches to the box conveys the specific role of the interface (DOD, 2001):

- *Input* represents data needed to perform the function;
- *Output* represents the data that is produced as a result of the function;
- *Control* constrains or governs the function;
- *Mechanism* represents the person or device performing the function.

The basic framework of the standardized strategic assessment framework is depicted in Figure 14 based on IDEF0. The figure demonstrates six theoretical models, including R&D activities, product innovation, process innovation, technology adoption, operational excellence, global engagement, and other supporter factors, which include qualified workforce, and machine and equipment. There is detailed explanation of each theoretical model and their relationships respectively in this chapter. The arrows in the figure represent hypothesized relationships. Each of these hypotheses should be tested. Causality of the relationships is claimed only within the models and not between the models within the SSAF

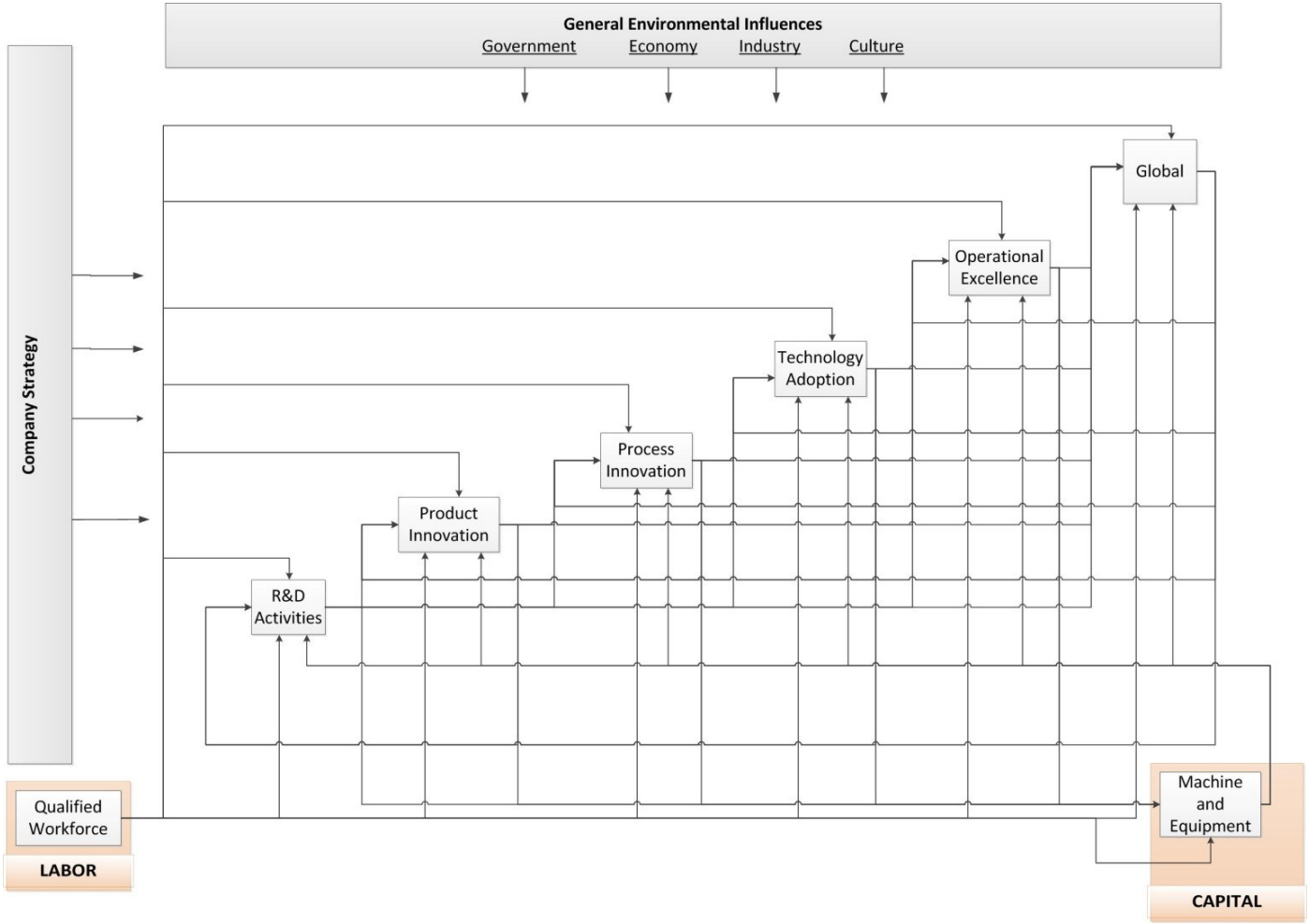

Figure 14. An IDEF0 – type model for the SSAF.

Transformational System

In order to build framework within the SSAF, a transformational system approach is used. The transformational (functional) system is depicted in Figure 15. The system "receives inputs from its environment, transforms them to outputs, and then releases the outputs to the environment, whilst seeking to maximize the productivity of the transformation" (Katsundo, 1996, p. 27). The transformational system approach is used to show the relationship between each theoretical model in the SSAF. In this study, R&D activities model was expanded upon based on a transformational system approach. In R&D activities model, inputs (tangible resources, intangible resources, and human resources) are transformed by R&D activities (basic research, applied research, and experimental development) to release outputs. However, in this study only the relationship between inputs and R&D activities are considered. In the R&D activities theoretical model, the company considers the environment (external factors) in which it competes, such as market orientation and R&D collaboration.

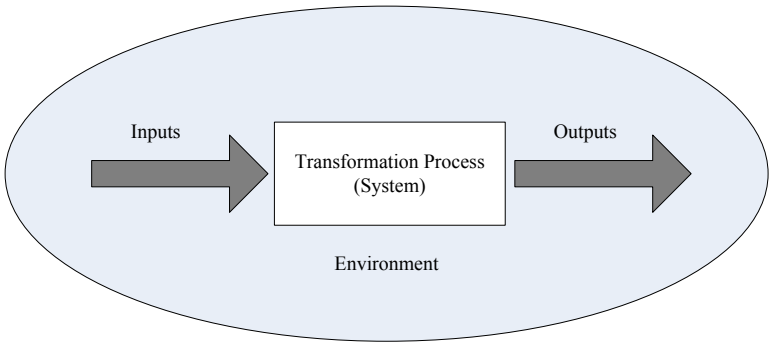

Figure 15. Transformational system.

Note. Adapted from "*Manufacturing Systems Engineering*," by K. Hitomi,1996, Bristol, PA: Taylor and Francis Ltd, p. 28.

SSAF Models

Five technology-intensive theoretical models, as developed in the introduction and metholodogy sections of this paper, are considered within the SSAF, including:

(1) R&D activities model

(2) Product innovation model

(3) Process innovation model

(4) Technology adoption model

(5) Process improvement model

Other than technology-intensive models, one output model, identified as Global Engagement, is used to measure companies' competitiveness in the market. There are different types of Global Engagement mechanisms, including: global management teams, global operations and products, global technology and R&D, global financing, and global marketing (Marquardt & Snyder, 1997). In the SSAF, only company export performance is considered as a Global Engagement model.

Correlating to the original six models, there are supporting factors (labor and capital), company strategy, and environmental influences. Each of them can be defined in terms of the SSAF perspective:

- Labor and capital supporter factors: In order to determine who performs the models within the SSAF, qualified workforce (e.g. engineers, scientists, technicians, etc.) as well as machine and equipment are categorized as labor and capital supporting factors. Because of this

distinction, qualified workforce, and machine and equipment are developed separately in each technology-intensive model, because of their unique effects on the different models. Nevertheless, in this study, labor and capital are considered only within the realm of an R&D activities model. Therefore, labor was categorized as R&D workforce under human resources inputs. Capital, which includes machines & equipment, and company plants, is categorized as capital intensity and company size under tangible resources.

- Company strategy: All models within the SSAF have relationships with company strategy. Company strategy is not a model within the SSAF, but it drives all models, because strategy comprises both internal and external factors and it determines the position of a company in the market. In terms of R&D activities model, company strategy determines the position of the company in the market by performing R&D activities and, through such, innovation, investment of new technology, process improvement, and marketing.
- Environmental influences: In the SSAF, environmental influences are explained as any external effect on a company, including government, economy, industry, and culture. Each SSAF model has a different pattern in terms of each of these influences. For R&D activities model, marketing orientation is regarded as an environmental influence. Based on marketing orientation, the model identifies a company's situation by gathering information from a company's customers, and then providing information

related to the competitor's strategy in the market in which the company competes.

In this section, only the R&D activities model and its related hypotheses are explored. Other models are supplementary in this section, but their effects should be further evaluated in future research.

Research and development activities model. Company R&D is one of the critical theoretical models in the SSAF. "R&D comprises creative work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD, 2002, p.30). Based on general literature review and this explanation of R&D, the following functional model, which is depicted in Figure 16, was designed via systems engineering approach for the SSAF. According to Figure 16, R&D activities model is an impact and response function and, in order to simplify the figure, only R&D activities and their relationships with other patterns are illustrated. The relationships within the model are hypothesized.

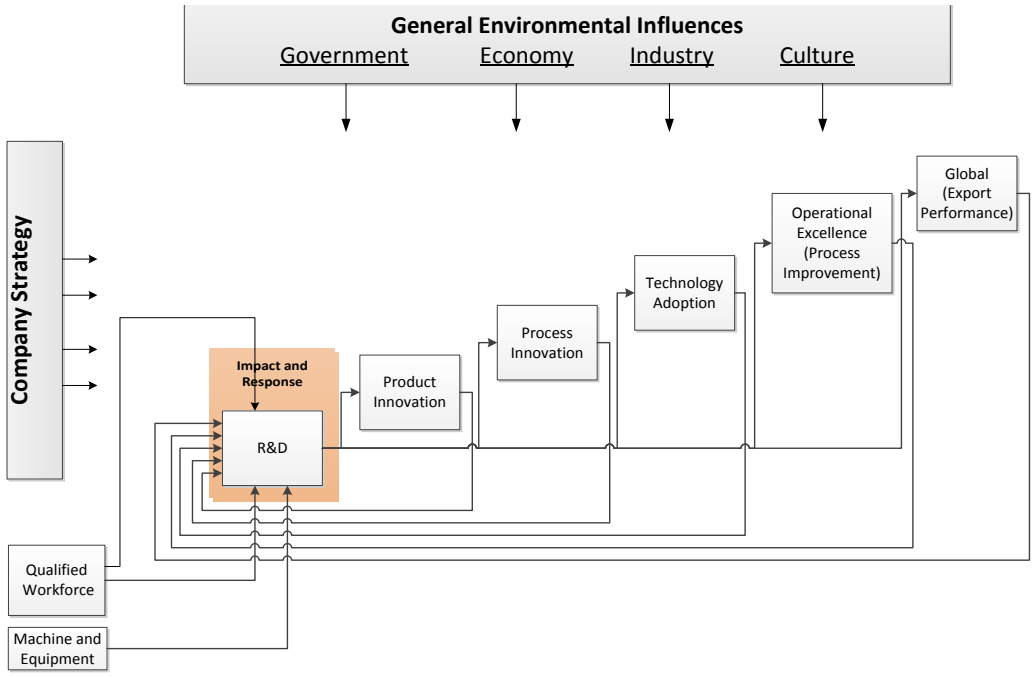

Figure 16. R&D activities and their relationship with the models within the SSAF.

According to Figure 16, the models have impacts on R&D activities and R&D activities have responses based on these impacts. Table 6 demonstrates each relationship of R&D activities in terms of a systems engineering approach. All these relationships are developed based on literature review and then further hypothesized. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 6

R&D Activities and their relationship with the models of the SSAF

Type of Arrow	R&D Activities
Input	Product innovation is an input of R&D activities.
	Process innovation is an input of R&D activities.
	Technology adoption is an input of R&D activities.
	Process improvement is an input of R&D activities.
	Export performance is an input of R&D activities.
Output	R&D activities are *inputs* of product innovation.
	R&D activities are *inputs* of process innovation.
	R&D activities are *inputs* of technology adoption.
	R&D activities are *inputs* of process improvement.
	R&D activities are *inputs* of export performance.
Control	Qualified workforce *controls* R&D activities.
Mechanism	Qualified workforce *performs* R&D activities.
	Machine and/ or equipment *perform* R&D activities

Company R&D, which carries out internal company innovative activities, is a precursor to new products or new processes for a company. The general R&D process in a company is depicted in Figure 17. In Figure 17, the R&D process is divided into three parts, including R&D inputs, R&D activities and R&D outputs.

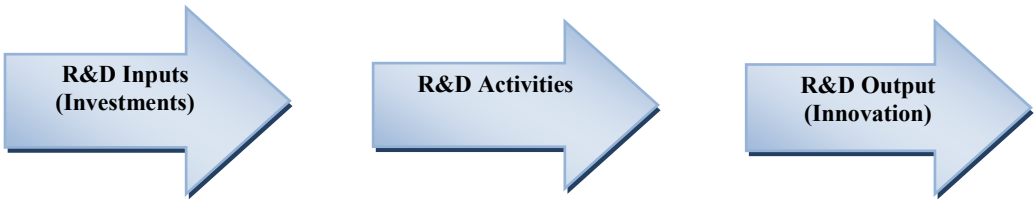

Figure 17. Company R&D process.

Note. Adopted and modified from "A Resource-Based Analysis of the Factors Determining a Firm's R&D Activities", by J. G. Del Canto and I. S. Gonzales, 1999, *Research Policy*, 28, p. 894; and "*Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*," by Organization for Economic Co-Operation and Development, 2002, France: OECD Publication Service, p. 17.

In terms of the R&D process, the importance of company strategy is highlighted in this study. Company strategy comprises all of the models within the SSAF. Figure 18 shows a more detailed approach of the R&D activities model. According to the figure, the R&D activities model has three inputs, including tangible resources, intangible resources and human resources. The relationship between R&D inputs (resources) and R&D activities is considered in this figure. R&D inputs and R&D activities within the R&D activities model is identified in the literature review discussed after Figure 18.

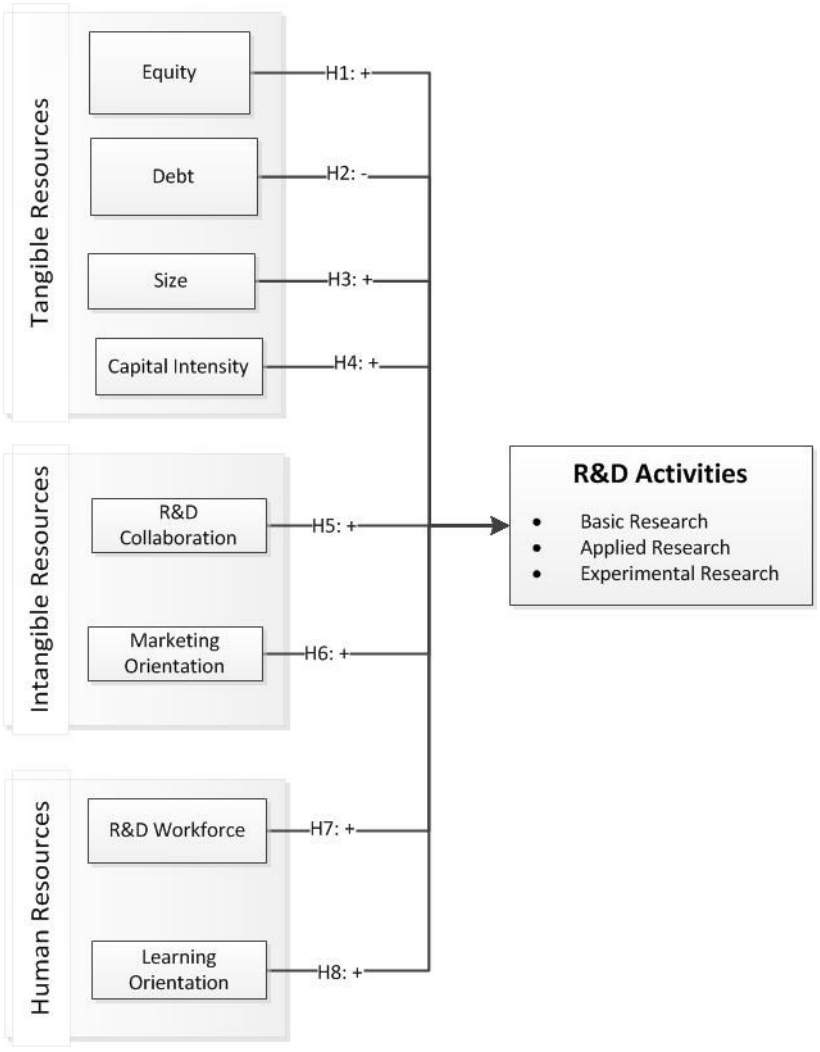

Figure 18. Company R&D activities model.

R&D inputs. In terms of determining company productivity growth and its long-run performance, R&D investment has a crucial role (Long & Ravenscraft, 1993). R&D investment consists of company resources and capabilities. Del Canto (1999) emphasizes that a company's resources can be distinguished as tangible, intangible, and human resources (Del Canto & Gonzales, 1999).

In R&D activities model within the SSAF, four tangible resources are considered including equity, debt, company size, and capital intensity.

(1) Equity and debt: Company equity financing is a better resource than debt financing for investment in R&D, because a capital structure based on debt can inhibit the carrying out of R&D projects (Long and Ravenscraft, 1993, p.121). If using debt is absolutely necessary, it can be used for finance redeployment or non-specific assets (Del Canto & Gonzales, 1999). Debt financing of an R&D project creates moral hazard, asymmetric information and transaction cost problems. Thus, these problems adversely affect raising funds for productive R&D projects. However, debt also reduces unproductive R&D expenditures (Long & Ravenscraft, 1993). In summary, the hypothesis regarding the relationship between a company's equity, debt and the decision to invest in R&D are the following:

H1: *There is a positive relationship between company equity and the level of R&D activities.*

(i.e. A hypothesis suggests that,when company equity increases, then the level (quantity) of R&D activities increases.)

H2: *There is a negative relationship between company debt and level of R&D activities.*

(i.e. A hypothesis suggests that, when company debt increases, then the level (quantity) of R&D activities decreases.

(2) Company size: Relative scale is also another factor which can be considered as a physical resource. Based on the Schumpeterian perspective, large companies have more advantages than small companies - regardless of innovation (Del Canto & Gonzales, 1999). In short, the effects of company size on its willingness to carry out R&D activities can be hypothesized as the following:

H3: *There is a positive relationship between company size (number of employees) and the level of R&D activities.*

(i.e. A hypothesis suggests that, when company size (number of employees) increases, then the level (quantity) of R&D activities increases.)

(3) Capital intensity: Capital intensity includes company's equipment, manufacturing facilities and buildings, and "relative importance of these fixed assets with respect to the rest" (Del Canto & Gonzales, 1999, p.896). R&D activities require a minimum prior investment in highly sophisticated technical equipment. This fact induces the following hypothesis:

H4: *There is a positive relationship between capital intensity and the level of R&D activities.*

(i.e. A hypothesis suggests that, when company capital intensity (technical equipment, machines, etc.) increases, then the level (quantity) of R&D activities increases.)

In this study, two intangible resources are considered in the R&D activities model within the SSAF, including R&D collaboration and marketing orientation.

(1) R&D collaboration: R&D collaboration can provide valuable supplementary technological knowledge for companies. Collaboration of R&D focuses on technological outputs (patents and new products) and increasing company capabilities (technological capabilities) (Dodgson, 1992). Also, collaboration of R&D changes the dynamics of the R&D process in the company and develops a supply chain in the research and technology market (Howells, 1999). From this perspective, the following hypothesis can be deduced:

H5: *There is a positive relationship between company outsourcings and the level of R&D activities.*

(i.e. A hypothesis suggests that, when company R&D collaboration (universities, private research organizations, etc.) increases, then the level (quantity) of R&D activities increases.)

(2) Marketing orientation: Basically, marketing orientation provides information on customer needs. It also participates in decisions on product

positioning and feature delivery (Griffin & Hauser, 1996). Based on this perspective, the following hypothesis can be deduced:

H6: *There is a positive relationship between marketing orientation and the level R&D activities.*

(i.e. A hypothesis suggests that, when a company applies process improvement in R&D activities, then the level (quantity) of R&D activities increases.)

SMEs are especially more human-oriented than system oriented (McAdam, Moffett, Hazlett, & Shevlin, 2010). There are two types of human resources that are considered in the R&D activities model, including R&D workforce and learning orientation

(1) R&D workforce: R&D workforce consists of all the experience, knowledge, judgment, abilities, skills, risk taking prosperity, and wisdom of individuals regarding the company. Within these, human capital, a team of scientists and technicians, possesses higher skills and knowledge within the company (Del Canto & Gonzales, 1999). Therefore, the following hypothesis is exposed:

H7: *There is a positive relationship between a high stock of qualified human resources and the level of R&D activities.*

(i.e. A hypothesis suggests that, when company qualified human resources (e.g. engineers, scientists, etc.) increase, then the level (quantity) of R&D activities increases.)

(2) Learning orientation: learning orientation "refers to organization-wide activity of creating and using knowledge to enhance competitive advantage" (Calanton, Cavusgil, & Zhao, 2002, p.516). It consists of obtaining and sharing information about development of new products and processes, competitor actions, customer needs, and market changes (Calanton, Cavusgil, & Zhao, 2002). The effects of learning orientation, adopted by company human resources, have a positive impact on company R&D and innovativeness, and, therefore, competitive advantage. In summary, the following hypothesis is exposed:

H8: *There is a positive relationship between learning orientation and the level of R&D activities.*

(i.e. A hypothesis suggests that, when company learning orientation increases, then the level (quantity) of R&D activities increases.)

R&D activities. There are many ways by which companies can carry out R&D activities, including continuous internal investments, outside the structured area of R&D investments, and informal mechanisms of developing innovative capabilities (embodied in people and organizations) (Del Canto & Gonzales, 1999). R&D activities are divided into three parts (OECD, 2002):

(1) Basic research: In the SSAF, basic research can be defined as "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view" (OECD, 2002, p.30).

(2) Applied research: In the SSAF, applied research which can be defined as "original investigation undertaken in order to acquire new knowledge" (OECD, 2002, p.30).

(3) Experimental development: In the SSAF, experimental development, which can be defined as "systematic work, drawing on existing knowledge gained from research and/or practical experience. It is directed toward producing new materials, products or devices, installing new processes, systems and services, or substantially improving those already produced or installed" (OECD, 2002, p.30).

Product innovation model. Product innovation is a vital model in the SSAF, because new products are central to the growth and prosperity of a company. In order to be more competitive in the market in which a company competes, it needs to "quickly and accurately identify customer needs and develop more complex products to satisfy those needs" (Shepherd & Ahmed, 2000, p.101). Figure 19 shows the relationship between the product innovation model and other models within the SSAF. The relationships within the model are hypothesized. However, the product innovation model's effects should be further evaluated in future research.

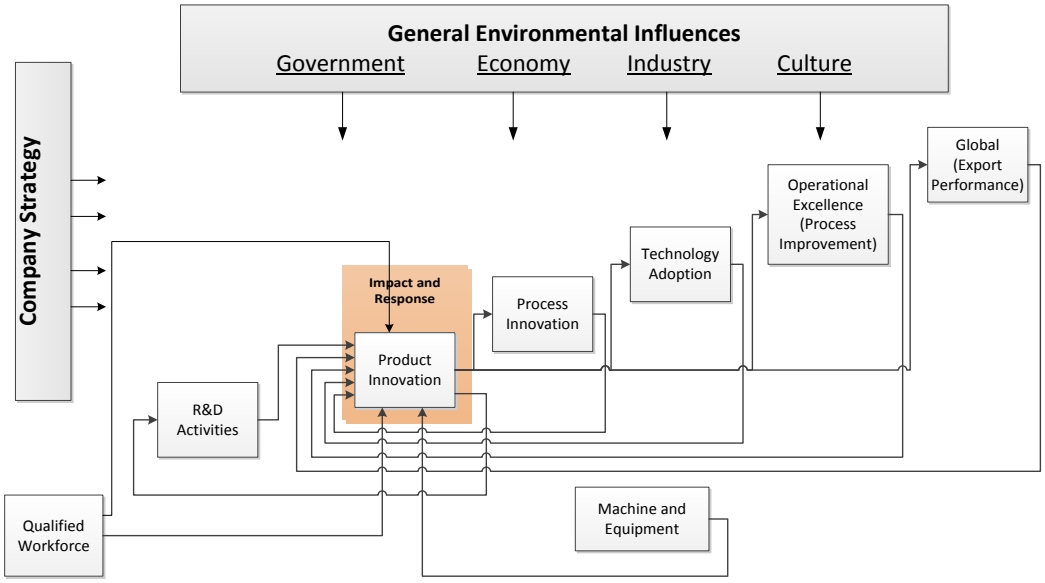

Figure 19. Product innovation and its relationship with the models within the SSAF.

From the processes of Figure 19, Table 7 was deduced. It interprets the inputs, outputs, control and mechanisms of the product innovation model. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 7

Product Innovation and its relationship with the models of the SSAF

Type of Arrow	**Product Innovation**
Input	R&D activities are *inputs* of product innovation.
	Process innovation is an *input* of product innovation.
	Process improvement is an *input* of product innovation.
	Operational excellence is an *input* of product innovation.
	Export performance is an *input* of product innovation.
Output	Product innovation is an *input* of R&D activities.
	Product innovation is an *input* of process innovation.
	Product innovation is an *input* of process improvement.
	Product innovation is an *input* of operational excellence.
	Product innovation is an *input* of export performance.
Control	Qualified workforce *controls* product innovation.
Mechanism	Qualified workforce *performs* product innovation.
	Machines and/ or equipment *perform* product innovation.

Similar to the R&D activities model, the product innovation model consists of inputs, include tangible resources (e.g. R&D expenses - company equity and/or debt, company equipment, and company size); intangible resources (e.g. R&D activities, company/brand reputation, communication channel(s), distribution and sales channel(s), knowledge of customer needs, and process improvement); and, lastly, human resources (e.g. qualified workforce). Its outputs include anything related to company export sales. This model is included for consideration in this study, but the relationship between its inputs and outputs should be further evaluated in future research.

Process innovation model. The SSAF focuses on not only product innovation, but also process innovation. Manufacturing process technologies are a key component of achieving sustainable competitive advantage. For a manufacturing company, it is not enough to focus on only product innovation, but it also needs to focus on process innovation because "competitive advantage is more sustainable by using intensive process R&D efforts to generate continuous incremental process improvement" (Shroeder, 1990, p.25). Figure 20 shows the relationship between the process innovation model and other models within the SSAF. The relationships within the model are hypothesized. However, process innovation's effects should be further evaluated in future research.

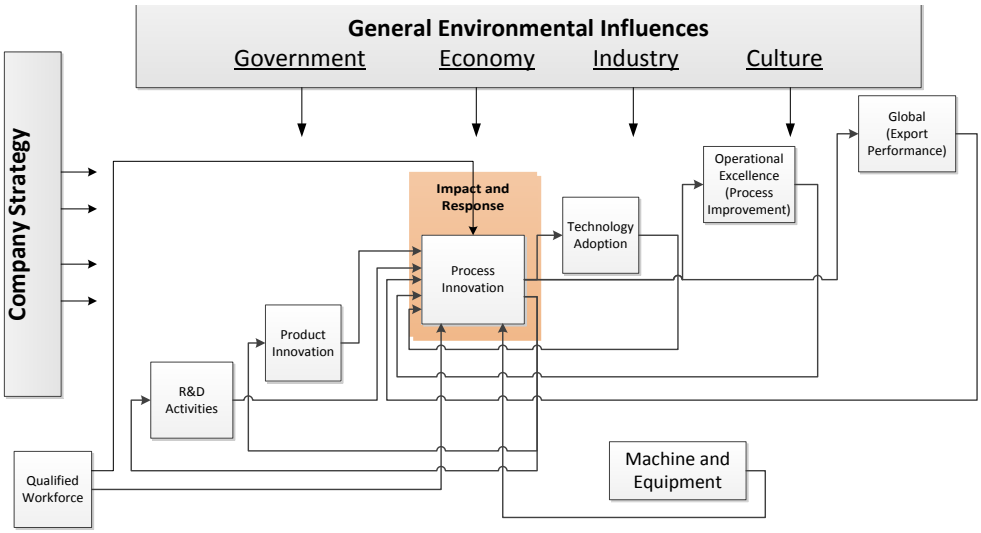

Figure *20*. Process innovation and its relationship with the models within the SSAF.

Based on Figure 20, Table 8 was designed in order to show the meaning of the arrows, including inputs, outputs, control and mechanisms of process innovation model. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 8

Process Innovation and its relationship with the models of the SSAF

Type of Arrow	**Process Innovation**
Input	R&D activities are inputs of process innovation.
	Product innovation is an input of process innovation.
	Process improvement is an input of process innovation.
	Operational excellence is an input of process innovation.
	Export performance is an input of process innovation.
Output	Process innovation is an *input* of R&D activities.
	Process innovation is an *input* of product innovation.
	Process innovation is an *input* of process improvement.
	Process innovation is an *input* of operational excellence.
	Process innovation is an *input* of export performance.
Control	Qualified workforce *controls* process innovation.
Mechanism	Qualified workforce *performs* process innovation.
	Machines and/or equipment *perform* process innovation.

Technology adoption model. In the SSAF, another technology intensive model is the technology adoption model. There are two important reasons why the technology adoption model was included within the SSAF. First, the focus area of the SSAF is Small and Medium Enterprises (SMEs). This is because SMEs tend to adopt new technology rather than develop it by themselves due to high risk and high cost. Secondly, the SSAF focuses on high-tech industries. In high-tech industries, R&D and technology adoption affect a company's production and knowledge absorption capacity (Sohal, Sarros, Schroder, & O'Neill, 2011).

There are different kinds of technology adoption processes such as information technology adoption, advanced manufacturing adoption, etc. In this case, Advanced Manufacturing Technology (AMT) was chosen for the analysis, because it facilitates the creating of high quality and low cost technological products (Sohal, Sarros, Schroder, & O'neill, 2011).[10]

Also, imitation through technology adoption provides learning experience that gives possibility for product or process innovation (Hu, Jefferson, Xiaojing, & Jinchang, 2003). Therefore, there is a relationship between technology adoption, and product and process innovations. In this case, the technology adoption model has a hypothetical relationship with other models within the

[10] AMT can be defined as "a family of manufacturing process technologies whose common element is the use of computers to store and manipulate data" (Sohal, Sarros, Schroder, & O'neill, 2007, p.5226). Ariss et al. (2000) define AMT as a "computerized system of manufacturing machines to produce products with reduced human intervention" (Ariss, Ranhunathan, & Kunnathar, 2000, p.14). Based on definitions, basic feature of AMT is data management by computer in terms of manufacturing process such as Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Computer Numerically Controlled (CNC) Machines, Manufacturing and Enterprise Resource Planning Systems (MRP II and ERP, respectively), etc.

SSAF. Figure 21 shows the relationship between the technology adoption model and other models. The relationships within the model are hypothesized. However, technology adoption's effects should be further evaluated in future research.

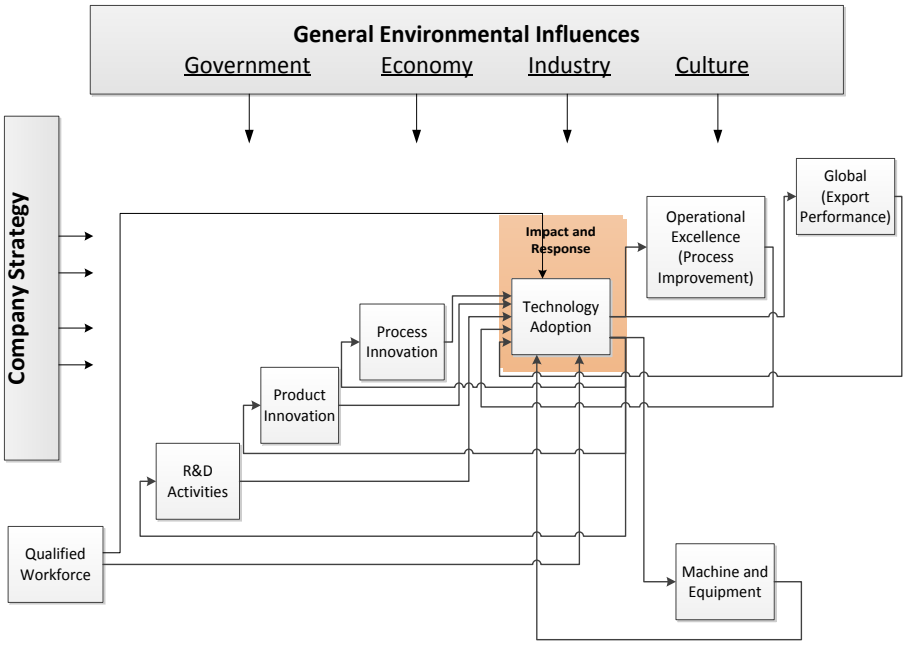

Figure 21. Technology adoption and its relationship with the models within the SSAF.

According to Figure 21, other models in the SSAF impact the technology adoption model and, as such, there are responses from technology adoption to other models within the SSAF. Table 9 shows the relationship between technology adoption and other models within the SSAF. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 9

Technology Adoption and its relationship with the models of the SSAF

Type of Arrow	Technology Adoption
Input	R&D activities are inputs of technology adoption.
	Product innovation is an input of technology adoption.
	Process innovation is an input of technology adoption.
	Process improvement is an input of technology adoption.
	Export performance is an input of technology adoption.
Output	Technology adoption is an *input* of R&D activities.
	Technology adoption is an *input* of product innovation.
	Technology adoption is an *input* of process innovation.
	Technology adoption is an *input* of process improvement.
	Technology adoption is an *input* of export performance.
Control	Qualified workforce *controls* technology adoption.
Mechanism	Qualified workforce *performs* technology adoption.
	Machines and/ or equipment *perform* technology adoption.

Operational excellence model: the case of process improvement.

Operational excellence, which is a synonym of business excellence, is a technology-intensive model of the SSAF. Operational excellence can be defined as "the goal of conducting business in a manner that improves quality, obtains higher yields, faster throughout, and less waste" (Adkins, 2007, p. 52). In the SSAF, the operational excellence model was chosen because it attempts to improve and sustain business performance (Basu, 2004). Figure 25 shows the relationship between the operational excellence model and other models within the SSAF. The relationships within the model are hypothesized. However global engagement should be further evaluated in future research.

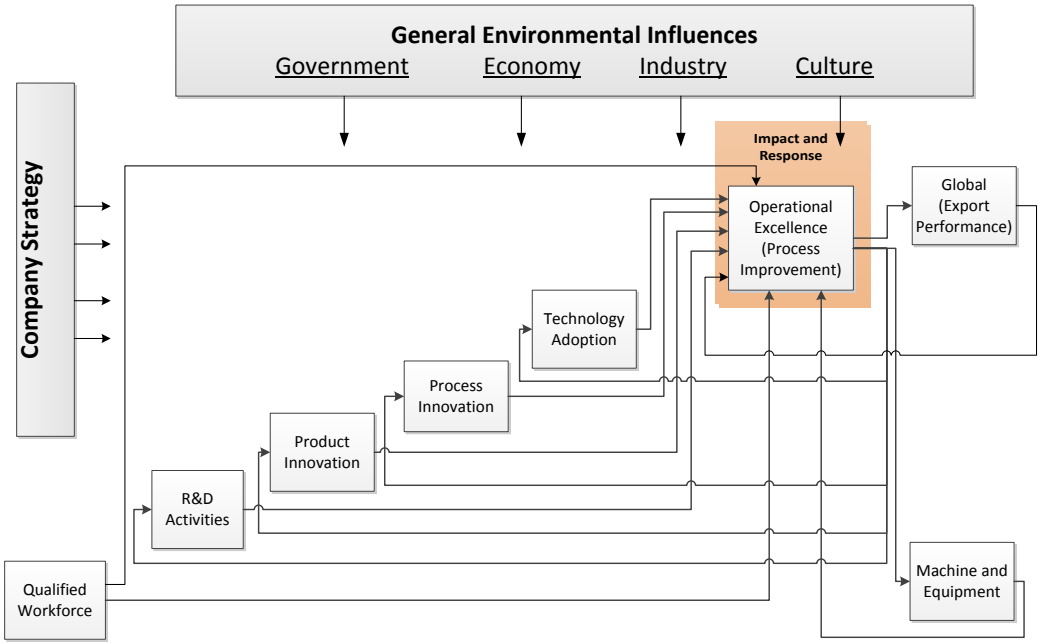

Figure 22. Operational excellence and its relationship with the models within the SSAF.

According to Figure 22, Table 10 was designed. Table 10 shows the relationships between the operational excellence model and other models within the SSAF in terms of the systems engineering approach. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 10

Operational Excellence and its relationship with models of the SSAF

Type of Arrow	Operational Excellence (Process Improvement)
Input	R&D activities are *inputs* of operational excellence.
	Product innovation is an *input* of operational excellence.
	Process innovation is an *input* of operational excellence.
	Technology adoption is an *input* of operational excellence.
	Global engagement is an *input* of operational excellence
Output	Operational excellence is an *input* of R&D activities.
	Operational excellence is an *input* of product innovation.
	Operational excellence is an *input* of process innovation.
	Operational excellence is an *input* of technology adoption.
	Operational excellence is an *input* of global engagement.
	Operational excellence is an *input* of machine and equipment
Control	Qualified workforce *controls* operational excellence.
Mechanism	Qualified workforce *performs* operational excellence.

Quality is the goal of the operational excellence model. Quality improvement methods are a potential source of sustainable competitive advantage. Operational excellence includes many aspects in terms of manufacturing, including quick and reliable deliverables, short lead times, high resource utilization and low inventories. Therefore, the relationship between operational excellence's inputs and outputs is focused within the SSAF. In this case, the operational excellence's inputs include tangible resources (e.g. company size); intangible resources (e.g. technical information and communication); and human resources (e.g. qualified workforce). The outputs include critical success factors (e.g. reduction of cycle time and reduction of cost). The relationship between operational excellence's inputs and outputs should be further evaluated in future research.

Global engagement model: the export performance. The global engagement model is not a high-tech intense model. The global engagement, "involves creating a business advantage through people, partnership and systems that can open doors to global markets, talent and resources" (Urbain, 2011, p. 28). Globally engaged companies are more productive and more innovative, because "they learn more from their intra-company worldwide pool of information and from their suppliers, customers and universities" (Criscuolo, Haskel, & Slaughter, 2010, p.191). Therefore, the SSAF focuses on this model because of company performance perspective.

In the SSAF, companies' export performance is focused on global activity. Especially, company export activities provide companies competitive advantage by "playing in a big market; standardizing core products; concentrating on value-added activity in a few countries; adopting a uniform market position; [and] integrating competitive strategy across countries" (Marquardt & Snyder, 1997, p. 107).[11] Figure 23 shows the global engagement model and its relationship with other models within the SSAF based on a systems engineering approach. The relationships within the model are hypothesized. However global engagement's effects should be further evaluated in future research.

[11] There are several ways to become a global company, including (Marquardt & Snyder, 1997): (1) Global integrating mechanism used to develop collaboration efforts among subunits, including direct contract between managers, liaison roles between departments, temporary or permanent task forces, global management teams, global strategy, global operations or products, global technology and R&D, global financing, global marketing (Marquardt & Snyder, 1997).

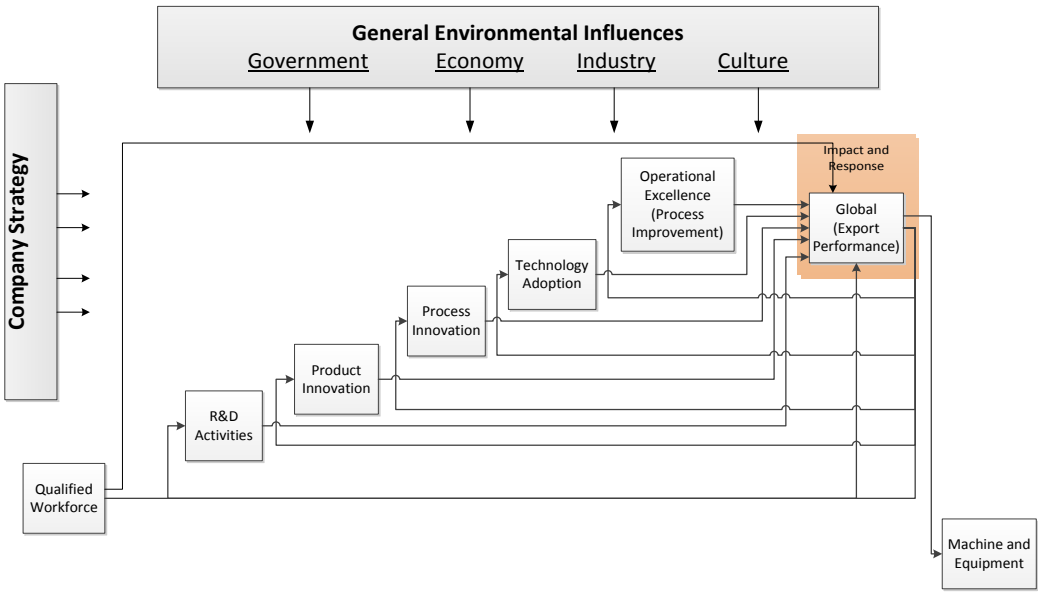

Figure 23. Global engagement and its relationship with the models of the SSAF.

According to Figure 23, the following table was designed. Table 11 shows the relationships between the global engagement model and other models within the SSAF in terms of a systems engineering approach. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

Table 11

Export Performance and its relationship with models of the SSAF

Type of Arrow	**Global Engagement (Export Performance)**
Input	R&D activities are *inputs* of export performance.
	Product innovation is an *input* of export performance.
	Process innovation is an *input* of export performance.
	Process improvement is an *input* of export performance.
	Technology adoption is an *input* of export performance.
Output	Export performance is an *input* of R&D activities.
	Export performance is an *input* of product innovation.
	Export performance is an *input* of process innovation.
	Export performance is an *input* of process improvement.
	Export performance is an *input* of technology adoption.
	Export performance is an *input* of machine and equipment
Control	Qualified workforce *controls* export performance.
Mechanism	Qualified workforce *performs* export performance.

Other than a general relationship between global engagement models and other SSAF models, the relationship between the global engagement model's inputs and outputs are considered within the SSAF. The global engagement model inputs include tangible resources (e.g. company size and original equipment manufacturer(s) or supplier(s)); intangible resources (e.g. competition and export experience); and human resources (e.g. dedicated export staff). The outputs include export sales. Also, the relationship between global engagement's inputs and outputs should be further evaluated in future research.

Summary

The first three chapters of this study discussed the theoretical background of the research topic and methodology. This chapter discussed the framework of standardized strategic assessment framework based on IDEF0 and its six models based on transformational systems approach, including R&D activities model, product innovation, process innovation, operational excellence, technology adoption and export performance. However, only one of them, R&D activities model, was elaborated and eight hypotheses were exposed in order to analyze for future study.

In order to test eight hypotheses for R&D activities model, survey questions were prepared and sent to academicians and four industry experts. Based on the survey instrument validation, content validity is established and questions, format, and scales are improved for future study. Survey questions can be found under Appendix A.

CHAPTER 5

CONCLUSIONS AND FUTURE RESEARCH

This chapter provides final comments regarding the relevance of the thesis and its applicability. In it, the conclusions are derived from the studies and research done throughout the development of this thesis. First, the study is reviewed by summary and conclusion. Lastly, future recommendations for this study are offered to further the understanding of the theories thus far proposed.

Summary and Conclusions

Research of strategic management has attempted, from its inception, to answer the fundamental question of how companies achieve sustainable competitive advantage. In this study, two fundamental theories are taken into consideration, including Market-Oriented Theory (MOT) in terms of company resources and Resource-Based Model (RBM) in terms of companies within their market.

The research focused on ways in which a company can achieve sustainable competitive advantage in terms of company resources and company strategy within the market in which companies compete. After reviewing available literature for market competitiveness, it was concluded that there is inconclusive research on the complementary perspective of the RBM and the MOT. Therefore, the primary goal of this study is to lay the groundwork for Standardized Strategic Assessment Framework (SSAF), and the second goal is the development of its related models to explain relationships between a company's resources, capabilities, and competitive strategy. The SSAF, which consists of a

set of six models, aids in the evaluation and assessment of current and future strategic positioning of Small and Medium Enterprises (SMEs). These six models are: R&D activities model, product innovation model, process innovation model, operational excellence model, technology adoption model and export performance model. Only one of these models, R&D activities model, was investigated in depth, and led to a new model via transformational system analysis. Causality of the relationships is claimed only within the models and not between the models within the SSAF.

In this study, the SSAF was visualized through a lens of Integration Definition for Function Modeling (IDEF0). Methodologically, it describes manufacturing functions for analysis, development, reengineering, and integration. It is applied to information systems, business processes, or software engineering analysis. Shortly, IDEF0 focuses on an interdisciplinary field, and the SSAF is, thus, an interdisciplinary research study. The relationships which are visualized by IDEF0 are hypothesized.

In this study, the models within the SSAF are visualized by using a transformational system tool. Basically, this tool clarifies operational process, which consists of inputs, capabilities and outputs. A transformational system tool simplifies the model in terms of demonstration of the models because each model within the SSAF includes inputs (company resources) and capabilities (company capabilities).

In this research, only R&D activities model was elaborated, due to time constraints. Each factor in the model was examined through in-depth literature

review and conceptualized by a transformational system tool. Therefore, for R&D activities model, the following research question was developed in order to guide the analysis:

Do company R&D inputs affect R&D activities?

(3) R&D inputs: tangible, intangible and human resources.

(4) R&D activities: basic research, applied research and experimental development.

Based on the research question, eight hypotheses were exposed for testing the relationships between resources and capabilities, and capabilities and outputs. Based on these hypotheses, survey questions were prepared, and sent to academic staff and industry experts. The survey was sent to several departments in Arizona State University, including the department of Technological Entrepreneurship and Innovation Management, Department of Engineering Technology, Department of Economics, and Learning Sciences Institute. Only three members of academic staff in these departments responded: Technological Entrepreneurship and Innovation Management, Department of Engineering Technology, and Learning Sciences Institute. The survey was also sent to Kinetx, Inc., Nichols Precision, Inc., Spirit Electronics and Airborne Systems Group. Only two responses were received from Kinetx, Inc. and Nichols Precision, Inc. The total number of responses to this survey was five. Based on this survey instrument validation, content validity was established and questions, format, and scales were improved.

Contribution

The contribution and benefits of this study can be segmented as follows:

First, a standardized strategic assessment framework evaluates companies, especially SMEs, in the high-tech manufacturing industry. From this evaluation, current and future competitiveness was developed. This means that the SSAF can help companies determine their competitive status in their industry, and - drawing from their results - they can improve their status.

Second, this study shows that there are a variety of resources and capabilities within a company. If these resources and capabilities are taken into consideration to help distinguish between various models, based on different effects, company evaluation will become simpler. In terms of R&D perspective, company resources are sorted as tangible, intangible and human resources.

Other contributions are related to the application and visualization of the SSAF and its models. The SSAF was developed based on a systems engineering approach. Literature analysis establishes that this is a relatively new method to use for evaluation of companies' competitive strength. Another visualization tool is transformational system approach, which is used to ideally visualize a model. Thanks to this approach, it is possible to gain a better understanding of inputs, capabilities, outputs and their processes within the model.

Recommendations for Future Research

At the beginning of this study, some of the assumptions were emphasized in the first chapter. Other concepts and ideas were also mentioned during the study which needs more in-depth analysis. These are considered opportune areas for future research.

Determining the exact number of models within the SSAF is one of the biggest obstacles. There is no exact number of models. In this case, new models can be added within the SSAF in order to get more accurate and precise results for companies. Therefore, dynamically, improvement of the SSAF can be shown for future research.

Also each model within the SSAF can be developed and changed more based on industry and market structure. Therefore, improvement of the SSAF models must be considered as another future research, dynamically.

The SSAF was developed and visualized based on literature review. Overall the SSAF research comprises software implementation. Therefore, after development of the models, the software application can be implemented on the SSAF by related software tool. Hence, software application of the SSAF is a future research area.

In this study, only R&D activities model was developed based on literature review, and only survey instrument validation was done, because of time constraint. Based on the survey instrument validation, content validity was established and questions, format, and scales were improved. However, the questions still need to be sent to companies in the industry in order to gather an appropriate sample size for statistical analysis. This is also future research within the SSAF concept.

Other models within the SSAF, product innovation model, process innovation model, operational excellence model, technology adoption model and export performance model can be developed and hypothesized based on literature

review is the same way as R&D activities model. Therefore, each of these models development and statistical analyses can be considered for future research area.

Thus, there is much work to be done examining the relationships among the inputs, activities and outputs within the six SSAF models, and also the relationships among the models within the SSAF. In this case, the SSAF opens a whole new area of inquiry and suggests many productive avenues for research in the future.

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APPENDIX A

SURVEY QUESTIONS

Greetings

We are requesting your participation in an important study of the Standardized Strategic Assessment Framework (SSAF). The SSAF aids the evaluation and assessment of current and future strategic positioning of SMEs. The purpose of this study is to lay the groundwork for the SSAF.

Thank you! Your participation is greatly appreciated. Email any questions to Gary.Waissi@asu.edu or Mustafa.Demir@asu.edu .

Gary Waissi, PhD, Professor, College of Technology and Innovation, Arizona State University

Mustafa Demir, Faculty Associate and Graduate Student, College of Technology and Innovation, Arizona State University

Survey Participant:

First Name : ……

Last Name : ……..

Phone : ……

E-mail : ……

Demographic Questions

1. What is your responsibility in the organization?

   □ Chairman of the Board

   □ Chief Executive Officer/President

   □ Chief Operations Officer

   □ Chief Financial Officer

   □ Business Decelopment Executive

   □ Sales Executive

   □ Director

   □ Manager

   □ Operational Employee

   □ Other (Please specify)…….

2. Year company was established **…….. (year)**

3. Type of company

   □ Private □ Public □ Non-profit

4. How many employees does your company have in Arizona?

   ……. (Number of employees)

5. If you work for Government, what % of your Government work is DOD

   ….. %

6. Does your company have Defense Contract Audit Agency (DCAA) capability?

   □ Yes □ No

7. Is your company subject to International Traffic in Arms Regulations (ITAR)?

   □ Yes □ No

8. What % of your company work is commercial? …..%

9. Total estimated revenue for last fiscal year (estimate) $.....

10. Which of the following describes your company's business activity? (Check all that apply)

Table A1

Aerospace and defense industry NAICS codes

	NAICS Code	**Description**
□	3327221	Aircraft (including aerospace) fasteners other than plastics (meet specifications for flying vehicles)
□	332912	Fluid power valve and hose fitting manufacturing
□	3339957	Aerospace type fluid power cylinders and actuators, hydraulic and pneumatic
□	3339967	Aerospace type fluid power pumps and motors
□	3339996	Aerospace type hydraulic and pneumatic filters
□	3342201	Communication systems and equipment, except broadcast, but including microwave equipment, and space satellites
□	334290	Alarm systems, traffic control equipment, and intercommunication systems manufacturing
□	334511	Search, detection, navigation, guidance, aeronautical, and nautical systems and instrument manufacturing
□	3345192	Aircraft engine instruments manufacturing except flight
□	336411	Aircraft manufacturing
□	336412	Aircraft engine parts & engine parts manufacturing
□	336413	Other aircraft parts and auxiliary equipment manufacturing
□	336414	Guided missile & space vehicle manufacturing
□	336415	Guided missile & space vehicle propulsion & parts manufacturing
□	336419	Other guided missile & space vehicle parts & auxiliary equipment manufacturing
□	Other	Specify …….

R&D Related Questions

1. Did your company conduct R&D in 2011?

□ Yes □ No

2. Does your company currently conduct R&D in 2012?

□ Yes □ No

3. Is your company planning to conduct R&D in 2013?

□ Yes □ No

4. Does your company conduct R&D at a facility located in Arizona?

□ Yes □ No

5. What were the total R&D expenses for your company in 2011?

Estimate $.....

6. What were the sources of funds for the R&D expenditure:

□ Own funds Estimate $.....

(Include: equity, reserves, borrowing, and retained earnings, funds from AZ organizations in the same group)

□ Federal government agencies Estimate $.....

□ Private sector funding sources Estimate $.....

(Include: private and publicly listed organizations, state-owned enterprises, producer boards, reserve associations.)

□ AZ government agencies Estimate $.....

□ AZ local government entities Estimate $.....

□ Overseas funds Estimate $.....

□ Other funding sources (Please specify): **……..** Estimate $.....

7. In the last fiscal year, did your company buy new machine or equipment linked to R&D related activities?

□ Yes □ No

8. What percentage of your R&D related machinery and equipment are:

New ……%

In the middle of their life cycle ……%

End of their Life cycle (need to be replaced) ……%

9. In the last three fiscal years, did your company outsource R&D?

□ Yes Specify what % …….. □ No

10. If your company outsources R&D activities, then specify who performs?

□ Private consultant

□ Private research organization

□ University

□ Government research organization (e.g. National Laboratory)

□ Overseas organizations

□ Other (Please specify ……

11. Which of the following tasks are shared between marketing and R&D activities by your company? (Check all that apply)

□ Setting new product goals

□ Identifying opportunities for the next generation of product improvement

□ Resolving engineering design

□ Customer requirement trade-offs

□ Understanding customer needs

□ Information sharing about competitor strategies and reactions

□ Others (Please specify) ……..

12. What is the total number of employees in R&D at your company?

□ Researchers **……**

(Staff engaged in the creation of new knowledge or products.)

□ Technicians **……**

(Staff engaged in technical tasks in support of R&D, normally under the direction and supervision of a researcher.)

□ Other Support and Administrative Staff **……**

(Include administrative and managerial staff working on, or directly associated with, R&D activity.

13. Please indicate qualification levels of R&D employees:

Qualification	**Number**
PhD	…….
Masters Degrees	…….
Bachelor Degrees	…….
Technical or trade certificates	…….

14. Please indicate your level of agreement with the following factors:

Table A2

Learning factors.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The basic values of our company include learning as key to improvement	□	□	□	□	□
The sense around here is that employee learning is an investment, not an expense.	□	□	□	□	□
All employees are committed to the goals of this company.	□	□	□	□	□
We continually judge the quality of our decisions and activities taken over time.	□	□	□	□	□
We have specific mechanisms for sharing lessons learned throughout the company.	□	□	□	□	□

15. What type of R&D activities does your company conduct?

□ **Basic Research:** experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena or observable facts without any particular application or use in view.

□ **Applied Research:** original investigations performed to acquire new knowledge directed toward a specific objective. Typical activities could include: improving an existing production process or product using results of basic research.

□ **Experimental Research:** using knowledge from basic or applied research, and experience, to evaluate and produce new goods or services, or to substantially improve existing goods and services. Typical activities could include: making new products or significant redesign of a product that uses new technology.

16. Which of the following are correct for your company? (Check all that apply)

□ We produce products new to our company, but not new to our markets.

□ We produce products new to our company and new to our markets.

□ We produce standard products only. They are not new to our company or to our markets.

□ We do not produce products. We only deliver services.

17. Did your company introduce any of the following during the three-year period, 2009 to 2011?

a. New or significantly improved goods (excluding the simple resale of new goods purchased from others and changes of solely aesthetic nature) …

□ Yes □ No

b. New or significantly improved services ……

□ Yes □ No

c. New or significantly improved methods of manufacturing or producing goods or services ……□ Yes □ No

d. New or significantly improved logistics, delivery, or distribution methods for your inputs, goods, or services

……..... □ Yes □ No

e. New or significantly improved support activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing □ Yes □ No

18. Please give an estimate for the percentage of your total sales in 2011 from:

(a) New or significantly improved products and services introduced during 2009 to 2011 that were new to one of your markets ……..%

(b) New or significantly improved products and services introduced during 2009 to 2011 that were only new to your company …..…..%

(c) Products and services that were unchanged or only marginally modified during 2009 to 2011 (include the resale of new goods or services purchased from other companies)… ……..%

(d) None of the above

19. Which of the following quality management approaches are used by your company? (Check all that apply)

□ Kaizen (Continuous Improvement)

□ The Deming Cycle (Plan-Do-Check-Act)

□ Total Quality Management (TQM)

□ Malcolm Bridge Award

□ Six Sigma DMAIC

□ Six Sigma DFSS

□ Lean

□ Capability Maturity Model (CMM)

□ ISO certifications (Please specify number, e.g . 9001)….. …..

□ Others (Please specify) ……..

□ None of the above

20. Does your company use Advanced Manufacturing Technology (AMT)? (Basic feature of AMT is data management by computer in terms of manufacturing process such as Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Computer Numerically Controlled (CNC) Machines, Manufacturing and Enterprise Resource Planning Systems (MRP II and ERP, respectively), etc.)

□ Yes □ No

21. If you say 'Yes' the previous question, please indicate the importance of each of the followings in your company's decision to adopt AMT? Not Important at All: 1, Extremely Important: 5 (Check all that apply).

Table A3

External and Internal Factors.

External and Internal Factors	**1**	**2**	**3**	**4**	**5**
Be cost competitive	□	□	□	□	□
Product and process technology uncertainty	□	□	□	□	□
Customer demand uncertainty	□	□	□	□	□
New product and process information from suppliers	□	□	□	□	□
Export orientation	□	□	□	□	□
R&D activities	□	□	□	□	□
Low cost of capital (e.g. low maintenance cost, price of the advanced manufacturing technology)	□	□	□	□	□

22. Did your company export in the last fiscal year?

□ Yes □ No

23. What % of your business is exporting? ….%

24. In which geographic markets did your enterprise sell goods or services during the past three years (2009, 2010 and 2011)?

Table 4A

Geographic Markets.

Geographic Markets	**Yes**	**No**
Arizona	□	□
The rest of the U.S. (outside of Arizona)	□	□
Canada	□	□
Mexico	□	□
The European Union	□	□
Other European Countries (e.g. Norway, Switzerland, Turkey)	□	□
Russia	□	□
Central Asia (e.g. Kazakhstan, Uzbekistan, Kyrgyzstan)	□	□
China	□	□
Japan	□	□
Other countries in East Asia, South East Asia and Australia (e.g. the Philippines, Australia)	□	□
South Asia (e.g. India, Pakistan, …)	□	□
Central America, South America, the Caribbean	□	□
Africa and the Middle East	□	□

BIOGRAPHICAL SKETCH

Mustafa Demir was born in Kayseri, Turkey, on June 18, 1982. After he graduated from Hurriyet Industrial and Technical High School, he attended the Faculty of Simav Technical Education in Dumlupinar University, Kutahya, Turkey, majoring in Mechanical Education in 2000. Upon graduation in 2004, he entered the Graduate College at Erciyes University to pursue a Master of Science (MS) in Economics. During his MS degree, he also started working at Turkish Airlines, Inc. The development of econometric models was part of his MS thesis: "The Importance of Innovation from the Perspective of Export Performance: The Case of Turkish Manufacturing Industry". The research resulted into an academic journal article, which has been accepted for publication and appeared in Dogus University Journal in 2012. In 2010, he entered the Graduate College at Arizona State University to pursue his Master of Technology degree in Technological Entrepreneurship and Innovation Management (TEIM). He worked as a research assistant during his graduate studies. Currently, he is working as a Faculty Associate in the department of TEIM at Arizona State University.