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LINKING HISTORICAL ROOTS AND CURRENT  
METHODOLOGIES OF ENGINEERING SYSTEMS

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# **LINKING HISTORICAL ROOTS AND CURRENT METHODOLOGIES OF ENGINEERING SYSTEMS**

ROOT: IMPACT OF TECHNOLOGY ON THE ECONOMY  
METHOD: STRATEGY DEVELOPMENT

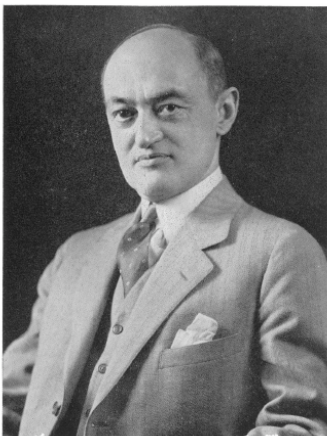
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## I. INTRODUCTION

This paper reviews the historical context and present impact of two sets of literature: the work of Joseph Schumpeter and the field of Strategy Development. Schumpeter's theories about the impact of technology or innovation on the economy are an important input into modern Engineering Systems (ES) thinking. Meanwhile, Strategy Development is an active contemporary methodology that is relevant to Engineering Systems. Both Schumpeter and the scholars in Strategy Development view the world through a fundamentally economic lens. All of these scholars are concerned with how firms perform, but Schumpeter's approach is descriptive while Strategy Development prescribes.

The approach in this paper is as follows. Section II introduces the theories of Schumpeter on innovation. Section III introduces the ideas within Strategy Development. Sections IV and V are historical reviews. First, Section IV looks forward to find the impact that Schumpeter has had on modern fields; then Section V looks backward to understand the roots of Strategy Development. These historical reviews are initially done independently. Finally Section VI asks whether there are direct historical links between Schumpeter and the scholars or ideas of Strategy Development. Closing thoughts are included in Section VII. The major result of this investigation is that Schumpeter's influence is widespread as are the roots of Strategy Development. The writing of Schumpeter is related to Strategy literature, but this connection is just one of many for the two fields and does not appear to be the most important link.

## II. OVERVIEW OF ROOT: SCHUMPETER'S WORK ON INNOVATION AND THE ECONOMY



**Figure 1: Photo of Joseph Schumpeter, 1935 (Haberler, 1950)**

The economist Joseph Schumpeter (shown in Figure 1) made important and long-lasting contributions to the world's understanding of the dynamics of economic activity. His theoretical analyses of the role of innovation, the creativity of the entrepreneur, the inevitability of cycles in the economy and the evolution of a capitalist society have become foundational to many modern economic theories and methods. While not everyone who cites Schumpeter completely agrees with or even fully comprehends what Schumpeter wrote, there is great evidence that Schumpeter's work heavily impacted the fields of economics, management, political science and engineering systems. This study focuses on Schumpeter rather than a group of theorists because his ideas alone have so much depth and breadth on the subject of technology and the economy.

Schumpeter's work spans the first half of the 20<sup>th</sup> century. Between 1908 and his death in 1950, Schumpeter wrote five books that summarize the major theories for which he argued (Moss, 1993). This section does not attempt to summarize the content and evolution of this large breadth of work. Rather this section has two goals. First, it strives to show the elements of Schumpeter's work that directly relate to the impact of technology on the economy. Second, this section shows how Schumpeter's work built on itself and considered progressively wider views of the economy. Some of Schumpeter's early work can be considered very local and focused on individual firms and actors. The work gradually expanded to consider how the behavior of these firms and actors affects the whole economic system. From there Schumpeter expanded even more to say how the economic system affects the larger social and political systems, finally concluding that capitalism would cause democracy to evolve into socialism. Figure 2 below shows graphically the three expanding bodies of work in which Schumpeter addressed the impact of technology on the economy. The figure also shows the titles and original publication dates of the major books that Schumpeter published on these topics.

Some aspects of Schumpeter's biography are important to understanding his work. Schumpeter was born in 1883 in an area of Austria that later became part of Czechoslovakia. He spent most of his life in academia, working at various universities in Europe and finally moving to Harvard, where he spent his last 20 years. Thus, his life and work have two major professional periods, from about 1908 to 1930 in Europe and from 1930 to 1950 in the United States. Schumpeter published his first two major books in Europe (*The Nature and Principal Content of Theoretical Economics*; *The Theory of Economic Development*) and the final three important works represent his work at Harvard (*Business Cycles*; *Capitalism, Socialism and Democracy*; and *History of Economic Analysis*). As Haberler

noted just after Schumpeter's death in 1950, he was not an expert in particular economic specialties, but "as a master of all branches of economics and as a universal scholar, Schumpeter held a unique position among contemporary economists" (Haberler, 1950).

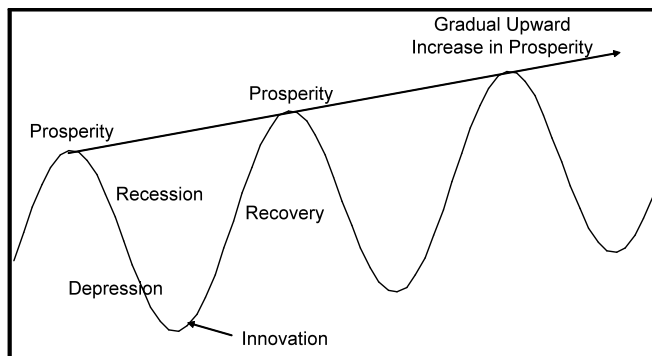
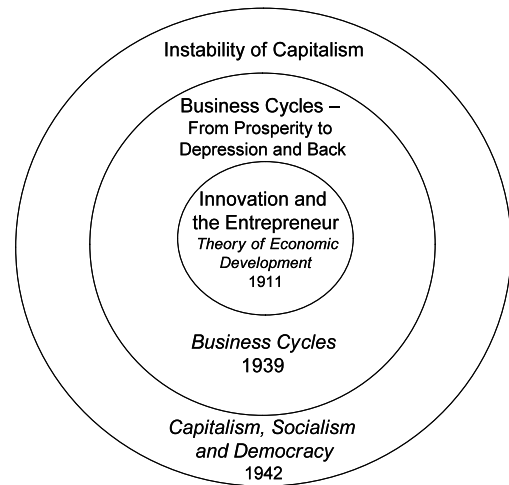
**Figure 2: Overview of Three Levels of Schumpeter's Work on Technology and the Economy**

a. *Summary of Major Ideas on Innovation and the Economy*

The following sections give more detail about the theories presented in the three books described in Figure 2. Note that the ideas in the books overlap with each other.

*Innovation and the Entrepreneur.* In *The Theory of Economic Development*, Schumpeter creates a theoretical model by which to explain endogenously why economies change rather than remain statically in equilibrium (Schumpeter, 1936). He begins by assuming a static economy that experiences gradual growth due only to population growth and savings. Goods and services are produced in the economy by combining land (natural resources) and labor in a "circular flow" (Schumpeter, 1936). People generally do the same kind of work repetitively; there is very little incentive to change. No external crises cause change in the economy. Given these assumptions, Schumpeter argues that no change or major growth will occur in this economy unless there is innovation. Schumpeter carefully defines innovation as distinct from invention. Innovation is not when a technology is first developed or a scientific breakthrough is made. Innovation occurs when someone changes the way inputs are combined to make outputs in economic activity. Schumpeter further proposed that innovation happens because an individual called an entrepreneur takes a leadership role and challenges the status quo in order to bring about change. Once one person takes this risk, other people imitate the original entrepreneur and a cluster of innovations results. This cluster fundamentally changes the technical rules by which the economy operates. The economy moves into a period of increased prosperity because the innovations increase the capacity to create wealth (Schumpeter, 1936). Schumpeter claims that "the mechanisms of economic change in capitalist society pivot on entrepreneurial activity" (Schumpeter, 1947). He terms such activity "creative destruction" (Schumpeter, 1976) or "creative response" (Schumpeter, 1947).

*Business Cycles.* Schumpeter's model of business cycles continues the story described above of the static economy that changes when an entrepreneur brings innovation. From the static state, the economy begins to experience increased prosperity due to innovation. This does not last, however. Eventually some of the firms who do not adjust to the new technical rules of the economy are not able to compete. Some firms have to reorganize while others simply close. This transition leads to a recession and ultimately a depression. The economy suffers until a new wave of entrepreneurs initiate innovations. Thus, the economy cycles continuously through periods of prosperity, recession, depression and recovery, as shown in Figure 3. With each wave of innovation and prosperity, though, the overall level of wealth increases so that the economy is on an increasing wave of cycles. Schumpeter cites the work of other economists on cycles and shows that there are multiple cycles happening to the economy simultaneously at different time scales and levels of severity (Schumpeter, 1927).



**Figure 3: Schumpeter predicts economic cycles from innovation to prosperity to depression to innovation**

*The Instability of Capitalism.* These ideas are found primarily in the book, *Capitalism, Socialism and Democracy* (Schumpeter, 1976) as well as the paper, "The Instability of Capitalism" (Schumpeter, 1928). Schumpeter considers the economic system of a

capitalist country. He assumes that they experience business cycles as outlined above. As the cycles continue, the overall prosperity level of society is increasing. Schumpeter expects that the economic and social system will adapt to these cycles and try to minimize the force of the recessions and depressions. Innovation will become the job of large firms that do systematic research and development. The government will provide regulations or safeguards that protect firms from closing due to recessions. Gradually, the society eases into an economic system that is more socialist than capitalist.

This overview is provided to give a high level understanding of Schumpeter's work on the impact of innovation on the economy. In the following sections, the focus will be more on the theories about innovation, the entrepreneur and business cycles than on the theory about the instability of capitalism. These former ideas are more important in terms of the way they impacted future scholarship and practice on innovation.

#### *b. Contemporaneous Scholarly Views on Schumpeter*

Many authors have taken Schumpeter's theories and built on them, criticized them, or both. Schumpeter's writings include an active dialogue with his contemporaries about points of agreement or disagreement. Later sections will show how Schumpeter has influenced modern scholars and disciplines. This section gives examples of contemporaries of Schumpeter who worked in similar areas and responded to his theories. Paul Sweezy, author of *The Theory of Capitalist Development* (Sweezy, 1942), was a student and colleague of Schumpeter's at Harvard (Hancock, 1952). Sweezy critiques Schumpeter's theories about the role of the innovator in facilitating economic change in a 1943 article (Sweezy, 1943). Sweezy's main concern is that Schumpeter's initial conditions for the model are too limited. He argues that other initial conditions for the model are equally plausible and would lead to different patterns of behavior. Sweezy suggests an alternative set of assumptions about class structure. Sweezy was an American economist who had strong Marxist views; thus it is not surprising that his review of Schumpeter's theory focuses on the class structure (Hancock, 1952). As another example, consider the review by Simon Kuznets of Schumpeter's book on *Business Cycles*. Kuznets was another contemporary of Schumpeter's who taught at several excellent universities, including Harvard, and won the Nobel Prize in Economics (Encyclopaedia Britannica, 2008). Kuznets published extensively on business cycles (Kuznets, 1930) and economic growth (Kuznets, 1947). In the review of Schumpeter's book, Kuznets' challenges various assumptions at the heart of Schumpeter's theories about innovation and the entrepreneur. His goal is not to disprove the theory, but to elaborate on it such that the ideas are more complete. For example, Kuznets is not sure whether he agrees with Schumpeter's assertion that innovations will happen discontinuously in clusters with long breaks between periods of no major change. Kuznets wonders whether this is due to a lack of entrepreneurs or a lack of feasible innovations. He concludes that Schumpeter's conclusion can be supported but must be stated with careful qualifications (Kuznets, 1940).

### **III. OVERVIEW OF METHOD: STRATEGY DEVELOPMENT**

The concept of business (firm) strategy has slowly evolved since its official inception in the mid-1950s. This next section provides a definition-driven overview of the concept, followed by a review of strategy development as Michael Porter and Henry Mintzberg—two of the most influential scholars in the field—see it. In Section V, additional contemporaries of Porter and Mintzberg are presented.

During the last half century, several definitions of strategy development have emerged. A definition broad enough to encompass the multitude of thoughts and ideas professed in individual definitions, yet detailed enough to be informative was chosen:

*“Strategy, [Development]... is... an understanding of the present situation ('where we are now'), the desired future position ('where do we want to be') and the path to take the organization from its present position into the future ('how do we get there'),”* (Middleton, 2003)

The selection of this particular definition merits explanation, as it is not obvious. A discussion of the specific parts of the definition provides a good overview of many key themes of strategy development as a current methodology.

First, the definition contains the three following important components: a past, a future, and a present. Across the vast literature on strategy development, this aspect remains unchallenged. It is important for a strategist to have a

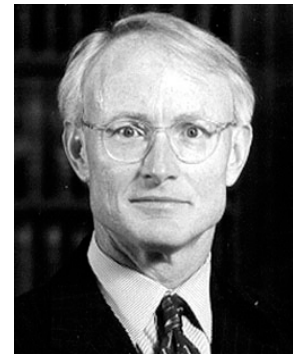
sense for what has happened in the past, what the general goals and motivations are for the uncertain future, and what types of paths may be chosen to reach these goals.

Perhaps the most elucidative word in the string, however, is the word “understanding.” An important concept of strategy development today, is that it sits apart from the literature on “strategy planning,” (Mintzberg, 1994). The difference is subtle, and will be discussed in more detail in a later section, but important. Strategy planning concerns a rational, reasoned, and ordered analysis of a situation (e.g., market, product development), generally carried out by an isolated set of individuals in an organization. It is followed by a sequential, often predictable, set of implementation orders intended to maximize economic profits. This classical definition of strategy has overwhelmingly been deemed an obsolete mode of thinking, when used in isolation (Whittington, 1993). Strategy development, as a method of reaching firm potential (both economic and non-economic), has transcended this limited view and is *additionally* concerned with a more intimate, emergent, and craftsman-like mode of thinking about situations and implementing actions to meet goals. Finally, it is important to note that strategy development also sits apart from the literature on operational analysis. Firm-level decisions become strategic versus operational when firms specifically seek to manage in a way that competitors cannot readily match (Porter and Reinhardt, 2007). The most notable scholar in the field today who holds this view is Henry Mintzberg, a management studies professor at McGill University and alumnus of MIT. Mintzberg published his most influential piece of work on strategy development in 1994. He was preceded by Michael Porter of Harvard University who published *Corporate Strategy* in 1980 (and set the groundwork for the new way to think about strategy). Both scholars are presented in the next section.

a. *Summary of Major Ideas on Strategy Development*

**Figure 4: Photo of Michael Porter, 2008** (Source: www.nndb.com)

When Michael Porter published, *Competitive Strategy*, in 1980, he changed the way business strategy was practiced. Porter is deemed one of the world’s pre-eminent strategic thinkers, and continues to be cited as the most influential of them all (Middleton, 2003; Brandenburger, 2002). Porter’s theories on strategy development straddle two important concepts: structural analysis of the industry forces that shape competition and firm value chains.



Porter was most interested in answering the question, “How can a company be best placed to compete in the long run?” Concern for firm profitability and financial success drove most of his early work (Middleton, 2003; Porter, 1980). Porter’s definition of firm success is, “maintaining a competitive position or series of competitive positions that lead to superior and sustainable financial performance,” (Porter, 1991). His identification of “Five Forces” that determine firm profitability, also called the “Porter Model,” has been his main contribution. According to Porter, the forces that shape competition within an industry are: 1) the threat of new entrants, 2) the power of suppliers, 3) the power of buyers (customers), 4) the threat of substitutes, and 5) the rivalry among existing competitors (Porter, 2008). These industry forces are what drive competition and determine firm success, and they are more important than whether industries are emerging vs. mature, technology intensive vs. technologically simple, or regulated vs. unregulated (Porter, 2008). Further, underneath these five forces lie various environmental factors that shape them. Industry growth rate, technology or innovation within an industry (or a single firm), and government involvement are some examples. The level and nature of these factors shape the underlying structure of the industry and the interaction between the five forces. Porter’s thesis argues that profitability depends on a firm’s ability to identify exactly how the forces in a particular industry are situated, which of the forces are the most influential, and how to position itself within the industry such that it can take advantage of the forces. Because the relative influence of the forces (and factors underlying the forces), differ from industry to industry, this evaluation is crucial (Porter, 2008; Porter, 1996).

A second concept that Porter brings to strategy development is a belief that strategy necessarily emerges from a firm’s distinctive value chain (its distinct choice of activities to develop its product or service) (Porter, 1991; Middleton, 2003). Firm activities include: 1) human resources, 2) purchased inputs, and 3) a technology for

performing them (Porter, 1991). Achieving a distinct position in a market is achieved by thoughtful activity structuring and is essential for a firm to achieve competitive advantage (Porter, 1991).



**Figure 5: Photo of Henry Mintzberg, 2008** (Source: McGill University Website)

Henry Mintzberg published, *The Rise and Fall of Strategic Planning*, fourteen years after Michael Porter published his Five Forces Model. During this time, strategy development was witnessing a shift towards requiring intimate knowledge about firm behavior and emergent patterns in industry, and away from hard planning and analysis. This version of strategy development ultimately came to full fruition through Mintzberg's ideas. Mintzberg's strategy model is less strict; it encompasses deliberate planning and examination of industry structure (e.g., elements of the Porter Model), but also includes and elicits a firm's vision, internal world, behavior, and activity patterns in a more artful way than Porter's value chain concepts did (Mintzberg, 1994; Mintzberg, 1978). While Porter states that he "favour[s] a set of analytical techniques for developing strategy,"

Mintzberg is known as a "fierce challenger of [such] conventional wisdom," (Mintzberg, 1994a; Middleton, 2003). According to Mintzberg, strategy development can be likened to a potter crafting a piece of pottery at her wheel—patiently, understanding and responsive to the patterns that have developed during her work. His main thesis is that the best strategy is emergent rather than prescribed. There is a place for conventional strategy, but it comes after, and in between, emergent strategy development modes (Mintzberg and Waters, 1982). Mintzberg's work also stresses the idea that the good strategies often develop at the level where firm activities are actually carried out daily (instead of in a board room far removed from the majority of the activities). He also believes that successful firms are structured to properly handle periods of change and periods of stability, and that this structure can be attained via structural and/or behavioral reorientations taken in leaps or through cycles of innovation and stagnation (Mintzberg, 1994a). There is much more to Mintzberg's work and influence than described above. Those presented are the key concepts relevant to the current discussion.

#### *b. Contemporaneous Scholarly Views on Porter and Mintzberg*

While his critics do exist, it should be noted that Michael Porter's intellect, vision, and general level of influence on the field of strategy development is not a source of contention. He is considered even by his critics to be a true leader. Consider Adam Brandenburger's 2002 commentary of Porter in, *Academy of Management Executive* (Brandenburger, 2002). According to Brandenburger, a professor of game theory and business strategy at the Harvard Business School, the Porter Model, "gives us a memorable mental picture of the business landscape—one that reflects what real-world business strategists actually think about," (Brandenburger, 2002). He insists that the Porter Model's strength is that it gives a clear picture of the *essential* activity of business, which can easily transfer across situations, and that Porter provided his research group a starting point with which to look at the part of game theory that concerns formalizing concepts such as value-adding activities and bargaining (Brandenburg, 2002). Ironically, Porter's critics tend to focus on the Porter Model as being too inflexible for practical use and as lacking recognition of the relative importance of internal firm forces. More specifically, Porter's theories on sustainable competitive advantage have been challenged (Middleton, 2003). Mintzberg, despite having had the advantage of publishing his work over a decade after Porter, has also had his share of critics. As an example, consider a 1996 review of his major book, *The Rise and Fall of Strategic Planning*, by Noel Capon, a professor of Marketing at Columbia's Business School (Capon, 1996). Capon notes that while many of Mintzberg's critics attack him unfairly, the empirical data he includes as the basis of his argument that strategy planning is no longer a useful concept is biased and flawed (Capon, 1996).

## **IV. FORWARD CASTING ANALYSIS: SCHUMPETER'S LEGACY**

This section discusses the influence of Schumpeter's theories about the impact of technology in the economy on modern fields, including contemporary engineering systems methodologies. The first section cites writers who argue that Schumpeter has affected a variety of contemporary fields. The second section shows how quantitative citation analysis can be used to provide further perspective on Schumpeter's legacy. The third section provides examples

that suggest Schumpeterian influence on specific engineering systems methodologies, including strategy development. Note that this work represents an independent effort to understand the impact of Schumpeter's work on the field of engineering systems. The effort to trace backward from strategy development will be discussed separately.

To understand Schumpeter's influence, first note that his work sits in juxtaposition with the economist John Maynard Keynes, who was born the same year as Schumpeter and was very popular during Schumpeter's life and in the decades immediately following. Keynes is well known for encouraging strong government involvement in controlling unemployment (Minsky, 1985). Some authors note that Schumpeter's ideas were better received once Keynes' popularity lessened in the later 20<sup>th</sup> century (Allen, 1991).

#### a. *Schumpeter's Influence on Modern Fields*

This section considers several authors who show how Schumpeter has influenced his own field of economics as well as other disciplines, including sociology, political science, and innovation policy. Harry Dahms wrote in 1995 on Schumpeter's theories about the entrepreneur and innovation. He connects them with sociology. Dahms points out that Schumpeter's innovator takes creative rather than rational economic action. He sees that as an important input into sociological theory (Dahms, 1995). Cole of Oxford University also asserts that Schumpeter's "approach to the social studies had always a sociological content" (Cole, 1952). Medearis shows in 1997 how political scientists have used and analyzed Schumpeter's theories about capitalist society and democracy (Medearis, 1997). Hospers in 2005 attempts to describe broadly how various fields have been influenced by Schumpeter's theories about innovation (Hospers, 2005). First, he discusses how economists have built on Schumpeter. He argues that Solow's work to demonstrate the role of technological progress in explaining economic growth follows from Schumpeter's ideas about the importance of innovation (Solow, 1957). Hospers also notes that some interpret Schumpeter as implying that larger firms are more innovative than smaller firms; they try to test this with empirical evidence. Hospers mentions how Nelson and Winter call themselves Neo-Schumpeterians in their work to explain economic dynamics based on an evolutionary metaphor (Nelson and Winter, 1982). According to Hospers, theories by Arthur about the path dependency of innovation are influenced by Schumpeter (Arthur, 1994). Finally, Hospers argues that modern policy makers who seek to enhance innovation in a country or region often refer to Schumpeter's theories. He uses the case of Japan as an example (Hospers, 2005). These few examples seem to indicate that Schumpeter's influence has been strong and varied. The next section uses citation analysis to attempt quantitative confirmation of this idea.

#### b. *Quantitative Citation Analysis*

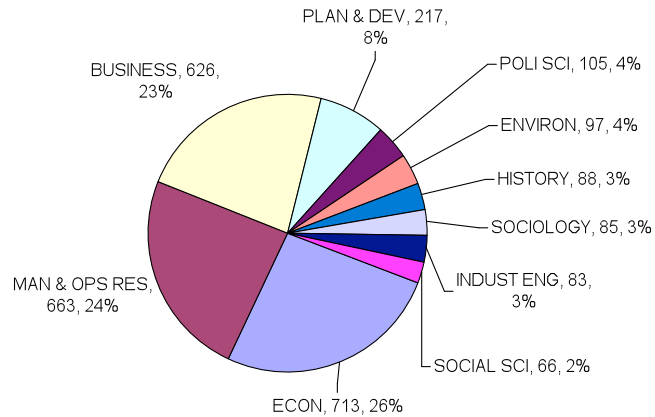
The analysis in this section uses quantitative evidence to support the idea that Schumpeter's theories about innovation and the economy have influenced a variety of modern disciplines. The Citation Database from the Web of Science was used to examine patterns in the citations for Schumpeter's book, *The Theory of Economic Development* (Schumpeter, 1934). This book was chosen for analysis because it is the work that introduces and focuses on Schumpeter's concepts about innovation, the entrepreneur and economic change. The analysis process was as follows. The Web of Science database was queried for any citation of *The Theory of Economic Development* for all the years covered by the database, which started in 1973. All document types were considered, including books, journal articles and reviews. This search yielded a little over 3000 cases of authors citing this book. The citations were organized by broad subject area. The top ten most frequent subject areas were plotted, covering 2743 cites. The chart in Figure 6 below shows the percentage of citations in each of the top ten subject areas for the citations of this book by Schumpeter since 1973. For each slice of the pie chart, the number of citations and the percentage (out of 2743) for that subject area is shown.



**Figure 6: Subject Area Results from Citation Analysis for One of Schumpeter's Major Books**

This chart reveals some expected and some surprising results. It is not surprising that the top three categories are Economics, Management & Operations Research, and Business. Schumpeter's work was written to these audiences. More interesting are the next three most frequently mentioned areas. In fourth place is Planning and Development, followed by Political Science & International Relations, then Environmental Studies. This result does confirm the ideas presented by the authors above. Schumpeter's work is cited by sociologists, political scientists, and economists, among many others.

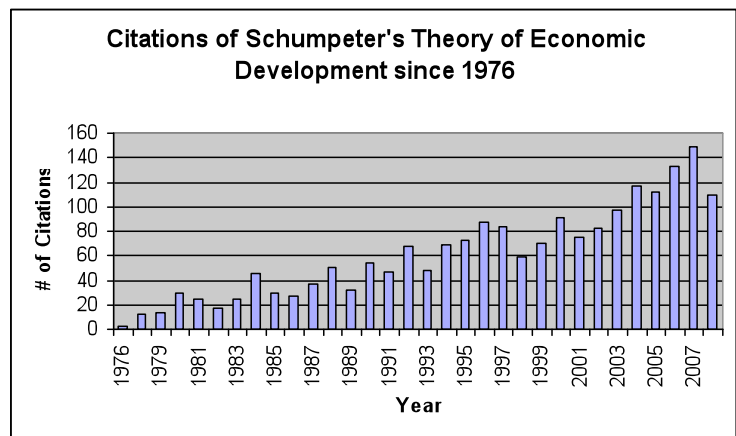
**Top 10 Subject Areas for Citations of Schumpeter's Theory of Economic Development**



Additional analysis was done to learn how Schumpeter's impact has changed over time. Figure 7 uses the same search results as discussed above but organizes the citations by year. Again, this only includes citations for Schumpeter's *The Theory of Economic Development* that are included in the Web of Science coverage starting in 1973.

**Figure 7: Time Trend Results from Citation Analysis for One of Schumpeter's Major Books**

Figure 7 suggests that Schumpeter's popularity and influence have been increasing over time, if the number of citations can be taken as a proxy measure for popularity. This must be considered cautiously, however. On one hand, the increase in citations may simply reflect that the Web of Science database has more information from the recent past than from the 1970s. On the other hand, the sections above mention that Schumpeter's popularity has grown since his death, especially as some rival theorists have declined in influence. At the very least, this graph can be considered a lower limit on the number of people who cite Schumpeter. Assuming that the Web of Science has accurate information for at least the past two decades, this graph suggests that Schumpeter's influence has been recently increasing and is certainly healthy today.



*c. How Schumpeter influences modern Engineering Systems (ES) methods*

The final element of analysis on Schumpeter's legacy asks specifically how Schumpeter's work on innovation and the economy has affected modern Engineering Systems methodologies, with a particular interest in the methods of strategy development. The method to answer this question was a rather ad-hoc internet search for any relationship between Schumpeter and the ES methodologies or the important scholars. The results are certainly not exhaustive, but they do represent valid examples of Schumpeter's legacy in these areas. Table 1 presents examples in which a scholar working on a contemporary ES methodology was inspired by Schumpeter. For each example in the table, at least one paper was found in which the scholar cites Schumpeter in a discussion of the relevant methodology. The references for these papers can be found in the bibliography.

**Table 1: Scholars from Modern Engineering Systems Methodologies Who Cite Schumpeter**

<i>Scholar</i>	<i>Field/Discipline</i>	<i>Methodology</i>
Michael Macy	Sociology	Agent-Based Modeling
Olav Sorenson	Innovation, Management, Entrepreneurship	Social Networks
R. Edward Freeman	Business and Ethics	Stakeholder Analysis
Jeremy Hall	Innovation, Management, Entrepreneurship	Stakeholder Analysis
<b>Ian MacLachlan</b>	<b>Geography</b>	<b>Strategy Development</b>
<b>Nicholas Argyres</b>	<b>Management</b>	<b>Strategy Development</b>
Andreas Groessler	Management	System Dynamics
John Sterman	Management	System Dynamics

To give more details about a few of these examples, first consider Michael Macy. Macy is a sociologist whose paper is concerned with demonstrating the value of agent-based modeling for elucidating sociological theory. Some of the theory that he draws on is from Schumpeter (Macy and Willer, 2002). Freeman is known for work on stakeholder analysis. He references Schumpeter’s *Capitalism, Socialism and Democracy* in a discussion on how to view capitalism through a stakeholder lens (Freeman, Martin, and Parmar, 2007). John Sterman of MIT uses system dynamics to better understand the business cycles discussed by Schumpeter (Sterman, 1985). Of course, the extent of the influence of Schumpeter on these various scholars varies. Some, like Macy, cite Schumpeter only in passing. Others, like Sterman, are using the ES methodology to wrestle with the meaning of Schumpeter’s theories.

A key goal of this paper is to learn if there are connections between the work of Schumpeter and modern scholars in Strategy Development. This section presents one preliminary conclusion in that area. Two examples were found in which scholars working on strategy development cited Schumpeter. Nicholas Argyres, in the field of Management, cites *Capitalism, Socialism and Democracy*. He makes the point that Schumpeter’s concept of imitation of innovative firms is an important input to firm strategy (Argyres, Bigelow, 2007). Ian MacLachlan references the same book in a paper about market dynamics and plant closure (MacLachlan, 1992).

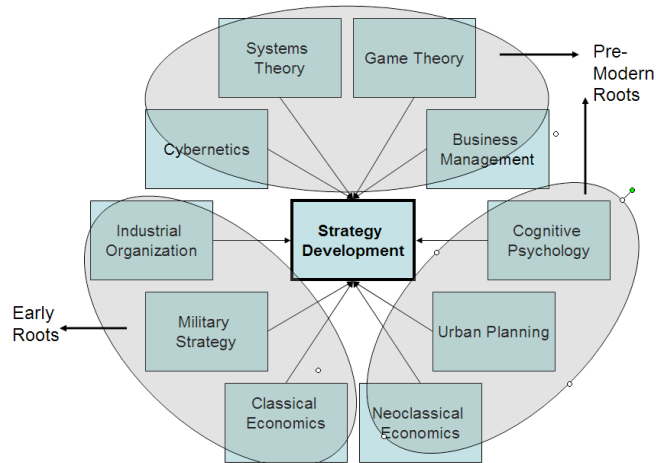
This review of Schumpeter’s legacy has shown that his work has touched many fields over many years. Three separate analysis methods – literature review, citation analysis and thematic search – provide a high level understanding of Schumpeter’s influence on modern fields. This review also shows specific examples of scholars on strategy development referencing Schumpeter. The following section traces backward to find the roots of Strategy Development.

## V. BACKWARD CASTING ANALYSIS

The goal for the backward casting analysis was to trace the method of strategy development back to its historical roots. Given that strategy development falls under the umbrella of Engineering Systems methodologies, this backward cast would ideally uncover the method’s historical Engineering Systems-related roots. As explained above, this analysis was undertaken independently, in order to objectively uncover the method’s roots without a bias towards uncovering any potential links between strategy development and Joseph Schumpeter’s theories on the impact of technology on the economy. The latter task will be discussed in a later section. The remainder of this section will provide an overview of the methods used and present the results of the analysis.

The backward cast used a different methodology than the forward cast for the historical root, as expected given the different type, level, and quantity of information available to a researcher performing a historical review of a concept. Often for backward casts, one can make use of information gathered by historians interested in similar issues and well-developed bibliographies for individual authors. This analysis used a combination of tools to develop a comprehensive backward cast: 1) published, historical accounts of the evolution of the field of Business Strategy, 2) manual citation traces using reference lists from major influential strategy development journal articles and books originating from Michael Porter and Henry Mintzberg, and 3) Web of Science database citation searches. Figure 8 provides an overview of the various key disciplines have that influenced strategy development. Note that Figure 8 includes only major influencing disciplines discovered during this research.

**Figure 8: Highly Simplified Diagram  
 Depicting the Historical  
 (Discipline-level) Evolution of Strategy  
 Development**



A review of the literature suggests that strategy development grew out of distinct disciplines and in three stages. These stages are discussed in the remainder of this section as being in one of three root categories: early, pre-modern, and modern. In general, the pre-modern and modern categories can be easily thought of as arising and influencing strategy development as networks of individuals working on the same general concepts. However, the early category spans such a wide time frame that it is lumped together for simplicity.<sup>1</sup>

*Early Roots (~500 B.C –1800).* The concept of “strategy” can easily be traced as far back as 500 B.C., to its roots in ancient military strategy and Sun Tzu’s widely credited account of how to deal with battle situations in *The Art of War*. In fact, Sun Tzu’s work is often regarded as the very first “formalized strategy text,” (Middleton, 2003). Nicolo Machiavelli’s ideas in, *The Prince*, published in 1532 is also recognized as a major historical document on strategy. Machiavelli’s concepts of means justifying the ends are bold, though often misinterpreted as being too harsh. Some of his ideas with continued relevance to business and management practice include the need for managers to “avoid being hated,” and to be stingy in their generosity (Middleton, 2003). Finally, strategy development has strong roots in classical economics. The father of modern economics, Adam Smith, is widely recognized as influencing Strategy Development (Middleton, 2003). The foundation of free market economics, rational self-interest, and competition that Smith laid forth in, *The Wealth of Nations*, in the late 1700s was his major contribution to the field (Encyclopedia Britannica, 2008a).

*Pre-Modern Roots (1900s).* Strategy development, or strategy planning as it was still called then, therefore began with a set of broad principles on management and traditional economic models for explaining firm success. Determinants of success were based on firms 1) developing and implementing internally consistent sets of goals and policies to define their position within the market, 2) aligning their strengths and weaknesses with the external industry environment, and 3) needing to differentiate themselves from others in the market (Porter, 1991). How well individual theories balanced these determinants is varied (Barney, 1986). This early philosophy was marked with rational analysis and rigorous planning methods, as described in Section III. Additionally, during this early period, firms were seen as having considerable potential to overcome their individual weaknesses and greatly influence their industries. While this view is alive today, it has been toned down in favor of a slightly more passive view of firm role, (Porter, 1991). Examples of key scholars working in this early network included Alfred Chandler (economic history) and Isor Ansoff (systems theory; cybernetics). Chandler’s contribution, though in hindsight often regarded as obvious, was immense during the 1950s and 60s. He is recognized as the first historian to assert the importance of strategy development in firm success (Middleton, 2003; Chandler, 1973). Ansoff is best known for the Ansoff-Matrix, a popular marketing tool that helps businesses brainstorm and organize their goals and strategic intents. The Ansoff model offers four classifications to help businesses organize their thoughts around: market penetration, product development, market development, and diversification (Middleton, 2003). Ansoff also worked in the 1950s and 60s—decades before Porter and Mintzberg—yet the underpinnings of the Porter Model are clear if one considers the similarities between the four classifications and the Five Forces Model (Ansoff, 1987). Early links to game theory, business management, and cognitive psychology were also discovered (Barnard, 1945; Drucker, 1958; Zvorikine and Drucker, 1961; Drucker 1959).

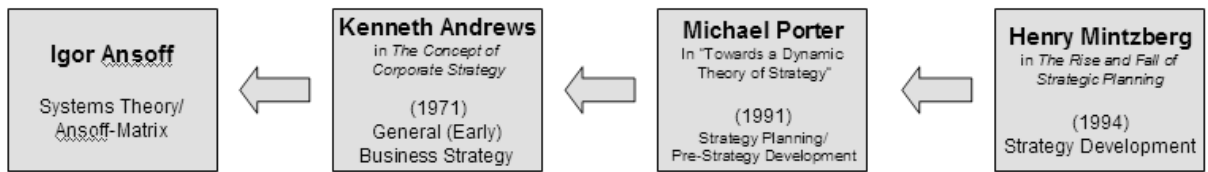
<sup>1</sup> The year in which an author has been placed is the year in which he had the greatest influence on the strategy development method, and does not necessarily coincide with expectations based on age.

Once the importance of developing firm strategy was widely recognized, strategy development appears to have gone through a transition period with the work of two research groups. The transition is subtle, and the timing does not afford it to be easily marked as a distinctly important period. However, a review of the literature reveals that the work of Porter and Mintzberg's contemporaries would not have been the same without the work of business strategists Andrews, Christensen, and Learned at the Harvard Business School in the late 1950s. Their work resulted in the concept of corporate strategy being defined as, "the essential concept of how a firm was attempting to compete in its environment, encompassing a choice of goals as well as operating policies in each functional area of the business..." (Porter, 1983). Their approach was analytical, heavily based in neoclassical economic theory, and their model offered firms a series of logical "consistency" tests to follow in developing their strategy (Andrews, 1971). It was in this transition period that the concepts of strategy and goal and activity alignment with internal and/or external forces became a formalized process (Porter, 1983). This formal process would later be challenged by modern scholars such as Mintzberg. Next, the work of an industrial economics group led by Mason and Bain in the 1950s formalized the concept that industry structure determined behavior and conduct of firms and finally offered the field a broad, working theory of competition. Mason and Bain proposed that barriers to entry, number and size distribution of firms, product differentiation, and elasticity of demand drove industry structure. They also contended that firm performance is mostly driven by industry structure (over individual firm conduct) (Porter, 1983). Industrial organization's influence on the Porter Model is thus readily seen.

*Modern Network (late 1990s – Present).* While Porter and Mintzberg appear to have had among the largest influence on these additional theories, it is obvious from the literature that several scholars emerged together—learning from and challenging each others' concepts in order to establish their unique voices. What is most fascinating is that amidst the number of contemporary authors working in the field, while their approach, level of detail, or model structure differ, the basic underlying strategy model remains the same (Mintzberg, 1994). Modern strategy development scholars such as Porter, Mintzberg, and their contemporaries saw a need to move beyond broad theories to provide still more structure and precision in the models aimed at understanding a firm's competitive environment. While the early work was a move in the right direction, the theories and models developed were plagued with too many assumptions and did not prove to be easily applied across different industries, firms, and operating environments. This was partly due to its economic traditions. In general, the work of the modern network has been aimed at loosening the rigorous models developed to guide firm strategy development (in varying degrees according to individual scholar). They tested and refined them by highlighting previously omitted variables, and captured complexity, dynamicism, and the various ranges of decisions firms can make.

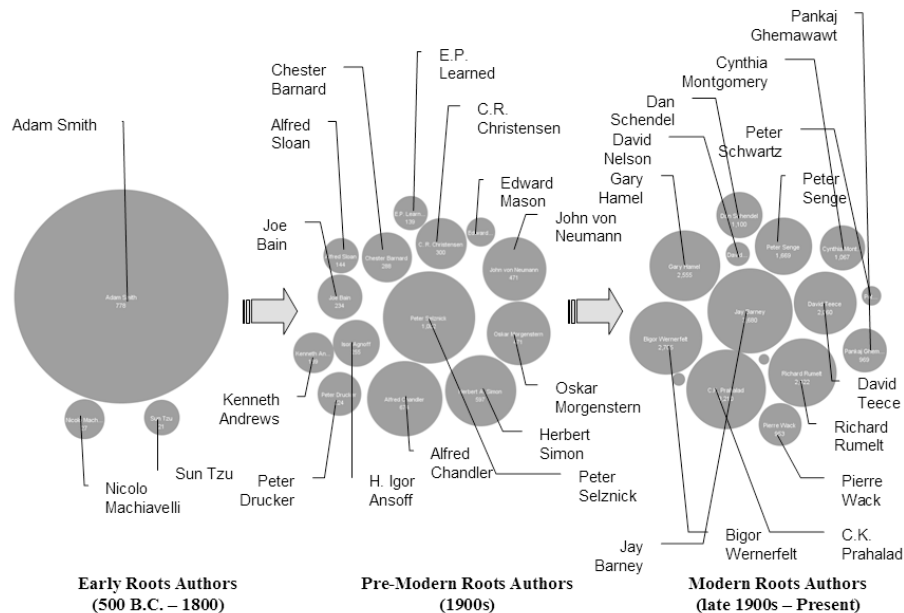
C.K. Prahalad and Gary Hamel (game theory) and Jay Barney (strategic management) are among the many widely cited influential authors. Hamel and Prahalad present the "core competencies" view of strategy development, and present a more detailed look at how firms can assess their individual strengths and weaknesses to compete. They assert that Porter's model is an "outside-in" approach to strategy development because it uses external industry forces as its starting point, while theirs (more correctly) is an "inside-out" approach because it begins with looking at internal firm activities (Prahalad and Hamel, 1994; Middleton, 2003). In this way, it appears that Hamel and Prahalad favor a more "Mintzberg" like view of strategy. Barney, a professor of strategic management at Ohio State University, focuses on resource-based views of competition and on developing integrated models of the competitive forces a firm can expect to face over time (Barney, 1986; Barney 2002). In general, the contemporaries appear to be split between the "Porter" school and the "Mintzberg" school of thought on strategy development. Authors identified as part of this modern network appear in Figure 9, which is discussed in the last part of this section (Rumelt, Schendel, and Teece, 1991; Barney, 2002; Rumelt, 1982; Hansen and Wernerfelt, 1989; Simon, 1993; Ghemawat, 2002; Middleton, 2003)

An example direct manual citation trace using reference lists originating from Porter's and Mintzberg's works is presented in Figure 9 below. Dozens of such citation traces were developed during the analysis, and the type of connections and distance in "thought" (as illustrated in the number of individual authors in a given string of citations), were found to be strikingly similar from one trace to the next. The fact that Porter, Mintzberg, and their modern contemporaries cite authors from their own network, the pre-modern network, and the early network, while those in the pre-modern network tend to cite those in the early network, supports the historical review's accuracy.



**Figure 9: Example Backward Citation Discovery**

Finally, Figure 10 was developed using IBM’s open-source *Many Eyes* software program. It provides results from a Web of Science database citation search for authors identified from an initial, relatively exhaustive, manual citation search originating with strategy-related sources of Porter and Mintzberg and a review of the history of business strategy. Within each era, the size of an individual author’s bubble reflects the number of times he was cited in the fields of Business, Management, Economics, and/or Operations Research and Management Science. While other fields were applicable, the search was narrowed to the fields that most obviously influenced Strategy Development based on information discovered during the literature review. From the diagram, the relative influences of Adam Smith in the early network, Peter Selznick, Alfred Chandler, Herbert Simon, and Oskar Morgenstern/John von Neumann in the pre-modern network, and Jay Barney, C.K. Prahalad, and Richard Rumelt are easily seen. Note that a bubble diagram was used instead of a network diagram to focus on higher level trends. Also note that the relative size of the bubbles only apply within each network, not across networks. While this quantitative citation analysis is limited in rigor, it provides an additional level of confirmation that the authors (and their disciplines) identified during the historical account and manual citation checks were indeed influential.



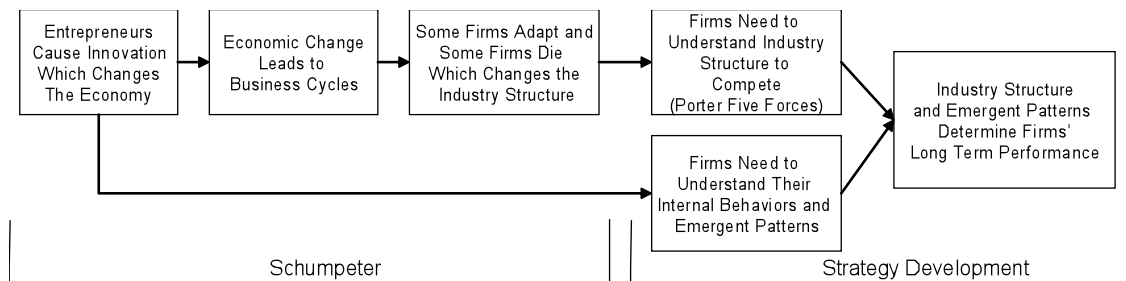
**Figure 10: Network of Authors and Impact on Business, Management, Economics, and/or Operations Research and Management Science**

## VI. DISCUSSION: ASSESSMENT OF FORWARD AND BACKWARD CASTING ANALYSES

The previous sections reviewed independent analyses of the influence of Schumpeter’s theories on modern fields and methodologies as well as the historical roots of strategy development. This section synthesizes the analyses into integrated observations about the links between Schumpeter and strategy development. The preceding analyses were purposely done independently of each other. They revealed weak links between Schumpeter and Strategy

Development. There was evidence from the forward analysis that a few minor authors in strategy development have cited Schumpeter. Meanwhile, a single direct link between Mintzberg and Schumpeter was uncovered through manual reference checking in the backward analysis. In Mintzberg's Spring 1999 article in *Sloan Management Review*, "Reflecting on the Strategy Process," he cites Schumpeter as a leader in what he calls the "Entrepreneurial" school of strategy formation. The article sought to describe ten schools of strategy formation, and assess whether any of the schools influenced modern strategy development. However, in the end, Mintzberg appears to quietly discount any strong Schumpeterian influence (Mintzberg and Lampel, 1999). Although the independent results are limited, the following section shows how a combined effort to look forward and backward reveals three main observations.

**The first observation is that there is a logical chain of ideas that flows from the work of Schumpeter to the scholars on strategy development.** Schumpeter's ideas are a logical antecedent to the ideas of Porter and Mintzberg. This chain was constructed based on the authors' understanding of important assertions of the scholars in question. Once this chain was established, additional literature was found that supported the ideas. Figure 11 outlines this chain of concepts. Schumpeter's ideas are descriptive. He explains how the innovative spirit within entrepreneurs drives technological innovation – therefore changing the economic landscape – and leads to the emergence of a new business cycle. Through these changes, those firms that can compete and adapt stay in the economy, while those that can no longer compete leave the market and forever change the structure of individual industries. The ideas in Strategy Development are a prescriptive response to these realities. Given the reality of business cycles, firms need a clever strategy that takes into account industry structure in order to improve long term performance. Meanwhile, because firms understand that it is the entrepreneur who initiates change, they need to understand their internal patterns to strategize on their role in the industry (e.g., a corporate technology strategy).



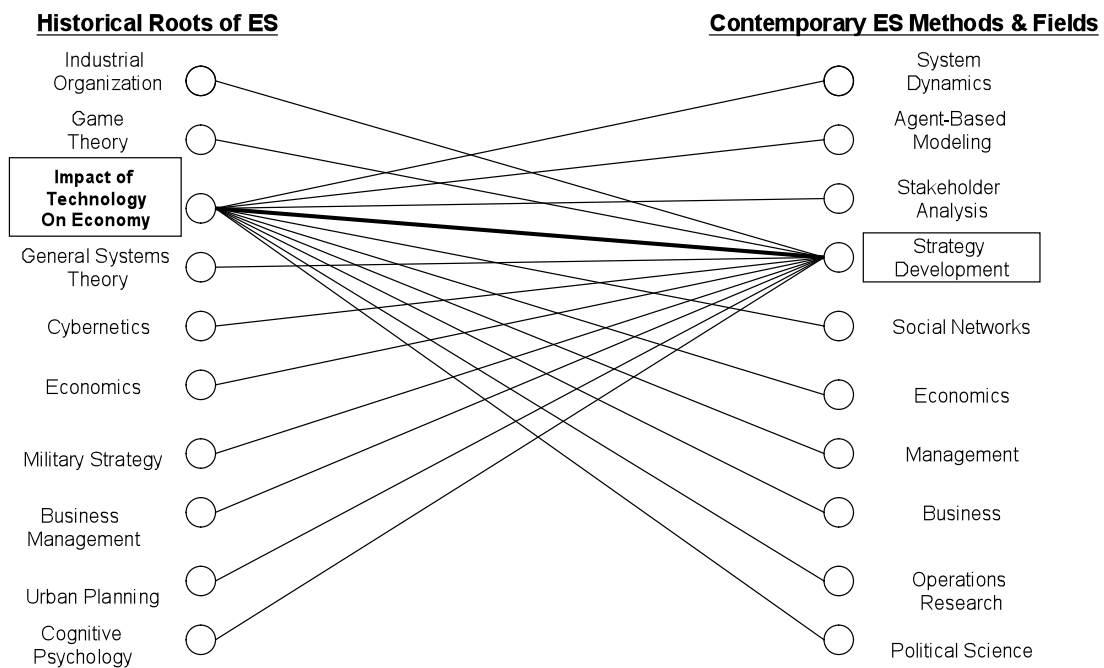
**Figure 11: Logical Flow of Concepts from Schumpeter to Strategy Development**

There is evidence that the strategy development community recognizes this logical chain. Work by Jay Barney, a contemporary of Porter and Mintzberg who works on strategy development, supports the construction of this logical chain of ideas. Barney built an integrated model linking Schumpeterian microeconomic theory, industrial organization, and a third economic theory in order to describe the types of forces a firm might face over time (Barney, 1986). Barney explains that firms live under the "constant threat" of Schumpeterian cycles, and therefore need thoughtful strategies. Note also that the Porter Model acknowledges the impact of technology on the economy as influencing industry structure, and therefore the way firms compete. Technology appears as a factor that shapes the Porter's Five Forces. Other strategy papers that focus on technology, entrepreneurialism, and competition also support this chain of logic (Itami and Numagami, 1992; Porter, 1985; Mintzberg and Waters, 1982).

**The second observation is that an integrated analysis of the links between Schumpeter and Porter reveals authors who cite both Schumpeter and Porter as foundational theory to their ideas.** Consider the example of Masafumi Ise in an article called "Entrepreneurial Innovation: Beyond Schumpeter" (Ise, 1995). Ise considers Schumpeter's model of an innovative entrepreneur as "one of the best known and accepted descriptive definitions of entrepreneurial innovation" (Ise, 1995). Ise takes Schumpeter's theory as a starting point and adds to it. He does the same thing with Porter's concept of a value chain. The contribution of the paper is to overlay Schumpeterian examples of innovation onto Porter's value chain. For Ise, Schumpeter and Porter are both trusted scholars who have contributed fundamental theories. Another example is Kenneth Lipartito who asks two questions in a 1993 article. The questions are, "How do firms contribute to technological innovation?" and "Does anything guarantee that firms will in fact remain innovative?" (Lipartito, 1993). Lipartito considers the work of both Porter and Schumpeter in order to address the second question.

**The third and final observation is that the link between Schumpeter’s theories about innovation and Strategy Development exists, but it is just one of many historical links flowing backward and forward for these fields.**

Figure 12 below shows a summary of the relationships identified in all the analyses of this project. The forward casting analysis for Schumpeter’s theories showed that his work has touched several contemporary engineering system methods. These include system dynamics, agent-based modeling, stakeholder analysis, social networks and strategy development. Schumpeter’s theories have also had a strong impact on contemporary economics, business, management, operations research, and political science. The backward casting analysis of Strategy Development as a method showed that this field drew from the following historical ES roots: industrial organization, game theory, general systems theory, cybernetics, and Schumpeter’s theories. Strategy Development is also strongly impacted by other historical fields including economics, military strategy, and management. Both Schumpeter’s work and strategy development clearly address questions that are fundamentally economic. Schumpeter’s work describes economic realities while strategy development advises managers on how to respond to economic realities. Finally, this figure shows that there is a great deal of interaction and cross-breeding between fields within the larger field of engineering systems.



**Figure 12: Links between Historical ES Roots and Modern ES Methodologies**

## VII. ROOT AND METHOD IN ACTION TODAY: EXAMPLES OF CURRENT APPLICATIONS

### a. Root: Schumpeter’s Work Alive Today

For evidence of how the work of Schumpeter is continued and applied today, consider the contributions of the International Joseph A. Schumpeter Society (ISS). Since 1986 this group, primarily composed of economists, has been striving to preserve and build on the theories of Schumpeter.<sup>2</sup> A review of some of the content from the 2006 Biennial conference of the ISS reveals examples of the domains in which Schumpeterian theories are applied. In each paper, the author explicitly acknowledges the work of Schumpeter. Author Kilicaslan, for example, uses data from forty-four countries to learn about the impact of labor market regulation on industrial performance (Kilicaslan, 2008). Meanwhile, Koleda’s work is about patent policy. Starting with Schumpeter’s “Growth Framework,” this author goes on to consider how requirements on novelty for patents can be used to encourage innovation (Koleda,

<sup>2</sup> For more information about the ISS, see their website at <http://www.iss-evec.de/information.htm> (Accessed November 10, 2008).

2008). Thirdly, Crespi compares innovation in manufacturing and service industries by considering data from six European countries (Crespi, 2008). These examples show that even within the community of economists, Schumpeter's work on innovation is applied to a variety of domains.

*b. Method: Strategy Development in Action*

For evidence of how strategy development as a method is practiced today, consider Porter and Reinhardt's application of a version of the Five Forces Model to climate change and firm success (Porter and Reinhardt, 2007). In this application, Porter and Reinhardt explain that current or future pricing of and regulations for greenhouse gas emissions will almost certainly infiltrate many, if not every, level of activity in a firm (varying according to their greenhouse gas intensities). Further, considering how to successfully perform in the new market is "best addressed with the tools of the strategist, not the philanthropist," (Porter and Reinhardt, 2007). They are referring to the fact that (to date) most firms have viewed climate change-related work as part of their corporate social responsibility activity chain. The job of the strategist will be to assess and reduce a firm's vulnerability to climate and related economic "shocks," but reach beyond simple operational effectiveness. The authors note that all affected firms will need to assess their costs and decide how to effectively redesign their operations to manage the change. However, for some firms, this change presents an opportunity to "enhance or extend their competitive positioning by creating products (such as hybrid cars) that exploit climate-induced demand, by leading the restructuring of their industries..." (Porter and Reinhardt, 2007). A call for using both the traditional Porter "outside-in," and the "inside-out," models for realizing this strategy is also present (Porter and Reinhardt, 2007).

## **VIII. CONCLUDING REMARKS**

This study has reviewed the content and historical context of Schumpeter, Porter, Mintzberg and related scholars. The review confirms that these scholars are eminent systems thinkers. Schumpeter demonstrated his prowess at systems thinking as he developed theories with progressively wider boundaries. During his career, he was able to consider the importance in the roles of individuals, firms and governments. The discussion on strategy development showed how scholars in this discipline gradually increased in their level of systems thinking. Both the transition from strategy planning to strategy development as well as the acknowledgement that a firm must understand its environment and its internal behavior show an increase in systems level awareness. The majority of this paper shows the details and peculiarities of Schumpeter, Porter and Mintzberg's ideas. By stepping back it is easily seen that these scholars were fundamentally pursuing the same goal – that of increasing the benefits to society of economic activity through systems thinking.



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