1.4.4.5.3 *Ontological Primacy* Embedded within Framework

> *"Of all the manifestos concerning the relationship of form and function, "**form follows function**" is surely the most famous, as well as being the most sweetly succinct. It is also one of the most **misinterpreted**. It is not a statement of importance, granting function a greater stature than form, but one of process: function must be discerned before form can be fashioned and, implicitly, to do otherwise would be **nonsensical**."*[177]

Finally, a note should be made regarding the assumptions on *ontological primacy* embedded within the framework presented. Although the framework appears to be presented as following the ideals of *institutional* as opposed to *neoclassical economic* approaches to strategy[178]; as following the ideals of *holism* as opposed to *reductionism*; as being led from the front by Aristotle's "*causa finalis*" (final cause) as opposed to being pushed from behind by the "*causa efficiens*" (efficient cause); as following the teleological notions that:

- *form* follows *function*
- *structure* follows *form*
- *performance* follows *structure*
- *environment* follows *performance*
- *function* follows *environment*
- (repeat…)

In reality, the framework is intended to acknowledge the cyclic interdependence of these variables, such that *emergence* is made possible.[179] In addition, the framework is intended to acknowledge the richness of multiple causality of the "product-producer" relationship, as opposed to the cause-effect relationship.[180]

[177] Richardson, A. (1993), pg. 35.
[178] Loveridge, R. (2003), pg. 99.
[179] Weidlich, W. (2000), pp. 13-21.
[180] Ackoff, R. (1981), pg. 21.

1.4.4.6 Framework as *Contingency* and *Configuration* Theories

> *"**Contingency** and **configuration** theories have received considerable attention, both in organizational theory and in **strategic management research**."*[181]

The framework attempts to re-engage and moderate the internal-external debate within the strategic management field by re-asserting the *contingency* and *configuration* theories as described in the following subsections.

> *"For many years, **contingency and configuration theorists** have asserted a connection between organizational **alignments and performance** (Burns and Stalker, 1961; Woodward, 1965; Lawrence and Lorsch, 1967; Miles and Snow, 1978; Mintzberg, 1979; Miller and Friesen, 1984.)"*[182]

Over the past 50 years, strategic management researchers have identified a range of factors that have been demonstrated to be influential in determining superior firm performance. These have progressed chronologically from the external factors of industrial organization economics (Bain, 1956) to the external-internal fit of contingency theory (Lawrence and Lorsch, 1967) to the internal factors of the resource-based view (Wernerfelt, 1984),

> *"*[the] *move from **external factors**, to **'fit' perspectives**, to **internal elements**... highlight the range of factors important to **superior performance**."*[183]

The shift away from contingency theory took place as theorists rediscovered the resource-based view, which manifested itself in practice as the "core competencies" movement of the 1980s and 1990s. This movement tended to focus on benchmarking dissected best practices from world-class companies, and attempting to copy them non-systemically, which was a noted departure from the holistic thinking of contingency theory. Recently, an number of notable academics at reputable institutions have called for a revisiting of the classical theories:

> *"Its one of the **oldest, most fundamental ideas in management theory**: that executives should understand how the many **distinct functional components** of a firm **interrelate** to achieve the **proper fit**. It is time to resurrect the idea of addressing the **part-whole relationship** of the firm. Without this **systemic** way of looking at companies, firms run the risk of engaging in compartmentalized thinking that can lead to the adoption of practices that are a poor fit and work to a firm's disadvantage."*[184]

While this research dissertation will appear to take the debate back along the intellectual pendulum towards environmental fit, as shown in Figure 89 below, it is hoped that a new light will be shed on contingency theory – particularly how and when external and internal factors interact via the enterprise architecture construct.

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[181] Powell, T.C. (1992), pg. 120.
[182] Powell, T.C. (1992), pg. 119 & 120.
[183] Rouse and Daellenbach (1999), pp. 487-488.
[184] Summary of the current research of Levinthal, D. and Siggelkow, N. at the University of Pennsylvania's Wharton School; in *Knowledge at Wharton*, May 17, 2006.

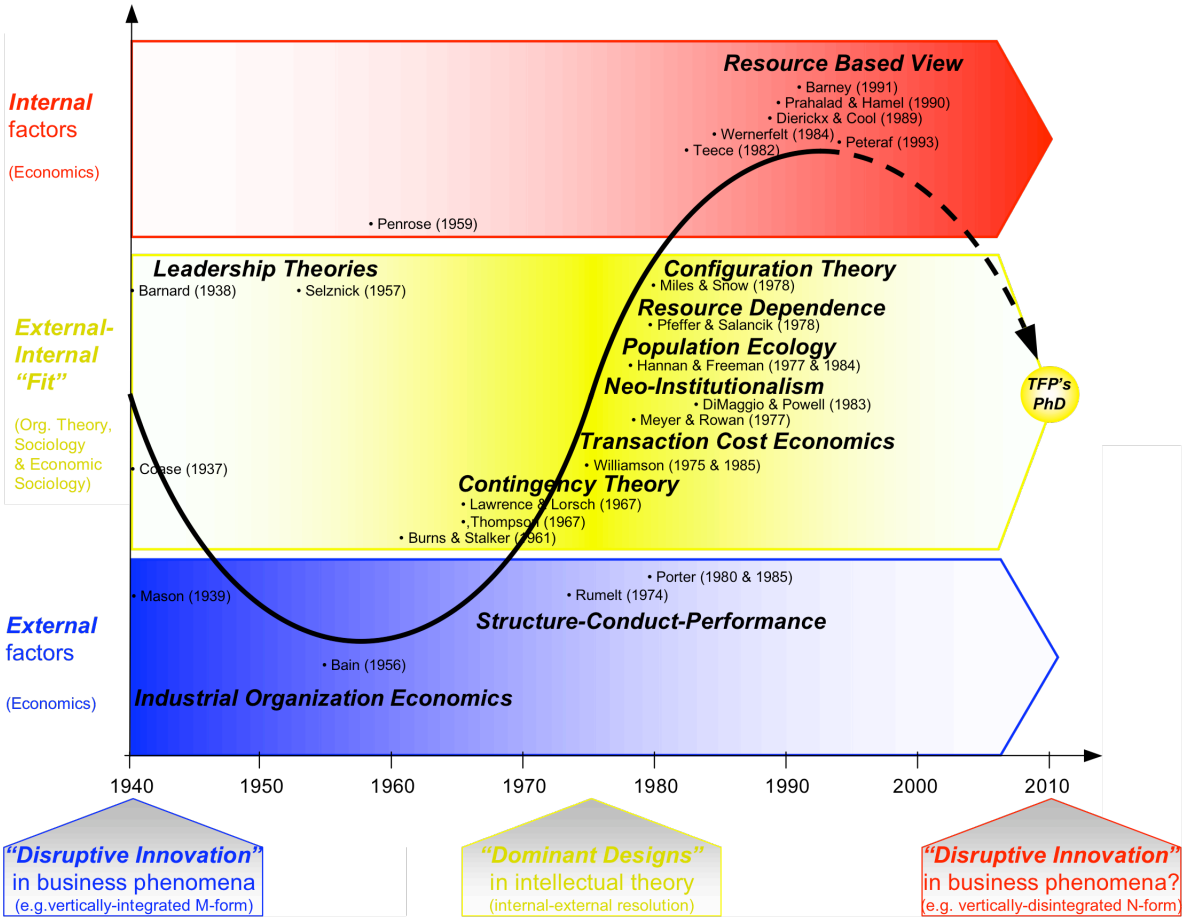

Figure 89: Intellectual "Double-Helix" in Strategic Management

Note that this research attempts to re-engage the sociological literatures which tend to focus on environmental "fit". While both contingency theory and population ecology tend to both agree on this feature, each differs as to the level at which change or adaptation takes place, with the contingency theorists focusing more on the organizational level in the form of "top-down" leadership and choice, and the population ecologists focusing more on the population level and the "bottom-up" leadership embedded in DNA (Levinthal, 1997).

1.4.4.6.1 Framework as *Contingency* Theory

> *"This is a **comparative study** of **six organizations** operating in the same industrial environment. The subsystems in each organization were differentiated from each other in terms of subsystem **formal structures**, the member's **goal orientation**, member's **time orientations** and member's **interpersonal orientations**. A relationship was found between the extent to which the states of **differentiation** and **integration** in each organization met the requirements of the **environment** and the **relative economic performance** of the organizations."*[185]

The above quotation, taken from the abstract of one of the most cited and influential pieces of research in the fields of strategic management and organizational theory, Lawrence and Lorsch's 1967 classic, "Differentiation and Integration in Complex Organizations," offers a close description of the research proposed herein.[186]

Like Lawrence and Lorsch's original work, this research also proposes a comparative study of six organizations, albeit in three pairs of organizations each operating in the same environments. In addition, this work proposes to identify differing member properties (e.g. goal- and time orientations) as characteristic of different architectural forms.

As will be discussed later in Chapter 2, although this research dissertation is founded on the basis of building grounded theory (in the same way as the original Lawrence and Lorsch work), it also serves to validate, refine and extend their original findings.

1.4.4.6.1.1 Endogenizing Lawrence and Lorsch

The proposed framework makes assertions (in the vein of contingency theory) that firm performance results from the alignment of *endogenous* organizational "design" variables with *exogenous* environment or context variables.[187] In fact, one of the aims of this research is to begin to endogenize the claims of contingency theory, in that contingent exogenous environmental variables can be endogenized causally, as shown in Figure 90 below.

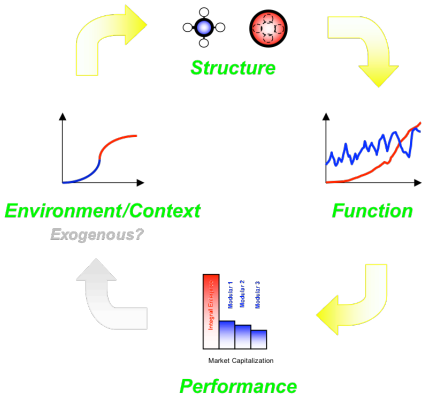

Figure 90: Framework as *Contingency* Theory

[185] Lawrence and Lorsch (1967), pg. 1.
[186] Lawrence and Lorsch (1967) was among the top 20 most influential works in the field of strategic management as determined in a bibliometric study by Ramos-Rodriguez & Ruiz-Navarro, (2004).
[187] The noted "problems" with contingency theory (Schoonhoven, 1981) will be addressed in the research.

On of the major differences of this research relative to classical contingency theory lies in its positing how firm performance endogenously shapes the environmental context, which in turn defines organizational form. Classical contingency theory (e.g. Lawrence and Lorsch, 1967) is essentially *variance* theory, in which the environment is a variable which moderates between the independent variable of firm structure and the dependent variable of firm performance.

As shown in Figure 91 below, the framework proposed herein explicitly endogenizes more of the environment, and in this sense is now an *inter*-organizational or "ecological contingency theory" as opposed to an *intra*-organizational "structural contingency theory." In this way, the framework is essentially *process* theory, whereby environment is not a moderating variable, but an interdependent variable. Crucially, classical contingency theory characterizes the environment using discontinuous states, whereby for example, environmental instability may or may not precede environmental stability. The framework presented herein however posits that states of environmental instability (i.e. increasing rates of quantity and quality growth) necessarily precede environmental stability (decreasing rates of quantity and quality growth), under conditions of logistic growth.

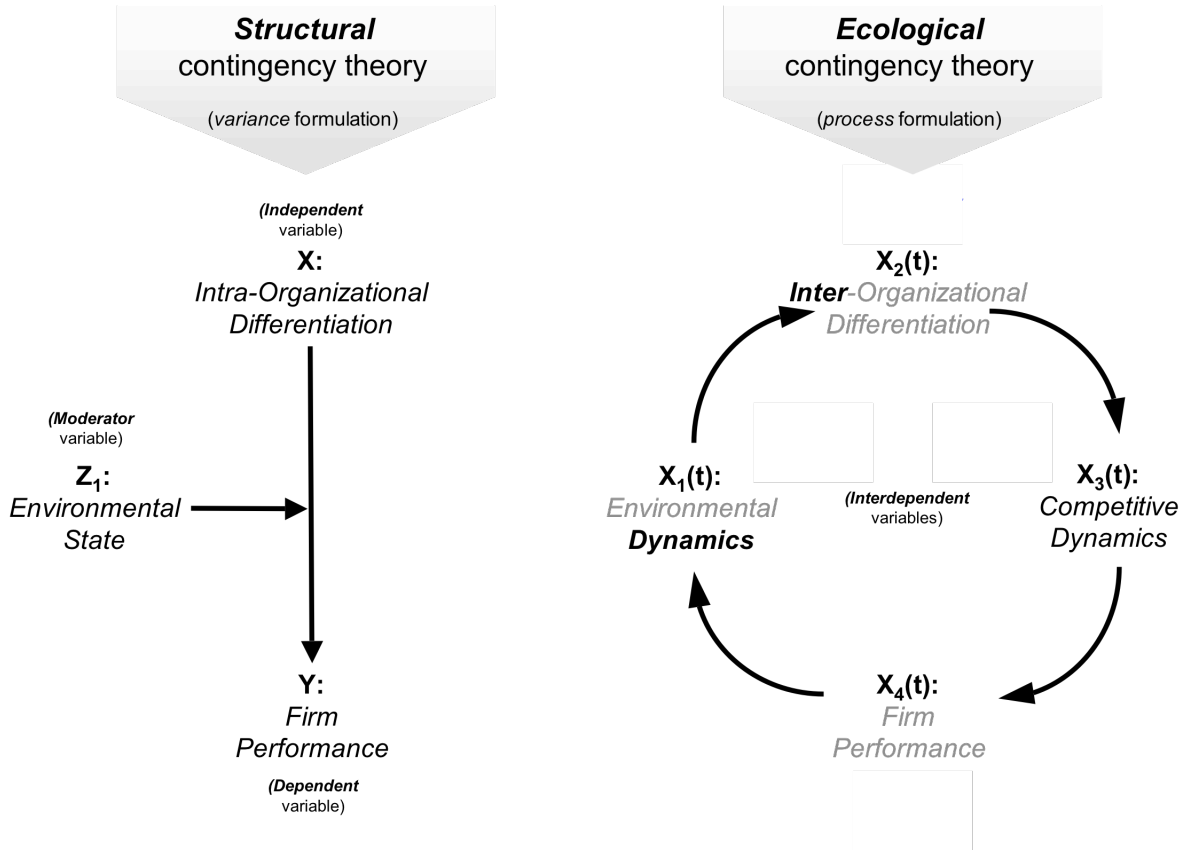

Figure 91: Comparing *Structural* vs. *Ecological* Contingency Theories

1.4.4.6.1.2 Differentiation and Integration in *Inter*-Firm Organizations

This research proposes to extend Lawrence and Lorsch's original ground-breaking research from the analysis of *firms* as "complex organizations" to the analysis of firms and their *extended enterprises* as "complex organizations". In this sense, this proposed extension of Lawrence and Lorsch's research searches for a contingent explanation for differentiation and integration as *inter*-firm as opposed to *intra*-firm phenomena, as shown in Figure 92 below.

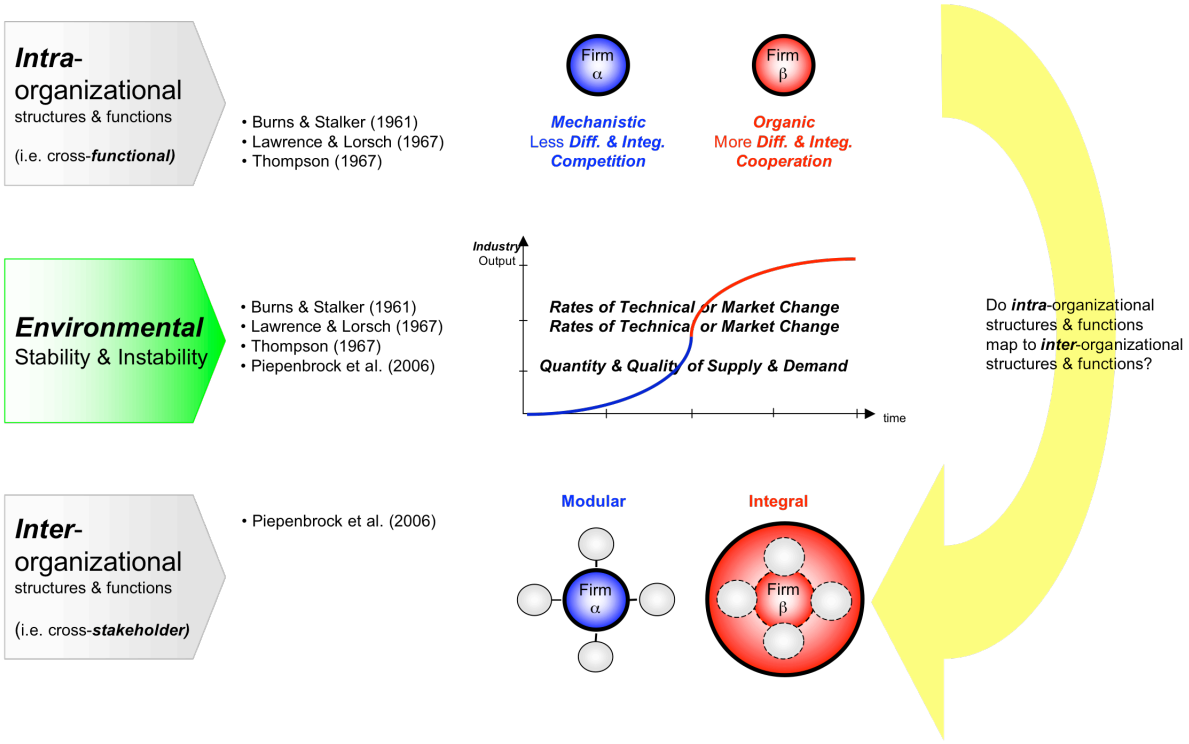

Figure 92: Situating the Framework within the Contingency Literature

1.4.4.6.1.3 Architecture-Context-Performance

At is simplest and most abstract level, this research points to a new form of the traditional *context-structure performance* relationships in contingency theory (Drazin and Van de Ven, 1985). As shown in Figure 93 below, this *architecture-context performance* relationship is hypothesized.[188]

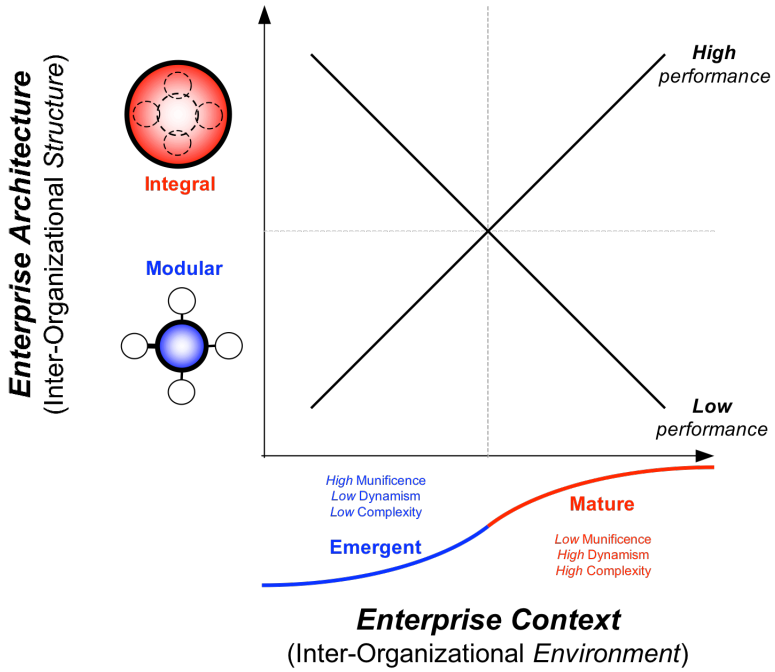

Figure 93: *Architecture-Context-Performance* Relationship

As will be discussed in greater detail in Part II, an "architect's dilemma" arises from this relationship. To summarize, there appears to be a general trend over time towards increasing pressure on enterprise architectures to "dis-integrate" as well as on environments to become more dynamically complex and thus requiring greater integration. This implies that there is a trend towards lower performance of incumbents, and towards greater opportunity for new firms (late entrants) to become dominant.

[188] Note: a more sophisticated version of this matrix discretizes context into three phases instead of two, whereby high performance is associated initially with integral architectures, then modular architectures, and finally integral architectures.

1.4.4.6.2 Framework as *Configuration* Theory

> *"People in [the **configuration] school**, in seeking to be **integrative**, cluster the various elements of our beast – the strategy-making process, the content of strategies, organizational structures and their contexts – into distinct **stages or episodes**, for example, of **entrepreneurial growth** or **stable maturity**, sometimes **sequenced over time** to describe the **life cycles of orgnizations**."*[189]

Configuration theory embraces rich, complex, holistic (not reductionistic) desciptions of organizations and their supporting environments.

> *"A **configuration** represents a number of specific and separate **attributes** which are meaningful **collectively** rather than individually.* [It] *represents a unique, **tightly integrated**, and therefore relatively **long-lived set of dynamics**."*[190]

From the previous brief description of the proposed meta-strategic framework, it is clear that our research attempts to build and test archetype or "configuration" theories in strategic management. The proposed archetypes include the enterprise architectures, their structural dynamics and competitive outcomes as well as the environmental characteristics which "grow" them.

> *"The use of configurations in studies of organizations allows researchers to express **complicated and interrelated relationships** among many variables without resorting to artificial oversimplification of the phenomenon of interest. Configurations are a means of achieving **parsimony** while presenting rich, complex descriptions of organizations."*[191]

Dess et al. (1993) note that strategic management researchers often present their constructs as *gestalts, configurations or archetypes*. This is similar to the way architects present their constructs – with architects defined as "specialists in the simplification of complexity" (Rechtin, 1999).

> *"Charles Darwin (1887:105) once distinguished 'splitters' from 'lumpers'. **Configuration** school people are **unabashed lumpers**: they see the world in terms of **nice, neat categories**. **Nuanced variability** is assumed away in favor of **overall clustering**; statistically speaking, **outliers are ignored in favor of central tendencies**."*[192]

Such a "lumped" architectural approach is important in the early "fuzzy front end" of theory development, but whose use must be bounded by an appreciation for value and the corresponding limits of parsimony.

> *"Everything should be made as **simple as possible**, but **no simpler**."*[193]

Some researchers also link organizational *transformation* as the logical complement to *configuration* (Mintzberg et al., 1998).

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[189] Mintzberg, H., Ahlstrand, B., and Lempel, J. (1998), pp. 6-7.
[190] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[191] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[192] Mintzberg, H., Ahlstrand, B., and Lempel, J. (1998), pg. 303.
[193] Albert Einstein, *The Evolution of Physics*.

1.4.4.6.2.1 *Configuration* Theory: beyond *Contingency* Theory

> *"The configurational approach makes a clean break from the **contingency mainstream**, within which researchers have been preoccupied with abstracting a **limited set of structural concepts** and measuring their relationships with a **limited set of abstracted situational concepts**."*[194]

At first glance, the multi-domain aspect of configuration theory appears to sound like contingency theory. However a closer inspection reveals that configuration theory is an intellectual advancement beyond contingency theory as it embraces the nonlinear dynamic and evolutionary nature of organizations.

> *"Our comparison of the assumptions underlying **contingency and configuration theories** can be likened to* [the] *distinction between the assumptions of **Newtonian physics** and those of emerging **chaos theories**. Like **contingency theorists**, those taking the Newtonian perspective envision a world where stability, order, uniformity, and equilibrium predominate. The important relationships are linear. In contrast, the **configurational approach** shares chaos theory's acknowledgement of 'disorder, instability, diversity, disequilibrium, nonlinear relationships, and temporality – a heightened sensitivity to the flows of time' (Prigogine and Stengers, 1984, pp. xvi-xv). A central insight of chaos theory is that patterns lurk beneath systems' seemingly random behaviors. **Chaos theorists call these patterns 'strange attractors'; organizational theorists call them configurations**."*[195]

1.4.4.6.2.2 Classifications of Organizations

> *"**Naming** something," said Alice to the Red Queen, "isn't the same thing as **explaining** it."*[196]

One of the more important roles of configuration research is to classify organizations, which aides in the development of theories in organization, and especially normative theories in strategic management.

> *"Classification systems provide a means for defining sets of **homogenous organizations** which should significantly **increase levels of explained variance of key variables** across organizations… By **aggregating** and organizing a large body of facts and data into a meaningful set, propositions and **theories may be developed**."*[197]

The constructs of enterprise architectures developed in this research dissertation are essentially configurations used for the aggregation of attributes and for the classification of homogenous organization types, in order to aid in the development of theories of their long-term competitive performance.

1.4.4.6.2.2.1 Single Domain *Taxonomies* and *Typologies*

In order to distinguish configurations from their "classification cousins" *taxonomies* (empirically-driven) and *typologies* (theoretically-driven), this research dissertation uses the definitions proposed by Dess et al., 1993).

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[194] Meyer, A.D. et al. (1993), pp. 1176-1177.
[195] Meyer, A.D. et al. (1993), pp. 1178-1179.
[196] Lewis Carroll's *Alice's Adventures in Wonderland*, cited in Meyer, A.D. et al. (1993), pg. 1180.
[197] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).

> *"A **typology or taxonomy** contains elements or items that represent a **single domain** or an aspect of organizations, such as environment, structure, or strategy… A **configuration** contains relationships among elements or items representing **multiple domains**."*[198]

Well-known typologies within the field of organization science include Burns and Stalker's (1961) mechanistic and organic forms, while Woodward (1958, 1965) and Thompson (1967) distinguished organizations based on the technologies they used. Additionally, Miles and Snow (1978) distinguished among four organization types based on their strategies: defenders, analyzers, prospectors and reactors.

1.4.4.6.2.2.2 Multiple Domain *Configurations*

> *"The **multidimensionality of constructs** used to describe **strategy phenomena** has always posed a challenge for researchers."*[199]

Although the definition of appropriate *domains* in strategic management is not exact, researchers (Miller, 1987) have offered theoretical justification for the four "imperatives" of: *environment, structure, strategy,* and *leadership*.

> *"Configurations exhibit great **stability** because of their internal logic, integrity, and **evolutionary momentum**."*[200]

Given these definitions of appropriate domains in strategic management, it will become clear throughout this dissertation that the enterprise architectural configurations will embrace these and others.

1.4.4.6.2.3 Theoretical Issues

When developing configuration theory, Dess et al. (1993) highlight three important theoretical issues which will be addressed in this research dissertation.

1.4.4.6.2.3.1 Dimensional Complexity

> *"As the number of dimensions of a construct increases arithmetically, the number of combinations increases geometrically… The theorist is forced to **simplify** by restricting each variable to a **dichotomy**."*[201]

However, such configuration research is not without its tradeoffs, particularly the costs of parsimony. As will be discussed in essay #1, the construct of enterprise architectures will have many possible variable combinations and therefore a multitude of possible forms. For simplicity, however, the construct will be presented as a continuous spectrum of possibilities, with the dichotomy of modular vs. integral being covered in great detail.

1.4.4.6.2.3.2 Causal Ambiguity

[198] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[199] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[200] Miller, D. (1987).
[201] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).

> *"When additional domains are added to the research question, the **difficulty in establishing causal relationships** is exacerbated. Typically, however, in the context of configuration research, such causal relationships among multiple variables are stipulated as **reciprocal and mutually reinforcing**."*[202]

As was illustrated previously in the framework summary, the enterprise architecture configuration was shown to ultimately and reflexively cause its own evolution in closed-loop feedback. This will be discussed further in essay #3.

1.4.4.6.2.3.3 Temporal Stability

> *"Configurations, because of the enduring themes that unify and organize them, are characterized by considerable **temporal stability**... In order to cause a change in a configuration, a '**revolution**' would be necessary."*[203]

Although it has been posited that configurations are stable through time, this does not mean they are in a state of static equilibrium. In fact, in essay #3, we will contend that they are in a state of dynamic equilibrium.

> *"Since it is theoretically possible to have **more than one successful organizational configuration**, even within an industry, an interesting research issue would be: Are certain types of **transitions easier** for organizations to accomplish than others? In other words, longitudinal studies may reveal certain patterns or **favored paths** that organizations follow as part of their **evolutionary dynamics**."*[204]

Essay #3 will discuss ecological diversity in which multiple competing enterprise architectures can co-exist, however at any given time, they will not be equally successful.

1.4.4.6.2.4 Methodological Issues

When developing configuration theory, Dess et al. (1993) highlight three important methodological issues which will be addressed in this research dissertation.

1.4.4.6.2.4.1 Construct Specification

> *"Configurations are inherently multidimensional entities in which key attributes are tightly interrelated and mutually reinforcing. The researcher's prime task involves disentangling these complex relationships and **isolation key constructs**."*[205]

As configurations are made up of component constructs, Dess et al. (1993) identified four major classification of constructs used in the strategy literature:

- environment (e.g. munificence, dynamism and complexity)
- structure (e.g. integration and differentiation)
- strategy process (e.g. rational and consensus)
- strategy content (e.g. differentiation and cost leadership)

[202] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[203] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[204] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[205] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).

> *"In empirical studies of configurations* [researchers] *use **cross-validation** of responses by comparisons between **different groups of executives** and comparisons with alternate measures derived from **secondary data sources**."*[206]

As will be discussed in Chapter 2, the research methodology will clearly be rooted in a multi-method approach which targets executives of multiple stakeholders within a given enterprise architecture.

1.4.4.6.2.4.2 Data Aggregation

> *"With the exception of **fine-grained research methodologies** such as **single case studies**, the analysis and interpretation of research is dependent upon the aggregation of data collected from many participants across firms. When such data are aggregated, the uniqueness or richness of each firm is **compromised**."*[207]

Again, as will be discussed in Chapter 2, the research dissertation is based on fine-grained research methodologies based on a small theoretical sample of case studies in order to preserve the richness of each firm.

1.4.4.6.2.4.3 Unit of Analysis

> *"Choices regarding the unit of analysis…could lead to what is often referred to as "**ecological fallacy**", i.e. attempting to make inferences at a specific level on the basis of data obtained and analyzed at a different level of aggregation."*[208]

As described in this chapter, the unit of analysis is the firm and its extended enterprise, in order to arrive at the dependent variable of firm performance. In order to mitigate the possibility of ecological fallacy (Datta, 1980), the research methodology described in chapter 2 collects and analyzes data from the firm and it primary stakeholders.

1.4.4.6.2.4.4 Research Methodologies

> *"**Longitudinal research designs** or **causal modeling techniques**…can be helpful in providing insights into multivariate relationships… **Longitudinal qualitative analysis** of organizations can provide **meaningful insights about the evolution of configurations** as well as the specific relationships among the construct within a configuration. Through **careful comparison of in-depth case studies**, it is possible to arrive **inductively** at relationships among environment, strategy, structure, processes and outcomes… Qualitative studies are extremely **labor intensive** and subject to potential problems such as **researcher bias** and **non-replicability**."*[209]

As described in chapter 2, the research methodology will embrace longitudinal qualitative methods as well as causal modeling techniques in order to capture the relationships between constructs within the enterprise architectural configuration as well as the evolution of the enterprise architectural configurations themselves.

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[206] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[207] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[208] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).
[209] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).

1.4.4.6.2.4.4.1 *Inductive* development

Ketchen Jr. et al. (1993). Ketchen Jr. et al. (1997).

> *"Others have deplored the prevalence in the literature of **'armchair typologies'** and **'fuzzy frameworks,'** which are characterized as **'pseudotheories'** formed by causal **induction** instead of rigorous deduction from theory."*[210]

1.4.4.6.2.4.4.2 *Deductive* development

Ketchen Jr. et al. (1993). Ketchen Jr. et al. (1997).

[210] Meyer, A.D. et al. (1993), pg. 1179.

1.4.4.7 Framework as *Three Essays*

The main body of this dissertation consists of three essays, each of which is devoted to the independent variables associated with function, structure and evolution as shown in Figure 94 below. Essay #1 defines a typology/taxonomy of enterprise architectural forms and functions. Essay #2 translates the static architectural properties into a deterministic structure which drives behavior. Finally, essay #3 defines the environmental events and processes which ultimately shape or "grow" the enterprise architectures.

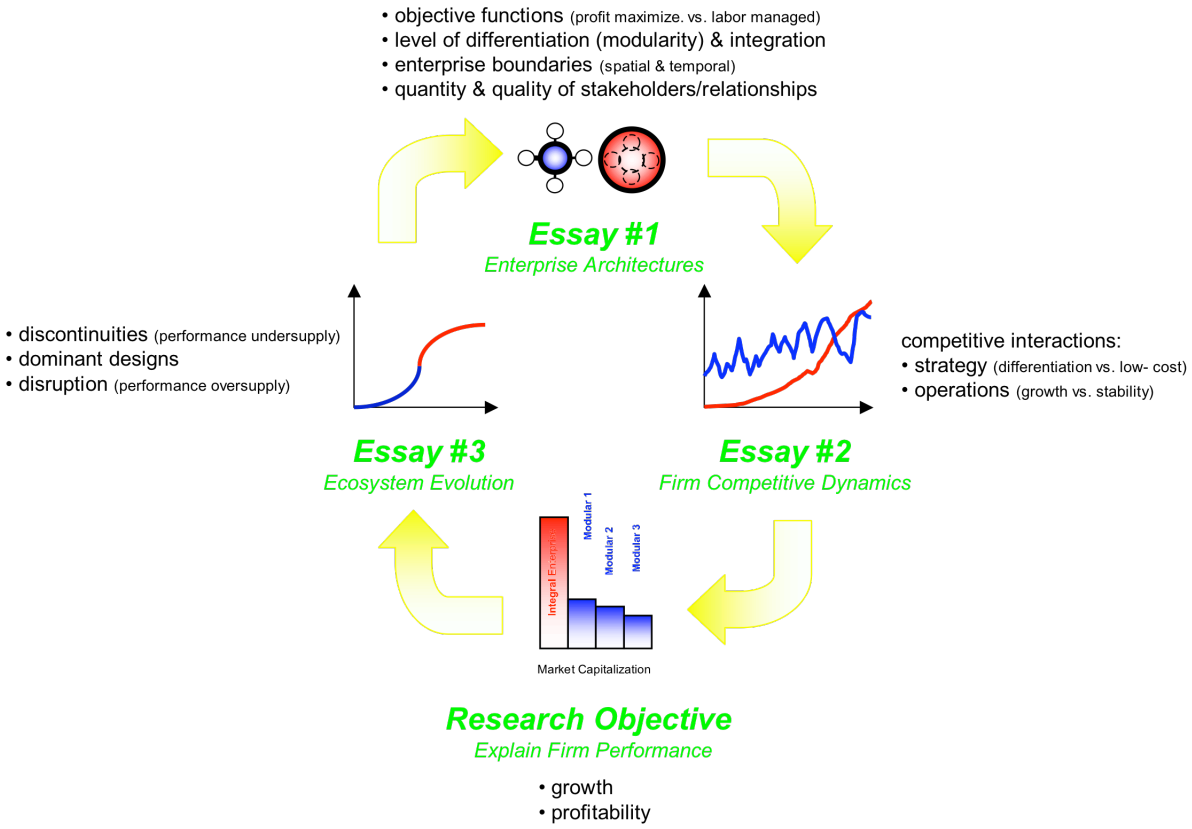

Figure 94: Layout of the Dissertation - *the Three Essays*

1.4.5 Aspects *of Theory*

The following discussion briefly discusses the five aspects of theory (Neuman, 2006, pp. 58-77) with respect to the framework proposed. The summary of the five aspects of the proposed theory is shown in

Figure 95 below.

Figure 95: Summary of the Five Aspects of the Proposed Framework

Direction of Theorizing	Deductive	***Inductive***	
Level of Analysis	Micro	***Meso***	***Macro***
Focus of Theory	Substantive	***Formal***	
Range of Operation	Empirical Generalization	***Middle-Range Theory***	***Theoretical Framework***
Form of Explanation	Interpretive	***Structural***	***Causal***

1.4.5.1 *Direction* of Theorizing

While the theorizing iterates both inductively and deductively, it clearly has an initial strong emphasis on *induction*, whereby concrete empirical evidence was gathered and molded into more abstratct concepts and theoretical relationships. The particular type of inductive social research used, was *grounded theory* (Glaser & Strauss, 1967; Eisenhardt, 1989) which emphasizes *comparison* in empirical observations.

1.4.5.2 *Level* of Analysis

Although much of the research gathers and analyzes data on a *micro*-level, which focuses on the face-to-face interactions among individuals or small groups over short time horizions (measured in days and months)[211], the primary level of analysis takes place on meso-and macro-levels.

1.4.5.2.1 *Meso*-level

The analysis is *meso*-level as it focuses on the relations, processes and structures of mid-leveel social phenomena (like organizations and extended enterprises) operating over moderate durations (measured in years, decades).

1.4.5.2.2 *Macro*-level

Finally, the analysis also approaches *macro*-level as it focuses on social institutions (e.g. international capital and labor markets) operating over long durations (measured in decades and centuries).

1.4.5.3 *Focus* of Theory

The focus of the theory is clearly *substantive*, as it aims to builds theory focused on a particular topic area of social phenomena: competition in business (firm-industry) ecosystems. The theory does begins to reach toward more *formal* theory, which focuses on more general processes or structures that operate across multiple areas of social phenomena: like competition in educational (university) ecosystems or competition in political (party) ecosystems.

Therefore, if the research domain is defined relatively narrowly as "business ecosystems", then the focus of the theory is *formal*, as it extends across mutiple industries (airplane, airline and automotive) and multiple sectors (manufacturing and services). If the research domain is defined more broadly as "social ecosystems", then the focus of the theory is *substantive*, as it explicitly covers business ecosystems but not explicitly educational or political ecosystems.

[211] One of the more important *micro-level* case studies that this research has uncovered is the process by which individual (or small teams of) leaders endeavored to transform a modular enterprise architecture into an integral enterprise architecture. This work is the subject of later publications.

1.4.5.4 *Range* of Operation

The range at which the theory operates beyond the rather narrow confines of *empirical generalization* and lies between *middle-range theory* and *theoretical frameworks*.

1.4.5.4.1 Middle-Range Theory

The research can be seen as middle-range theory (or more precisely, four middle-range theories). Within each "theory", the research has limited abstraction/range and is in the form of empirically verifyable statements. This is manifested in the linking of the construct sets (e.g. environmental fit, architectural forms, firm functions, and performance) to proposition sets.

1.4.5.4.2 Theoretical Framework

As an integrated theoretical framework, this research is a very general theoretical system with assumptions, concepts and social theories. Like, for example "structural functionalism" which purports that society is a system of interdependent parts that is in equilibrium, and over time it has evolved from a simple to a more complex form, with highly specialized parts, the theory of the evolution of business ecosystems purports that without limits to growth, similar evolutionary processes occur.

1.4.5.5 *Form* or Explanation

The explanation includes both *causal* and *structural* forms of explanation, and less *interpretative*. Due to the nature of the research as *theoretical framework*, a structural form of explanation is deemed most effective, with attempts at causal explanation also offered.

As the theory of the evolution of business ecosystems is ultimately a theory of evolution (based on Darwin's theory of evolution), it offers high-level process explanations (ased on variation, selection and retention) while not negating the need for individual causal explanations, it merely acknowledges the diffuculty in basing its theoretical explanation on traditional causal means.

> *"Darwin did not only proclaim that **species had evolved**, but also pointed to the **causal mechanisms of evolution**. **Darwinism invokes both a theory of natural selection and a universal commitment to causal explanations**. Darwin upheld that **complex outcomes** could be explained in terms of a **detailed succession and accumulation of step-by-step causal mechanisms**. In a paper of 1874, Huxley elaborated and generalized Darwin's argument as the '**doctrine of continuity**'. Under specific conditions, a broad and general version of Darwinism may apply to all **complex, open and evolving systems**. The possibility of **Universal Darwinism** suggests that such principles might apply to the **social sciences**, as well as to biology."*[212]

Such complex systems can be modeled deterimistically, yet exhibit chaotic or unpredictable outcomes. The theory herein (like Darwinism) is such a deterministic model, in that behavior is not pre-determined (i.e. it can not necessarily be predicted ex-ante), but it can be explained ex-post, without recourse to stochastic explanations.

> *"Statistical determination, as expressed in probabilities, does not imply the absense of a cause. As Bertold Brecht [said] '**Their movements are difficult to predict, or cannot be predicted, only because there are too many determinations, not because there are none**.' .We now know that non-lineaer systems addressed by chaos theory can simulate stochastic behavior. There are non-linear systems with such a high degree of sensitivity to initial conditions that no amount of accurate measurement of the appropriate parameter values can provide a sufficiently accurate prediction. It does not imply that events are necessarily predictable, or that any one set of events will always lead to the same, regular outcome. Furthermore the principle of determinacy does not imply a 'mechanistic' view... it upholds that **intentions are caused**."*[213]

[212] Hodgson, G.M. (2004), pp. 1-7.
[213] Hodgson, G.M. (2004), pp. 3-10.

1.4.5.5.1 *Structural* Explanations

Structural explanations differ from causal explanations in that they merely note where certain aspects of social life fit within a larger structure. Such *fit* can take the form of temporal fit or "sequential" theories, spatial fit or "network" theories, or "functional" theories.

> *"A **structural explanation** is a type of theoretical explanation about why events occur an how things work expressed by outlining an **overall structure** and emphasizing locations, **interdependencies**, distances, or relations among positions in that structure."*[214]

1.4.5.5.1.1 Sequential

Sequential theories communicate *temporal* structure and establish the order that events or stages occur, as in for example an organization's growth and death. It is not a causal explanation, as being in an earlier stage does not cause movement along the trajectory to the next stage.

This theoretical framework therefore goes beyond structural-sequential explanations that "maturity follows emergence" in an industry's life-cycle. Instead it offers causal explanations for the causal mechanisms driving the logistic S-curve (e.g. carrying capacities, reinforcing and balancing feedbacks).

1.4.5.5.1.2 Network

Network theories communicate *positional* structure, which are less central to the theoretical framework proposed herein.

1.4.5.5.1.3 Functional

Stinchcombe (1968, pg. 80) noted that a functional explanation is:

> *"one in which the **consequences** of some behavior or social arrangement are essential elements to the **causes** of that behavior."*[215]

Such closed-loop causality sounds like feedback in system dynamics, in which the analyst must identify the causal feedback loops by which the forces maintaining the structure are themselves activated by forces threating the equilibrium (Stinchcombe, 1968, pp. 88). The framework presented herein therefore can be expressed in the structural-functional format where structure (i.e. enterprise architecture) causes function (competitive dynamics), which in turn causes evolution.

> *"Functional theories often assume **long-term system survival** or **continuity** over time, with a need for balance or equilibrium for a system to continue smooth operation."*[216]

[214] Neuman, W.L. (2006), pg. 69.
[215] Neuman, W.L. (2006), pg. 72.
[216] Neuman, W.L. (2006), pg. 72.

> *"A functional theory of social change says that, over time, a social system moves through **developmental stages**, becoming increasingly **differentiated** and more **complex**. It evolves a specialized **divison of labor** and develops greater individualism. These developments create **greater efficiency** for the system as a whole."*[217]

1.4.5.5.2 *Causal* Explanation

In order to establish a causal explanation, three things must be established: temporal order, association, and the elimination of plausible alternatives. This dissertation aims to meet as many of these three as possible, but recognizes that full causal explanation will not be possible. Each will be briefly discussed in turn.

1.4.5.5.2.1 Temporal Order

While most causal relations are unidirectional in terms of cause and effect, the type of causality invoked in this research is recursive or reciprocal, as in the feedback rich models of system dynamics (Forrester, 1961).

> *"More **complex theories** specify reciprocal-effect causal relations – that is, a mutual causal relationship or simultaneous causality…or **feedback** relationships, but these are **difficult to test**."*[218]

1.4.5.5.2.2 Association

> *"Two phenomena are associated if **they occur together in a patterned way** or appear to act together. People sometime confuse correlation with association. Correlation has a specific technical meaning, whereas association hais a more general idea."*[219]

1.4.5.5.2.3 Elimination of Plausible Alternatives (*Spuriousness*)

> *"Eliminating all possible alternatives is **impossible**."*[220]

[217] Neuman, W.L. (2006), pg. 72.
[218] Neuman, W.L. (2006), pg. 65.
[219] Neuman, W.L. (2006), pg. 66.
[220] Neuman, W.L. (2006), pg. 66.

1.5 Bridging Intellectual Traditions: *Engineering Systems* & *Strategic Management*

1.5.1 *Engineering Systems*

While the research is designed to engage the academic field of *strategic management*, the intellectual bridges will be drawn from developed as well as emerging disciplines of *engineering systems*. This section therefore briefly outlines the research agenda for a bold new academic division at MIT - the *Engineering Systems Division*, and places this research plan within the context of ESD. It briefly explains why the ESD is uniquely placed to be the natural academic "home" to sponsor and supervise this research.[221]

1.5.1.1 *Engineering Systems* Defined

> *"We believe that it is important for industry, government, academia and other stakeholders…to work together to create a new field that we call Engineering Systems to develop a better understanding of the issues surrounding* ***large-scale, complex, technologically enabled systems****."*[222]

The ESD was born out of the increasing demands on the design of complex socio-technical systems (which also have significant socio-economic and socio-political components).

> *"The management of the enterprises that perform* ***design, manufacturing and operational processes*** *is a significant concern in the field. Furthermore,* ***the economic, social and political context*** *in which the engineering systems operate is a significant concern."*[223]

It is not a coincidence therefore, that the primary constructs used in this research plan: enterprise *architecture*, enterprise *structural dynamics* and the *industrial evolution* of the enterprise's environment all have their theoretical heritage rooted in "engineering systems".

> *"Engineering Systems is a field of study taking an* ***integrative holistic view*** *of* ***large-scale, complex, technologically-enabled systems*** *with significant* ***enterprise level interactions*** *and* ***socio-technical interfaces****."*[224]

An "engineering system", as conceived by the ESD, is comprised of the (micro-) product system, the (meso-) enterprise system, and the (macro-) environment system. This research plan therefore focuses on the meso-enterprise system[225] as the unit of analysis, as shown in Figure 96 below.

> *"The* ***interaction*** *between the* ***designing enterprise*** *and the engineering system is deep. While organizational theorists have well-developed theories of how organizations function and make decisions, this understanding needs to be* ***integrated*** *into the design phase in a quantifiable way."*[226]

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[221] Significant debate exists around this doctoral dissertation, regarding its natural home within a more traditional *management* or *business* school, and particularly within a strategic management department.
[222] Moses, J. (2004), pg. 3.
[223] Moses, J. (2004), pg. 2.
[224] Hastings, D. (2005), pg. 17.
[225] The enterprise system is sometimes referred to as an "extended enterprise" which includes the firm producing the product system and its key stakeholders, (e.g. customers, suppliers, investors, employees).
[226] Hastings. D. (2004), pg. 5.

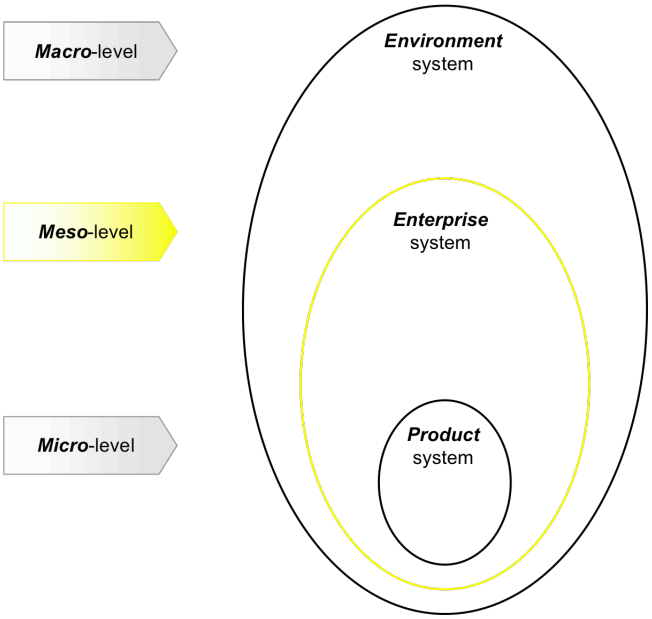

Figure 96: *General* research focus within the construct of an "engineering system"

1.5.1.2 Engineering Systems approach to Strategic Management

The following characteristics of engineering systems are particularly appropriate to the study of strategic management.

1.5.1.2.1 *Performance* as the Dependent Variable

A common characteristic shared between engineering systems and strategic management is the focus on *performance*, whether of products, product systems, production systems or enterprises performing these functions. When the notion of *relative* performance becomes relevant or important, then *competition* becomes important. This focus on competitive performance will be discussed in more detail later in the section on *enterprise architecting*.

1.5.1.2.2 Holism and Feedback Processes

> *"A particular feature in the Engineering Systems mode of thought is **holism**. That is, emphasizing the behavior of the whole in contrast to its parts. Holism lends itself to thinking about **appropriate abstractions** for describing and analyzing engineering systems as a whole."*[227]

This research dissertation therefore attempts to use holistic, non-reductionist thinking to bring heretofore absent "appropriate abstractions" (e.g. form, function, fit, etc.) to bear on the field of strategic management in order to explain long-term firm performance.

[227] Moses, J. (2004), pg. 1.

> *"Much attention is paid in the Engineering Systems mode of thought to certain **feedback processes**. For example, the organization of an enterprise can influence the architecture of the system it designs. Similarly, the architecture of a system can influence the organization of the enterprise."*[228]

In addition, this dissertation aims to entertain not a simple correlative approach, nor a linear open loop causal explanation for long-term firm performance, but a closed-loop feedback explanation via the development of an explanation for the evolution of business ecosystems.

1.5.1.2.3 Managing Change and the Life Cycle Perspective

> *"A key emphasis in the field is on **managing change**. Large-scale engineering systems tend to **change a great deal**, especially when we consider **long time frames**, such as the **entire lifetime** of the system. Engineering Systems takes a relatively **optimistic** view of ways of dealing with change. One way of managing change is to consider those aspects of the system that will remain relatively stable. For example, while the **overall function of the system may change dramatically** over time, its **macro-scale architecture may be relatively stable**."*[229]

Unlike many studies in the field of strategic management which tend to be cross-sectional, this research utilizes a longitudinal (including historical) approach examining long time frames in order to examine the entire lifetime of a system (firm and industry). In this way, it is hoped to determine whether or not the "system function" and its associated "macro-scale architecture" changed significantly over the life-cycle. In this way, this research hopes to re-engage the debate of social structure vs. agency in organizational theory.

1.5.1.2.4 The "-ilities"

> *"From the existing engineering science point of view, there are several **traditional** properties of engineering systems. These include: function, performance and cost. Engineering Systems emphasizes **non-traditional** properties or goals of systems, often called **'ilities.'** They usually arise from taking a **long-term or life-cycle** view of systems. These include: flexibility, robustness, etc."*[230]

The tendency of researchers in the field of strategic management is to focus on traditional short term properties of the firm like "profitability" expressed as various efficiency ratios like return on assets, return on equity, return on sales.

This research dissertation takes the long-term or life-cycle view of firms and their enterprise systems by focusing on the "non-traditional" properties of systems including the following "-ilities": flexibility, stability etc.

Therefore, although this research will use the traditional property of "profitability" as the primary dependent variable, it will focus on causal mechanisms which introduce the "-ilities" as independent variables.

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[228] Moses, J. (2004), pp. 1-2.
[229] Moses, J. (2004), pg. 1.
[230] Moses, J. (2004), pp. 6-7.

1.5.1.3 Engineering Systems sub-field: *Enterprise Architecture*

Within the emerging field of Engineering Systems, it is posited that the notion of "architecture" has theoretical relevance to all systems, whether natural or artificial, whether consciously designed or not. As shown in Figure 97 below[231], this doctoral research plan will attempt to contribute to a systems subfield called, *Enterprise Systems Architecture,* or *Enterprise Architecture* for short.[232]. The research attempts to address the architectures of "intellectual frameworks" on "organizational forms", where the organizations in question are "larger than single companies", namely *business ecosystems* as defined earlier.

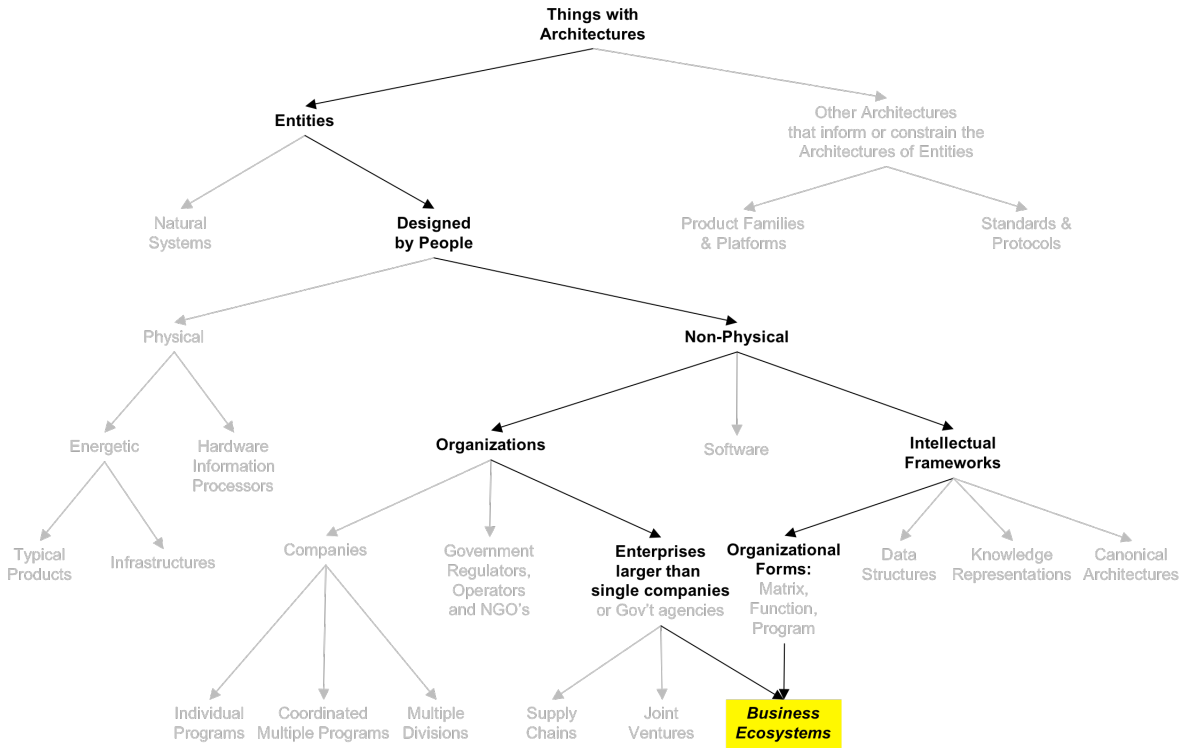

Figure 97: Decomposition of Architectures

> *"Architecture, especially* ***the architecture of the highest level*** *of an engineering system, is of great interest to Engineering Systems."*[233]

The proposed research will attempt to characterize enterprises at their the highest, most abstract level: i.e. their *form, function, structure* and *behavior* (both transient and steady state).

As will be discussed in more detail in Essay #1, this research will posit the construct of an *enterprise* architecture, which will draw concepts from *civil, product* and *system* architecture.

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[231] Adapted from Whitney, D. et al. (2004), pp. 15-16.
[232] The qualifying word "systems" is used to distinguish this endeavor from the growing body of research on "enterprise architecting" which represents a narrower IT space.
[233] Moses, J. (2004), pg. 8.

While these well-developed concepts tend to focus on the mapping of function to physical entities, the notion of enterprise architecture focuses primarily on mapping of function to organizational entities as shown in Figure 98 below.

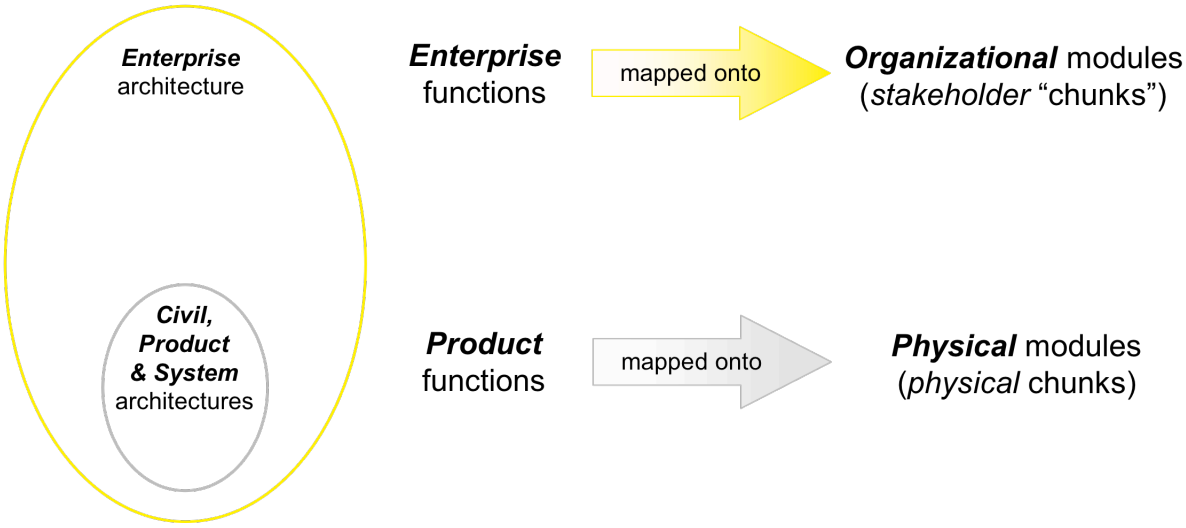

Figure 98: *Enterprise* Architecture vs. *Civil, Product & System* Architectures

Having defined an enterprise architecture, I will begin to explore questions that are central to the emerging field of enterprise architecting relating to the properties of architectures, as expressed by Nightingale and Rhodes (2004) below:

> *"How do you **architect enterprises** to optimize around certain properties? What enterprise architecture could **maximize long-term stability** of the enterprise versus what architecture would **maximize the flexibility of the enterprise in regard to its ability to design innovative new products**? Can a single enterprise model be 'optimized' for both such properties, or do we need to select for one over another?"*[234]

[234] Nightingale, D. and Rhodes, D. (2004), pp. 9-10.

1.5.1.3.1 Enterprise Architecting subfield: *Competition*

> *"In enterprise architecting we are faced with an important consideration: How do you architect an enterprise that can **most effectively produce** a desired 'product system'?"*[235]

By extension, an enterprise that is architected to effectively produce a desired product system, will exhibit higher long-term firm performance than other competing enterprise system architectures. The issue of enterprise architecture for effective product system delivery becomes one of enterprise architecture as an explanatory strategic variable for long-term firm competitive performance.

> *"Engineering systems are not designed, produced and operated in a vacuum. There are customers of these systems, **competing enterprises**, societal concerns and governmental policies that also need to be considered."*[236]

One of the primary academic contributions of this research therefore attempts to bridge the heretofore-separate intellectual traditions between *engineering systems* (an in particular, *systems architecting* and *system dynamics*) and *strategic management*.

The research focuses therefore the dynamics of competing meso-enterprise systems, on *complex, competitive enterprise architectures*[237], characterized as having differing architectural forms, as shown in Figure 99 below.

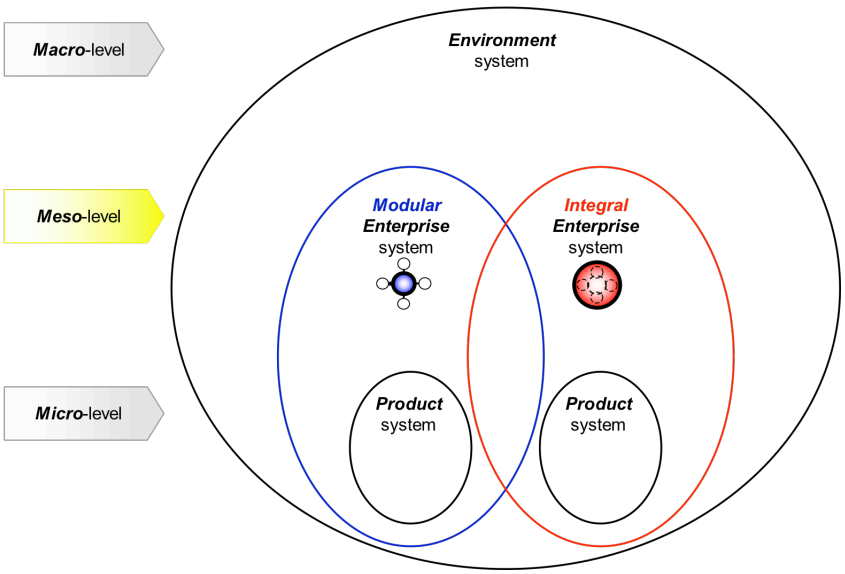

Figure 99: Specific research focus with the construct of an "engineering system"[238]

[235] Nightingale, D. and Rhodes, D. (2004), pp. 2.
[236] Moses, J. (2004), pg. 8.
[237] ESD Prof. Joe Sussman, furthered this concept in his white paper, "Home Run For LAI", July 8, 2005.
[238] Note that the overlap of the competing enterprises is shown to symbolically represent the fact that there are often sharing of key stakeholders among enterprise (e.g. customers, suppliers, investors, etc.).

1.5.1.3.2 Competition case study: *Boeing* vs. *Airbus*

> *"A Boeing-Airbus case study* [could be] *a* ***'home-run'*** [due to its]… ***high-visibility****... **international** frame of reference... multiple stakeholders interacting in **complex and subtle** ways... insights applied to **other domains**."*[239]

The primary case study in this research plan centers on the competition between *Boeing* and *Airbus*' global enterprises that design and manufacture large-scale, complex, technologically enabled systems. In addition, as these enterprises are embedded in complex economic, social and political contexts, it is appropriate that international faculty whose interests and expertise embrace these "non-engineering" disciplines, as well as engineering systems supervises the research.

1.5.1.4 Mapping Proposed Research onto ESD Intellectual "Topology"

Finally, in order to place this work within existing intellectual traditions, I note that in the spirit of ESD research, the work is intended to build systemic knowledge via bridges between heretofore disconnected academic disciplines.

As is seen in Figure 100 below, the proposed research draws upon - and lies in the intersection of - at least four academic areas identified by ESD[240]:

- Systems Analysis
- Systems Theory
- Organizational Theory
- Political Economy

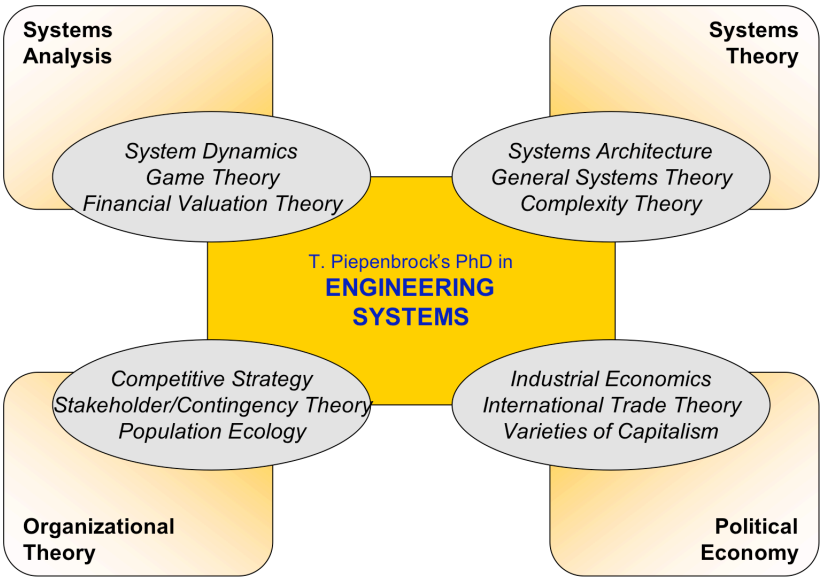

Figure 100: Proposed Research within ESD Intellectual "Topology"

[239] Joe Sussman, ibid.
[240] Hastings, D. (2005), pg. 17.

1.5.1.5 Firm-Industry Research Tradition

The research plan described herein builds on the academic tradition of MIT's *Engineering Systems Division* and its predecessor organizations in the scope of its studies of firms and industries as large-scale, complex, technologically-enabled systems with significant enterprise level interactions and socio-technical interfaces. ESD director, Prof. Dan Hastings gives the following examples of engineering systems:

> *"Examples of Engineering Systems include:* ***automobile*** *production systems,* ***aerospace*** *enterprise systems,* ***air transportation*** *systems…"*[241].

Figure 101 below shows examples of previous ESD research in each of these three domains:

- The *International Motor Vehicle Program's* (IMVP) study of the automotive industry, uncovered causal mechanisms of the emerging leader, *Toyota Motors.*[242]
- The *Lean Aerospace Initiative's* (LAI) studies of the aerospace industry[243] aim to uncover the causal mechanisms of its emerging leader, *Airbus Industrie*.
- The *Global Airline Industry*'s (GAI) study of the US airline industry, uncovering the causal mechanisms of the emerging leader, *Southwest Airlines.*[244]

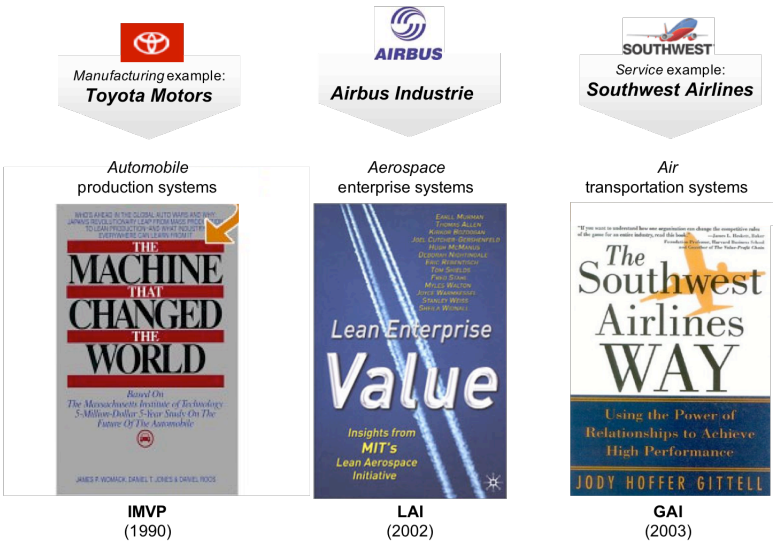

Figure 101: Case Study Building Blocks for Theory Development

As will be discussed later in the research methodology section, these three pieces of *firm-industry* research will form the basis of a theoretical sample upon which the grounded theory is developed and extended.

[241] Hastings, D. (2005), pg. 14.
[242] Womack, Jones and Roos, (1990).
[243] Murmann, E. et al. (2002).
[244] Hoffer-Gittell, J. (2003).

1.5.2 *Strategic Management*

Although the field of strategic management has had a rich intellectual history over the past 50 years, more recent critical debates have emerged among some of the field's most pre-eminent scholars which challenge its relevance and epistemological basis (Ghoshal, 2005; Kanter, 2005; Pfeffer, 2005; Hambrick, 2005; Mintzberg, 2005; Donaldson, 2005). This research dissertation is timely in that it attempts to address theses topical discussions.

> *"Over the last 50 years business school research has increasingly adopted the **'scientific' model** – an approach that Hayek (1989) described as the **'pretense of knowledge.'** This pretense has demanded theorizing based on **partialization of analysis**, the exclusion of any role for human intentionality or choice, and the use of **sharp assumptions** and **deductive reasoning** (Bailey and Ford, 1996)."*[245]

A recent paper, published posthumously by strategic management professor Sumantra Ghoshal (2005)[246] triggered an interesting academic debate among some of the leading academics in the field. Ghoshal critiques his own profession - business school academics - as contributing to the development of "bad management theories (which) are destroying good management practices." This research dissertation is designed to attempt to address the concerns articulated by these scholars.

1.5.2.1 **The Scientific Model** (and the "pretense of knowledge")

> *"Friedrich von Hayek dedicated his entire Nobel Memorial Lecture to the **danger posed by scientific pretensions in the analysis of social phenomena**. Because of the very nature of social phenomena, which Hayek described as '**phenomena of organized complexity**,' the application of scientific methods to such phenomena' are often most unscientific, and, beyond this, in these fields there are **definite limits to what we can expect science to achieve**.'"*[247]

> *"Why don't we actually acknowledge that **companies survive and prosper when they simultaneously pay attention to the interests of customers, employees, shareholders**, and perhaps the communities in which they operate? The honest answer is because such a perspective **cannot be elegantly modeled** – the math does not exist. **Such a theory would not readily yield sharp, testable propositions,** nor would it provide simple, reductionist prescriptions. With such a premise, the pretense of knowledge could not be protected. Business could not be treated as a science **and we would have to fall back on the wisdom of common sense that combines information on 'what is' with the imagination of 'what ought to be'** to develop both a practical understanding of and some pragmatic prescriptions for 'phenomena of organized complexity' that the issue of corporate governance represents. **This too is scholarship, but it yields theory that does not pretend to be scientific laws but merely serves as 'walking sticks'** – in Fritz Roethlisberger's (1977) terms – **to aid sensemaking as we go along, to be used only until a better walking stick can be found**."*[248]

> *"In describing himself and his work, Sigmund Freud wrote: 'You estimate me too highly. **I am not really a man of science,** not an experimenter and not a thinker. I am nothing but by temperament a conquistador – an adventurer' (in Jones, 1964, 171). Freud's **inductive and***

[245] Ghoshal, S. (2005), pp. 76-77.
[246] Professor of strategic management at the London Business School. Ghoshal received dual doctorates in management from the Massachusetts Institute of Technology and the Harvard Business School.
[247] Ghoshal, S. (2005), pg. 79.
[248] Ghoshal, S. (2005), pg. 81.

> ***iterative approach to sense making, often criticized for being ad hoc and unscientific, was scholarship of common sense***. *So indeed was Darwin's , who too practiced a model of research as* ***the work of a detective, not of an experimenter, who was driven by the passions of an adventurer, not those of a mathematician. Scholarship of common sense is the epistemology of disciplined imagination****, as advocated by Karl Weick (1989), and* ***not the epistemology of formalized falsification*** *that was the doctrine of Karl Popper (1968).*"[249]
>
> *"The trouble with the social sciences is that the* ***logic of falsification****, which is so very essential for the epistemology of positivism,* ***is very hard to apply with any degree of rigor and ruthlessness in domain of social theories***. *Typically, no theory – which are all, by definition, partial – explains a 'phenomenon of organized complexity' fully, and* ***many different and mutually inconsistent theories explain the same phenomenon****, often to very similar extents. As a result, nothing can be weeded out nor, given the very different framings, can anything be combined with anything else, except in a very synthetic and ad hoc manner.*"[250]
>
> *"The answer would help us understand the path toward replacing* ***'bad theories'*** *with better ones – or perhaps, I should say simpler theories with* ***more complex*** *ones, partial theories with* ***fuller explanations***. *I don't think ideas such as agency theory/economic man/shareholder rights/incentives as motivators are all wrong, and neither does Ghoshal. They are just* ***too simple and leave out too much***. "[251]

1.5.2.2 **Solving the Negative Problem** (and the "gloomy vision")

> *"These* ***negative assumptions*** *are manifest in the strong form of* ***determinism*** *in both* ***ecological*** *(e.g. Hannan and Freeman, 1977) and* ***institutional*** *(Di Maggio and Powell, 1983) analysis of organizations; in the* ***denial of the possibility of goal-directed adaptation*** *in behavioral theories of the firm (e.g. Cyert and March, 1963); in the focus on* ***value appropriation rather than value creation*** *in most theories of strategy (e.g. Porter, 1980); and in the assumptions about* ***shirking, opportunism, and inertia*** *in economic analysis of companies (e.g. Alchian and Demsetz, 1972; Williamson, 1975).*"[252]

[249] Ghoshal, S. (2005), pg. 79.
[250] Ghoshal, S. (2005), pg. 79.
[251] Kanter (2005), pp. 93-94.
[252] Ghoshal, S. (2005), pg. 82.

1.5.2.3 **Self-fulfilling Theories** (and the "double hermeneutic")

> *"All of this would not lead to any **negative consequences** for management practice but for the distinctive feature of **double hermeneutic** that characterizes the link between theory and practice in social domains. Unlike theories in **physical sciences**, theories in the social sciences tend to be **self-fulfilling** (Gergen, 1973). A theory of subatomic particles or of the universe – right or wrong – does not change the behaviors of those particles or of the universe. If a theory assumes that the sun goes around the earth, it does not change what the sun actually does. So, if the theory is wrong, the truth is preserved for discovery by someone else. In contrast, a management theory – if it gains sufficient currency – changes the behaviors of managers who start to act in accordance with the theory. Whether right or wrong to begin with, the theory can become right as **managers - who are both its subjects and its consumers** – adapt their behaviors to conform with the doctrine. "*[253]

When applying the scientific model to social domains, the object of the research (management *practice*) has the opportunity to implement the subject of research (management *theory*), which can lead to self-fulfillment (Ghoshal, 2005) as shown in Figure 102 below.

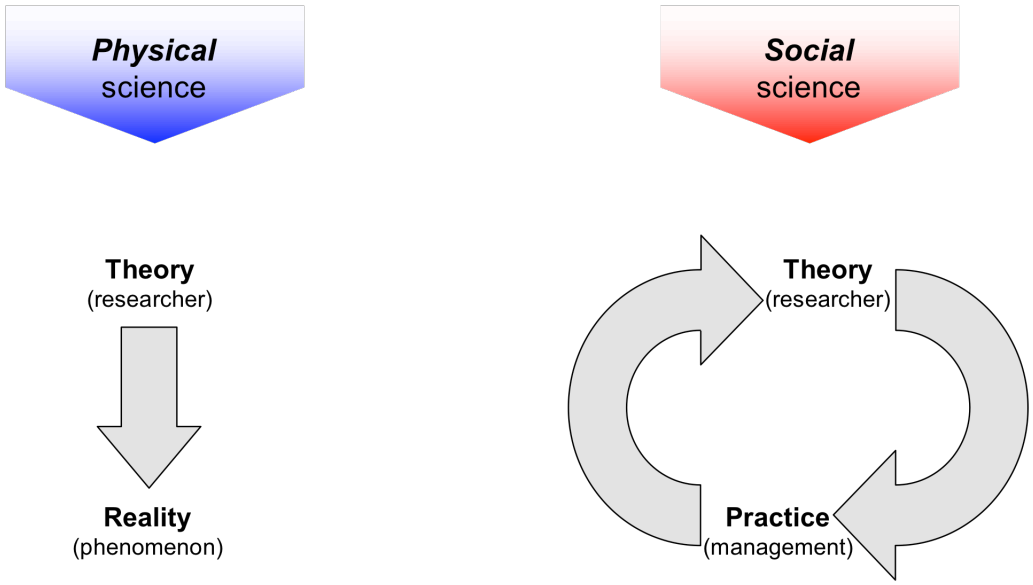

Figure 102: The Theory-Practice Double Hermeneutic in Social Science

> *"If you do not rest upon the good foundation of **nature**, you will labor with little honor and **less profit**."*[254]

[253] Ghoshal, S. (2005), pg. 77.
[254] Leonardo da Vinci.

1.5.3 Management / Engineering Knowledge *as an Example of the Framework*

Before proceeding into a discussion of the framework and its applications to competitive *business* environments, it is interesting to note its application to the competitive *academic* environments, namely the evolution of management / engineering knowledge.

1.5.3.1 Making "Intellectual Bricks" vs. Building "Cathedrals of Knowledge"

*"…the one will kill the other…**each mind is a mason**."*[255]

As shown in Figure 103 below, theory building can be thought of metaphorically as building buildings. One needs both structurally strong (i.e. rigorously derived and internally valid) components or "bricks" deduced from scientific reductionism as well as functional (i.e. relevant) systems induced from scientific holism. As the previous discussions on the current stalemate in strategic management reveal (Ghoshal, 2005 et al.), the intellectual pendulum has swung back towards the need to begin to reintegrate the bricks of knowledge.

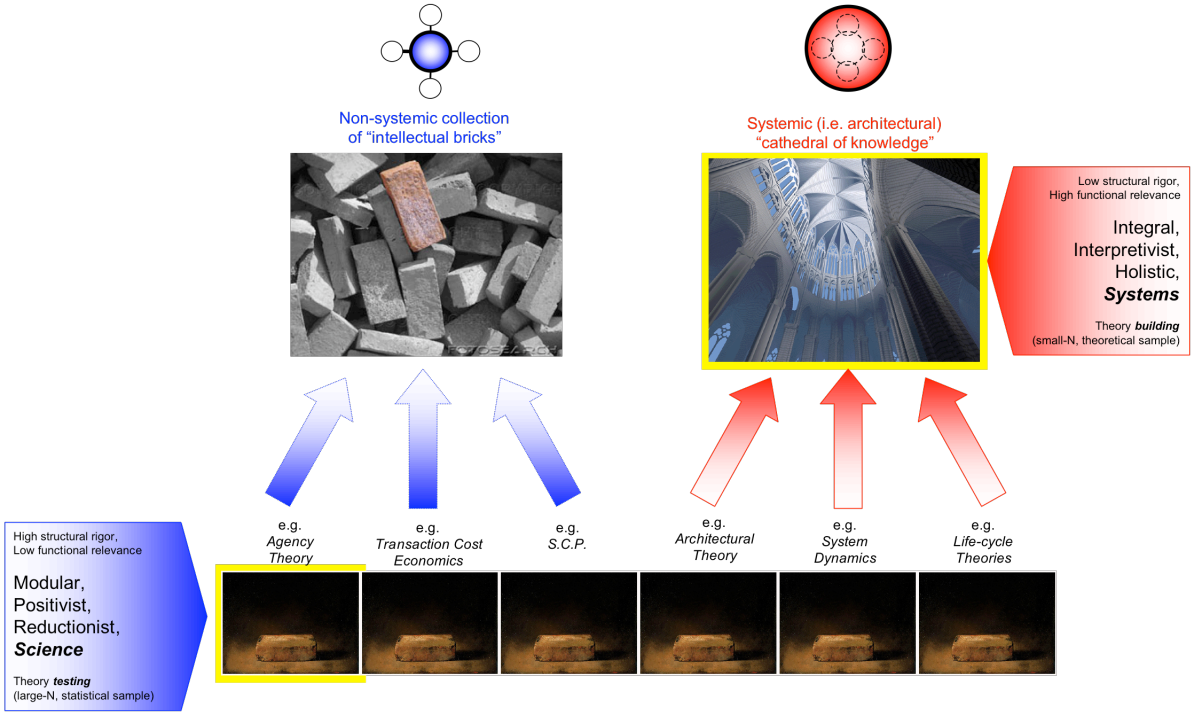

Figure 103: Making "Intellectual Bricks" vs. Building "Cathedrals of Knowledge"

This research takes as a point of departure, a collection of disconnected theories or well-established intellectual "bricks", which are each internally-valid enough to venture to assemble a structural system of knowledge which begins to have functional relevance and utility. One of the clear difficulties with endeavoring such "systemic" research is that scholars having specialized in building their strong "scientific" brick, are by definition

[255] Hugo, V. (1831) *Notre Dame de Paris*.

unfamiliar with other scientist's "bricks", and therefore demand a deep, narrow reductionist theory-testing approach to that second "brick". This is precisely why rigorous and relevant theories have yet to be built in complex socio-technical domains. A systemic framework or "cathedral of knowledge" consisting of say 100 bricks can never get beyond the second brick. The following observations from fellow academics reveal the dilemma:

> *"A PhD at the end of the day is the dedication of five years of your life to scientifically building a small, tight, impenetrable **brick** of knowledge in a very narrow, bounded intellectual domain."*[256]
>
> *"The frameworks that you suggest, are typically conceived by **emeritus professors**, near the end of their careers… but come to think of it, we **never really get around to it** … looking back on it all, the reality is that probably the most opportune time to conduct such 'big' research was **during our PhD years**."*[257]

1.5.3.2 Management / Engineering *Science* as *Modular* Enterprise Architecture

The deep and narrow functional specialisms of engineering science have grown up over the past half-century in concert with the "higher, faster, farther" demands of industry and government.

The organizational forms that deliver such *product* innovation tend to be *modular* enterprise architectures.

1.5.3.3 Management / Engineering *Systems* as *Integral* Enterprise Architecture

As the industrial and government customers begin to be "over-served" by the deep and narrow functional specialisms of engineering science, the educational ecosystem has evolved a complementary and symbiotically competitive architectural form which serves to integrate such knowledge from management / engineering science and other contextual disciplines in the form of engineering systems to serve the demands for "better, faster, cheaper" knowledge.

The organizational forms that deliver such *process* innovation tend to be *integral* enterprise architectures with long-term trust-based partnership between stakeholders such as academia, industry, government, etc. At MIT over the past 20 years, such separate integral enterprises like: the Technology and Policy Program (TPP), the Leaders for Manufacturing Program (LFM, the System Design and Management Program (SDM) have recently been brought under the umbrella of the integrating mechanism of the Engineering Systems Division (ESD).

This research therefore takes an integral enterprise architectural approach as shown in Figure 104 below, as the environments for knowledge in both the management and engineering fields appear to be more mature and therefore there is a need and opportunity to create innovative knowledge via integration or synthesis using inductive methods and via building long-term trust-based relationships with the phenomena under study.

[256] MIT Sloan PhD student, spring, 2005.
[257] Senior faculty member, fall 2004.

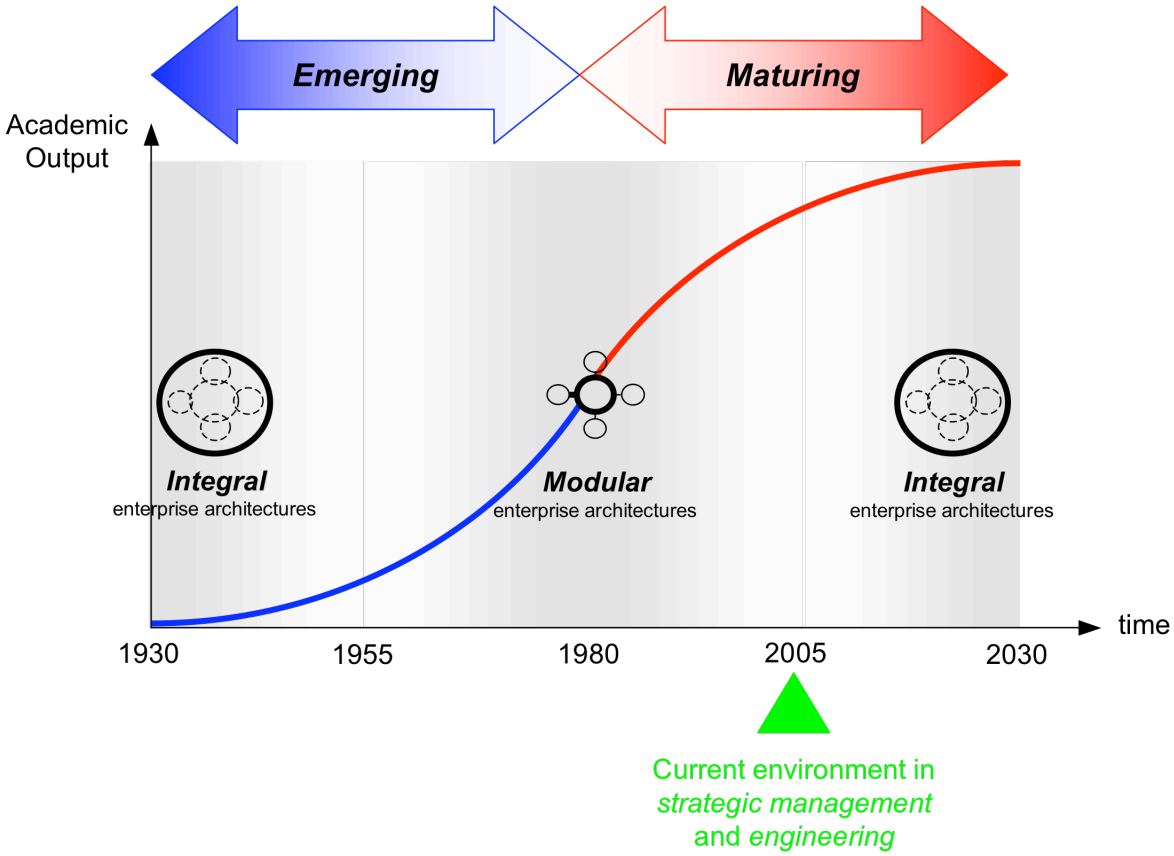

Figure 104: Dissertation as the Evolution of the Dominant Research Architecture

"Our primary endeavor as business school academics over the last half century has been to make business studies a branch of the social sciences (Schlossman, Sedlak, and Wecshler, 1998). Rejecting what we saw as the ***'romanticism'*** *of analyzing corporate behaviors in terms of the choices, actions and achievements of individuals (e.g. Andrews, 1980), we have adopted the* ***'scientific'*** *approach of trying to discover patterns and laws, and have replace all notions of human intentionality with a firm belief in causal determinism for explaining all aspects of corporate performance. Adoption of scientific methods has undoubtedly yielded some significant benefits for both our research and pedagogy, but the costs too have been high. Unfortunately, as philosophy of science makes clear,* ***it is an error to pretend that the methods of the physical sciences can be indiscriminately applied to business studies*** *because such a pretension ignores some fundamental differences that exist between the different academic disciplines."*[258]

[258] Ghoshal, S. (2005), pg. 77.

1.6 Literature Analysis

> *"Interesting research reported **contrarian** findings, disconfirmed established theories and challenged accepted assumptions. The lesson is that researchers should try to develop theories and gather data that disconfirm existing views. **Scholars must know the current body of knowledge but not champion it**."*[259]

1.6.1 *Previous Related Research*

There is clearly a considerable wealth of constituent research in the field of strategic management from two schools rooted in microeconomic theory: the Industrial Organization subfield dating back to Bain (1956) advanced the industry structure emphasis and on the resource-based view of the firm dating back to Penrose (1959), with their respective descendant proponents appearing a quarter century later in Porter (1980) and Wernerfelt (1984). Since this time, much research in this field has focused on the refinements of theories in each subfield, including: asset stock accumulation and dynamic capabilities (Dierickx and Cool, 1989; Teece, Pisano and Shuen, 1990).

> *"We need equally rich models of the **firm and the environment** that take both **organizational and economic** modes of explanation seriously."*[260]

Relatively little has been done in studying the longitudinal interactions between the firm and its environment, particularly with respect to developing grounded theory, and particularly with respect to embracing strategic management's primary constituent fields of economics and organizational theory.

> *"Fortunately, strategy researchers have always been willing to study subjects that **cut across existing conceptual boundaries**."*[261]

1.6.1.1 *Economics* and *Sociology* Literatures

In developing the concept of *enterprise architecture* and tying it to long-term firm performance, this research cuts across economic and sociological boundaries, embracing such diverse sources as: theory of the firm (Coase, 1937; Alchian and Demsetz, 1972; Williamson, 1985), agency theory (Jensen & Meckling, 1976; Fama, 1980), behavioral decision theory (Kahneman et al., 1982, Simon, 1982); organizational contingency theory (Lawrence and Lorsch, 1967), structural functionalism (Selznick, 1948), chaos theory in strategy (Levy, 1994), complexity theory in strategy (Stacey, 1995), structuration theory (Giddens, 1979; Whittington, 1992; Yates, 1997), institutional theory (Fligstein, 2001, Loveridge, 2003), institutional economics (Veblen, 1898; Commons, 1934), mixed duopoly economics (Law & Stewart, 1983; Mai & Hwang, 1989; Horowitz, 1991; Cremer & Crémer, 1992; Futagami & Okamura, 1994), macro- and international economics (Poire and Sabel, 1984; Thurow, 1992; Hall and Soskice, 2001), strategic complementarities (Milgrom and Roberts, 1990, 1995; Whittington et al., 1999), stakeholder theory of the firm (Follett, 1918; Freeman, 1984; Evan and Freeman, 1988; Ackoff, 1990; Donaldson and Preston, 1995;

[259] Daft R.L. and Lewin, A.Y. (1990), pp. 5-6.
[260] Henderson, R. and Mitchell, W. (1997), pg. 10.
[261] Henderson, R. and Mitchell, W, (1997), pg. 12.

Mitchell, Agle & Wood, 1997; Ramirez, 1999; Schilling, 2000; Freeman and McVea, 2006), trust, voice and exit (Hirschman, 1970; Helper, 1990; Sako and Helper, 1998), theory of the growth of the firm (Penrose, 1959; Forrester, 1966), general systems theory (von Bertalanffy, 1962) and systems view of the firm (Ashby, 1956; Forrester, 1961; Simon, 1969).

1.6.1.2 *Architecture* Literatures

In addition, *enterprise architecture* cuts across the many manifestations of "architecture" in management literature: e.g. complexity in- (Simon, 1962) building- (Alexander, 1964), product- (Ulrich, 1995), systems- (Meier and Rechtin, 2000; Nightingale and Rhodes, 2004), supply chain- (Novak and Eppinger, 1998), organizational- (Sanchez and Mahoney, 1996; Rechtin, 1999), human resource- (Lepak and Snell, 1999), innovation and- (Henderson and Clark, 1990), as well as the various interactions between architectures (Fine, 1998; Sako, 2003).

1.6.2 *Placement of Research within the* Strategic Management *Literature*

While the proposed research intends to engage the strategic management intellectual community, it attempts to do so via multi-disciplinary means, bridging both the economics and sociology literatures.

Appendix C illustrates this placement by highlighting those works of the 50 most cited publications in strategic management (Ramos-Rodriguez and Ruiz-Navarro, 2004) that have had the greatest impact on this dissertation.

1.6.3 *Placement of the* Proposed Framework *within the Literatures*

1.6.3.1 Framework as *Typology* (capturing the *internal-external* debate)

The framework proposes a typology of organizational sets, which has closest links to the following typologies:

- Political Economy: "Varieties of Capitalism" (e.g. Hall and Soskice, 2001)
  - Liberal Market Economy (LME) vs.
  - Coordinated Market Economy (CME)

- Economics: "Mixed Duopoly" (e.g. Lambertini and Rossini, 1998)
  - Profit Maximizer (PM) vs.
  - Labour Managed (LM)

- Sociology: "Contingency Theory" (e.g. Burns and Stalker, 1961)
  - Mechanistic vs.
  - Organic

1.6.3.2 Framework as *Evolution* (capturing the *adaptation-determinism* debate)

The framework proposes a theory of the evolution of the organizational sets, which has closest links to the following theories:

- Population / Community Ecology (e.g. Hannan and Freeman, 1977)
- Evolutionary Economics (e.g. Nelson and Winter, 1982)

In order to begin to place the research and its proposed framework within the academic literatures, Figure 105 below summarizes in stylized form a sample of some of the main influences at the intersections between the key constructs.

Figure 105: Placement of the *Framework* within the Academic Literatures

1.6.4 *Gaps in Literature*

> *"Unfortunately there is **relatively little research** that explicitly considers how capabilities and environments jointly shape each other… Clearly, **far more work remains** to explore the reciprocal relationship between capabilities and competition."*[262]

> *"I **scoured the literature** of the theory of the firm in theoretical economics for discussions of [the growth of the firm] with **increasing frustration**."*[263]

While each of the aforementioned references represents well-developed areas of domain knowledge, the interconnections among them have not yet been seriously explored. It is the space in between existing disciplines that this research attempts to exploit. If any research innovations are to be found in this research dissertation, they would lie in a framework which connects the disconnected, which re-members the dismembered, which integrates the disintegrated.

> *"Each of the research programs* [in strategic management] *has focused on a different element of the strategy picture: environment, resources, and organizational structure. This division of labor between programs of research has facilitated **scientific progress – but at a price**."*[264]

While there is a clear wealth of research from diverse theoretic sources - each providing different explanations for long-term firm performance - there is relatively little research in the strategic management literature providing more systemic, meta-theoretical frameworks which capture the plurality and complexity of performance causality into a unifying meta-strategic framework.

> *"This loudly divided counsel on the best strategy…reflects a certain troubling inadequacy in both perception and understanding. Of course, we do not mean that a good case cannot be made for some of these remedies. We mean, rather, that the sheer cacophony of prescription is itself evidence of a broad-based failure of interpretation, an inability or unwillingness to see that* [long-term firm performance] ***defies the standard categories of analysis and discussion**."*[265]

Gaps in the strategic management literature therefore exist in the synthesis and reconciliation of existing competing theories, as well as in bringing existing theories from other non-strategy (and in fact, non-management) sources like *systems architecting*.

> *"Much **exciting theoretical and empirical work** remains in coupling **dominant designs** and **technology cycles** to **environmental conditions and organizational evolution**."*[266]

> [Miller, 1986] *"…represented an early attempt to apply the approach of configuration to the field of strategy. Now, 10 years later, **we still have far to go**. What is **often lacking** from the configurational literature is the search for the configuration itself: for **complex systems of interdependency** and their **core orchestrating themes**."*[267]

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[262] Henderson, R. and Mitchell, W. (1997), pp. 10 and 11.
[263] Penrose, E. (1985).
[264] Farjoun, M. (2002), pp. 566.
[265] Abernathy, W., Clark, K. and Kantrow, A., *Industrial Renaissance: Producing a Competitive Future for America,* Basic Books Inc., New York, 1983, pp. 3-4.
[266] Tushman, M. and Murmann (1998).
[267] Miller, D. (1996), pg. 505.

1.6.5 *Contributions to Literature*

The primary contribution that this research aims to make is in bridging two heretofore separate and distinct academic and theoretical fields: *strategic management* and the emerging field of engineering systems, and in particular, *systems architecting* and *system dynamics*.

> *"In addition to the integration gained by the increased recognition of reciprocal causation,* ***integrative frameworks*** *have offered more eclectic views of concepts and phenomena, linked* ***previously disconnected constructs*** *and levels of analysis, and attempted to further the* ***bridging of fragmented models****."*[268]

The innovations that this research attempts to bring to the field of strategic management include:

- The notion of architecture applied to the extended enterprise.
- The notion that these enterprise architectures cause firm dynamics.
- The notion that these firm dynamics cause long term firm performance
- The notion of a "dominant design" applied to the extended enterprise architectures in the evolution of the industry.
- The development of and distinction between two types of organizational inertia: architectural and structural.

1.6.5.1 *Theoretical* Contributions to Literature

The three primary theoretical contributions to the strategic management and emergent engineering systems literatures are:

The first is the introduction of the heretofore-absent theoretical construct of *enterprise architecture* as an explanation for long-term firm performance. This construct acts both to unify other disconnected theories as well as to simplify the complexity of long-term firm performance.

> *"The* ***architecture*** *is the form of the system and is the* ***dominant factor*** *in its* ***behavior****."*[269]

The second theoretical contribution is the linkage of enterprise *architectural form* to the enterprise *structural dynamics* of stability and growth, which in turn impact long-term performance. In this sense, it is a modest theoretical extension and generalization of Edith Penrose's seminal work on the growth of the firm.[270]

Finally, the third theoretical contribution is the feedback linkage between architectural form, structural dynamics and firm performance to the dynamic evolution of the *industrial environment.*

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[268] Farjoun, M. (2002), pp. 569.
[269] Whitney D. et al, (2004), pg. 26.
[270] Penrose, E. (1959).

1.6.5.2 *Empirical* Contributions to Literature

> *"Considerable attention has recently been devoted to understanding behavior in large organizational systems. Although some of this work has been based on research, it has more typically been general theorizing with* ***little support from research data****. Our interest in examining complex organizations is to study* ***more systematically and empirically*** *their* ***internal*** *functioning in relation to the demands of the external environment on the organization and the ability of the organization to cope effectively with these demands, contributing* ***to a theory of the functioning of large organizations*** *based on* ***empirical research****."*[271]

As was discussed previously, this research dissertation attempts to validate and extend the ground breaking research performed by Lawrence and Lorsch (1967). Nearly forty years after their work, there is still little empirical data to support theories on large organizational systems.[272]

Like their original work, this dissertation is based empirically in building grounded theory. However, unlike their original research, this dissertation is interested in the phenomenon of the *external* (i.e. *inter*-firm) functioning of large organizational systems (or "extended enterprises"), as opposed to the internal functioning (i.e. *intra*-firm) functioning of large organizational systems (or "firms").

As will be discussed later, the theoretical nature of this dissertation will be grounded in extensive empirical work. As such, it is envisaged that there will be empirical contributions to be made, particularly in support of the theoretical work surrounding the shareholder vs. stakeholder debate – particularly by explaining how, when and why each model seems to be more competitively dominant.

The following is a partial list of some of the empirical contributions that this dissertation begins to make to the existing theoretical literature:

- Empirical evidence to begin to validate and extend Lawrence and Lorsch's (1967) structural contingency theories regarding differentiation and integration as *intra*-firm mechanisms to *inter*-firm mechanisms.

- Empirical evidence to begin to *endogenize* Lawrence and Lorsch's (1967) contingency theory – namely to explain what drives the dominance of differentiation and intergration and when this dominance switches between the two.

- Empirical evidence to begin to identify and explain variation of enterprise architectural *forms* in population ecology (Hannan and Freeman, 1977) and to demonstrate that certain *late entrants* do not have high mortality rates as the theory suggests, but not only do they survive, they go on to dominate the industry.

[271] Lawrence, P.R. and Lorsch, J.W. (1967), pg. 2.
[272] Lawrence, P.R. and Lorsch, J.W. (1967), pg. 2 cite the following seminal studies: Burns and Stalker (1961), and Rice, A. (1965).

- Empirical evidence to begin to support Pfeffer and Salancik's (1978) claims of resource dependence. As the authors themselves lament, 25 years after the publishing of their influeitial work:

"The image presented is one of ***dynamic interaction and evolution of organizations, environments, and interorganizational relations over time*** *as the various actors maneuver for advantage. Again the limits of both authors' methodological training and the available empirical methods and data did not result in* ***explicitly dynamic models*** *showing the evolution of both environments and ourganizational decisions and structures over time…Yet there is a* ***limited amount of empirical work explicitly extending and testing resource dependence theory*** *and its central tenets."*[273]

- Empirical evidence to begin to contextualize and revese the findings Arthur's (1992) and Delery and Doty's (1996) research in Strategic Human Resource Management that "*high commitment*" workforces tend to have *differentiation* strategies.

- Empirical evidence to begin to lend support to Penrose's (1959) theoretical hypotheses that firms have a *stakeholder* approach will differ in competitiveness, commitment, and strategic flexibility from firms that maximize *stockholder* wealth.

- Empirical evidence to begin to lend support to Forrester's (1961) theoretical hypotheses regarding the existence of firm strategies centered around attracting a particular portion of the underlying market demand.

- Empirical evidence to begin to validate the work on strategic complementarities (e.g Milgrom and Roberts, 1990 and 1995).

"We are hopeful that ***empirical work*** *will provide evidence of* ***distinctly separated clusters of firm characteristics*** *as support for our theory. Given our assumptions about* ***time trends in prices****, we also expect to find an increasing proportion of manufacturing firms adopting the* ***modern manufacturing strategic cluster*** *that we have described.."*[274]

- Empirical evidence to begin to validate the recent work in mixed duopoly economics (e.g. Lambertini & Rossini, 1995) which models the strategic interaction between profit-maximizing (PM) and labor-managed (LM) firms.

- Empirical evidence to demonstrate that *intra*-market economy variation can exist and in fact dominate an industry, supporting the "Varieties of Capitalism" theory (Hall and Soskice, 2001) that international political-economic convergence is not occuring as "Corporatism" would suggest. The case study of *Southwest Airlines* (a *Coordinated market firm*) exists within a *Liberal market economy* (LME).

- Empirical evidence and theoretical framework to demonstrate the concept of "Sustainable" Corporate Social Responsibility (CSR).

[273] Pfeffer and Salancik, (1978), pgs. xii and xvi.
[274] Milgrom and Roberts, (1990), pg. 527.

- Empirical evidence to support the claims of Lenox, Rockart and Lewin's (2006) numerical simulation models which postulate a relationship between environmental interdependencies and firm and industry profitability.

1.6.5.3 *Research Methods* Contributions to Literature

As will be discussed in detail in chapter 2, this research aims to contribute to the literature on appropriate and innovative research methods when studying complex socio-technical systems.

Few research designs in strategic management incorporate longitudinal field studies across several organizations that comprise the firm and its extended enterprise, as well as those of its competitor.

In addition, few research designs in strategic management view the phenomenon simultaneously from strategic, political and cultural lenses, which entails a combination of both unobtrusive ethnographic and obtrusive clinical methods.

1.6.6 *Publication Plan*

It is envisaged that this research would form the basis for both academic and practitioner publications both in book and journal article forms.

1.6.6.1 Journal Articles

1.6.6.1.1 *Academic* Journals

> *"The **journals of strategic management** are potentially fruitful territory for the kind of **interdisciplinary conversation** we believe is a key step in making progress on understanding why firms undertake the actions that we observe and how those actions affect their performance."*[275]

It is envisaged that each of the essays of Part II would form the basis for a different stream of publications in academic and practitioner journals. The likely traditional target academic journals which have been most influential in the field of strategic management would be the *Administrative Science Quarterly*, *Academy of Management Review*, *Academy of Management Journal* and the *Strategic Management Journal*.[276] In addition, some of the more recent academic management journals would include *Industrial and Corporate Change* and *Organization Science*.

1.6.6.1.1.1 Paper #1: Defining an *Enterprise Architectural Typology*

Paper #1 would introduce the concept of *enterprise* architectures and define a modular-integral typology (and possible taxonomy) within the context of various academic literary traditions. Although the paper would cite empirical archetypal examples ranging from *Boeing-Airbus* to *GM-Toyota* to *United Airlines–Southwest Airlines*, its purpose would not be to explicitly tie enterprise architectures to long-term performance. Its purpose would be

[275] Henderson, R. and Mitchell, W. (1997), pg. 13.
[276] In a recent bibliographic study of the most influential literature in strategic management from 1980-2000 (Ramos-Rodriguez and Ruiz-Navarro, 2004, pg. 987), these journals were observed to be the most cited in the *Strategic Management Journal*. Other research studies on the most influential journals (Tahai and Meyer, 1999) revealed similar results.

to merely establish definitions in the tradition of Ulrich's (1995) definition of *product* architectures and to advance a social science framework like social network theory in the tradition of Uzzi (1997).

The likely target academic journals for Article #1 would be the *Academy of Management Review, Administrative Science Quarterly, Organization Science* or *Research Policy.*

1.6.6.1.1.2 Paper #2: *Competitive Dynamics* of Enterprise Architectures

Paper #2 would present empirical evidence from the five-year *Boeing-Airbus* case study illustrating the mechanisms of how position and capabilities interact within the construct of the previously-defined construct of enterprise architecture. This article would be in the tradition of Hall (1976).

The likely target academic journals for Article #2 would be the *Strategic Management Journal*, *Academy of Management Journal, Administrative Science Quarterly* or *Organization Science.*

1.6.6.1.1.3 Paper #3: The *Evolution* of Enterprise Architectures

Paper #3 would present historical empirical evidence illustrating the mechanisms of how environmental states shape the previously-defined construct of enterprise architecture, and how competitive dynamic interactions contribution to the co-evolution of the environment which ultimately shape the evolution of the enterprise architectures. This article would be in the tradition of Tushman and Anderson (1986), Anderson and Tushman (1990 and 2001), Utterback and Suárez (1993) and Suárez and Utterback (1995).

The likely target academic journals for Article #3 would be the *Academy of Management Review, Administrative Science Quarterly*, *Organization Science* or *Industrial and Corporate Change.*

1.6.6.1.1.4 Paper #4: The Evolution of *Business Ecosystems*

Paper #4 would integrate the previous three papers into a coherent theory. As such, it would be a summary of this dissertation. A pure theoretical paper in the tradition of Schilling (2000) would target the *Academy of Management Review,* while an empirically-based paper would target *Administrative Science Quarterly, Academy of Management Journal* or *Industrial and Corporate Change.*

1.6.6.1.2 *Practitioner* Journals

The likely target practitioner journals would be the *Harvard Business Review*, *Sloan Management Review*, *California Management Review* and *Long Range Planning.*

1.6.6.2 Books

It is hoped that this document (and the subsequent dissertation) will form the basis for two different book audiences: academic and practitioner/general audience.

1.6.6.2.1 *Academic* book

Due to the inherent complexity and multivariate nature of strategic management, it is not unsurprising that of the 20 most influential publications in the field, 18 are in book form (Ramos-Rodriguez and Ruiz-Navarro, 2004).[277] As this research aims to bring a holistic systems/enterprise view to the academic field of strategic management, by definition it will be less effective and potent to decompose the work into separate coherent journal articles.

Although these books were based on empirical/theoretical research and were intended for academic audiences (i.e. as textbooks), their relevance to practitioners allowed their cross-over to more mainstream practitioner audiences (e.g. Porter, 1980 & 1985).

1.6.6.2.2 *Practitioner* book

In addition, a book primarily aimed at practitioners is planned along the conceptual lines of various academic cross-over authors covering multi-industry studies like Christensen (1997), Collins and Porras (1994), Dertouzos, Lester and Solow (1989), Fine (1998) and Utterback, (1994) as well as those covering single-industry studies like Dyer (2000), Hoffer-Gittell, (2003), Murmann et al. (2002) and Womack, Jones and Roos (1990).

A representation of the publication plan is shown in Figure 106 below against the proposed framework.

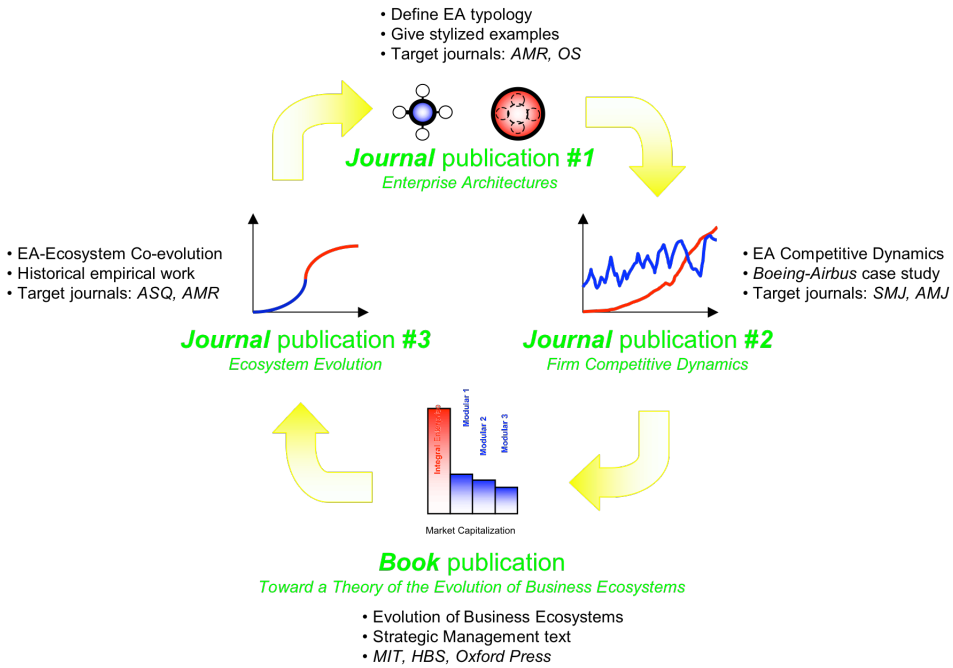

Figure 106: Proposed Publication Plan

[277] Interestingly, the only two journal articles in the top 20 most influential publications in strategic management (Wernerfelt, 1984 and Barney, 1991) re-ignited the resource-based view debate initiated 25-30 years earlier in the 16th-ranked publication, *The Theory of the Growth of the Firm*, by Edith Penrose (1959).

1.7 Research Importance

> *"**Longitudinal studies** that explicitly focus on the nature of these **organizational and environmental interactions as they evolve over time**, and that pay particular attention to the ways in which capabilities and environmental conditions shape each other, are thus likely to be particularly **fruitful for both theory and practice**."*[278]

> *"The models of firm decision making have not gone beyond the **static** implications of the fact that firms are political coalitions. They do not attempt to reflect shifts in coalitions per se. The later task – leading to a more general theory of **coalition development** – has hardly been touched except conceptually. **The significance of such a theory to a theory of the business firm and its growth is obvious.**"*[279]

If successful, the importance of the proposed research will lie in the value of the meta-theoretical framework as exceeding the value of the sum or the existing theoretical models. Instead of merely connecting heretofore disconnected models, it is hoped that the research will reveal a new way of viewing the interaction of firms and their environments for competitive advantage.

As this research attempts to answer the recent calls from the strategic management academic community to build systemic *theory* grounded in *practice*, it should prove to be important to leaders of firms and strategy consultants who are primarily concerned with- and responsible for delivering firm performance, long-term or otherwise.

> *"The practitioner and researcher are doubly-linked: the **researcher supplies the insights, relationships, and theory** for the practitioner. But the **practitioner supplies puzzles, ideas, judgments, and priorities** for the researcher."*[280]

It is hoped that the importance for practitioners of understanding when and why different enterprise architectures produce superior performance, will be matched by the importance for academic theorists in understanding which ontological and epistemological lenses are needed to understand each architecture.

Finally, for enterprise architects including CEOs and Strategy VPs who are in constant pursuit of firm growth, this work endeavors to assist in advancing the understanding of how and why firms grow.

> *"The goal GE has set for **sustained organic growth** – two to three times the growth of global GDP – translates to about 8% today. **Few companies have achieved the kind of growth** GE is seeking, and none on a revenue base of $150 billion."*[281]

As *General Electric* CEO, Jeff Immelt recently lamented:

> *"We're now in a **slow growth** world. Things were different 25 years ago. **The business book that can help you hasn't been written yet**."*[282]

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[278] Henderson, R. and Mitchell, W. (1997).
[279] March, J.G. (1962), pg. 678.
[280] Bowman, E. H. (1990), pg. 27.
[281] Stewart, T.A. and Immelt, J. (2006), pg. 62.
[282] Stewart, T.A. and Immelt, J. (2006), pg. 62.

Chapter 2 Research Methodology

Having described in chapter 1 what questions are to be tackled, and why they are important and worthy of research, this chapter discusses how the research questions are to be approached, namely it will answer the "how?", "where?" and "when?" questions.

2.1 Fit between Resesarch Methods and the State of Existing Theory

Recently, researchers have posited a contingent relationship between the state of the existing theory in a field, and the appropriate research method (Carlisle and Christensen, 2004; Edmondson and McManus, 2006). Hoskisson et al. (1999) propose such an evaluation for the strategic management field.

Figure 107 below attempts to map the state of the field from the "double helix" discussed in the previous chapter to the appropriate research methods that I plan to use for this research.

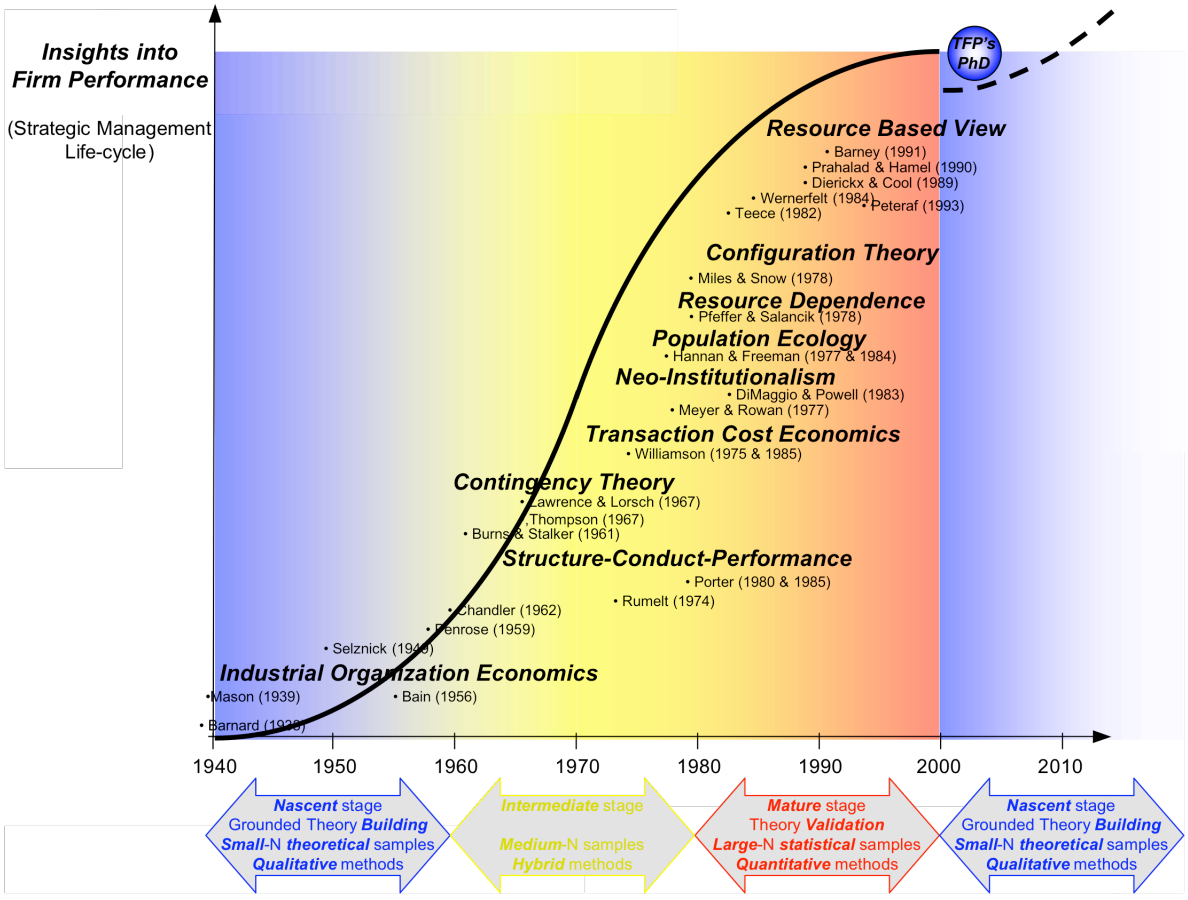

Figure 107: Fit between Research Methods and the State of Strategy Research

2.2 Overview of Research Methodology

> *"Given the overwhelming changes taking place in organizations and their environments, how can scholars contribute to knowledge? We believe that scholars who have been following traditional research paradigms need* ***to adopt a new mindset for research*** *into the new organizational forms. We believe that at this stage of theory development, research on new forms of organization requires a* ***new approach, quite different from research typically found in academic journals****. This work will be characterized by* ***midrange theory*** *and method,* ***grounded research****, and research that* ***does not presume to test hypotheses empirically****."*[283]

In recent years, organizational scholars have noted rapid and radical changes to traditional organizational forms as a result of significant changes in the environment including increased volatility and hyper-competition in an interdependent global economy (Daft and Lewin, 1993). These scholars have called for a new research paradigm and in fact have founded new research journals.[284]

> *"The point of* ***heretical research methods*** *is to find new channels through which to obtain organizational insights and to change the mix of research methods. Although no method is truly heretical,* ***researchers should be encouraged to do whatever it takes to learn about organizations****."*[285]

As organizational theorists see organizational form as a strategic variable, such calls for new research have found their way into the more mainstream strategic management journals.

> *"Strategy researchers are particularly well positioned to conduct the complex,* ***multidimensional, multilevel longitudinal studies*** *that we suspect are necessary if we are to fully understand the interactions between competence and competition."*[286]

In order to answer the stated research questions, the philosophy that guides this research design and execution is in-depth, fine-grained (i.e. case-based as opposed to large data base) grounded theory building, using multi-method, multi-level, multi-industry longitudinal studies described in this section.[287]

> *"Strategy research can benefit from using* ***multiple time frames****, comparative (historical) research, simultaneous exploration of different levels of analysis, and* ***multiple theoretical lenses****. Clearly, such a research agenda is more* ***demanding*** *and therefore it may be better approached in* ***research programs****,* [and] *in* ***large, book-length studies****."*[288]

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[283] Daft, R.L. and Lewin, A.Y. (1993), pg. ii.
[284] For example, *Organization Science* in 1990.
[285] Daft, R.L. and Lewin, A.Y. (1990), pg. 6.
[286] Henderson R. and Mitchell W., (1997).
[287] A good introduction to theory-building research (which has proved influential in my research design) is the October 1989 special issue of the *Academy of Management Review*, dedicated to theory building.
[288] Farjoun, M. (2002), pg. 585.

2.2.1 *Grounded Theory* Building

2.2.1.1 Motivation

As this research endeavored to solve a rather perplexing substantive problem regarding *Boeing* and *Airbus'* competitive advantages, I decided to take a more (initially) inductive approach to the problem, by building theory from data, taking a fresh look at the phenomena of long-term firm performance, unencumbered with the prevailing concepts, constructs, propositions and theories of the day, and oblivious (initially) to the prevailing theoretical debates in the fields of strategy and organization science.

> *"Glaser and Strauss criticized the* ***'overemphasis in current sociology on the verification of theory, and a resultant de-emphasis on the prior step of discovering what concepts and hypotheses are relevant for the area that one wishes to research'*** *(Glaser & Strauss, 1967, pp. 1f) and bemoaned '****that many of our teachers converted departments of sociology into mere repositories of 'great-man' thiories'*** *(Ibid, p. 10)* ***leading to an antagonism between 'theoretical capitalists' and a mass of ''proleteriat testers'*** *(p. 11)."*[289]

As this research plan has highlighted gaps in the existing literature pertaining to the questions posed, the research design was guided by the need to build grounded theory (Glaser and Strauss, 1967; Eisenhardt, 1989; Dougherty, 2002). In other words, this research approach focuses on building new theory and only indirectly on testing or verifying existing theories.

> "Grounded theory building *"reaches into the 'infinite profusion' of social action in organizations in order to tease out, identify, name, and explicate themes that capture the* ***underlying dynamics and patterns*** *in the blooming, buzzing confusion that is… management. Grounded theory building tries to understand why and how structures, conditions, or actions might arise, to ferret out* ***generative mechanisms****, to explore conditions under which these effects might vary or not, and to qualify their* ***temporary and emergent*** *aspects."*[290]

> *"In fact,* ***inductive and deductive logics are mirrors of on another****, with inductive theory building from cases* ***producing new theory from data*** *and deductive theory testing* ***completing the cycle by using data to test theory****."*[291]

As grounded theory building is inherently iterative, the research design unfolds longitudinally over time visiting and revisiting various case history sites over and over as will be described later in this chapter.

> *"****Knowledge*** *begins and ends in experience; but it* ***does not end in the experience in which it began****."*[292]

[289] Kelle (2005), pg. 2.
[290] Dougherty (2002), pg. 851.
[291] Eisenhardt, K.M. and Graebner, M.E. (2007), pg. 25.
[292] Lewis, C.I. (1929).

2.2.1.2 Varieties of Grounded Theory

It should be noted that by "grounded theory", I do not restrict my methods to those defined by its original authors, Glaser & Strauss (1967); nor do I wish to engage in the subsequent debate between the Glaserian and Straussian schools over the split in methodology (Kelle, 2005). I merely take a more catholic approach to grounded theory, as espoused by Eisenhardt (1989, 2007).

2.2.1.2.1 Glaser & Strauss (and Glaser vs. Strauss)

Although Glaser & Strauss (1967) were among the first to give a clear articulation of grounded theory in the social sciences, they later disagreed as to how to best create grounded theory (Kelle, 2005).

> *"Grounded theory according to **Glaser emphasizes induction or emergence, and the individual researcher's creativity** with a clear frame of stages, **while Strauss is more interested in validation criteria and a systematic approach**."*[293]

The primary distinction lies in the ability of the researcher to "architect" theory (abstractly and conceptually) vs "engineer" theory (concretely and precisely).

> ***"Strauss** and Corbin's coding paradigm is linked to a perspective on social phenomena prevalent in **micro-sociological approaches** emphasizing the role of human action in social life. **Researchers with a strong background in macro-sociology** and **system theory** may feel that **this approach goes contrary to their requirements and would be well advised to construct an own coding paradigm rooted in their own theoretical tradition.** Glaser's approach of '**theoretical coding**' whereby researchers introduce ad hoc theoretical codes and coding families which thay find suitable for the data under scrutiny provides a strategy applicable for a greater variety of theoretical perspectives. However, as has been said before **following this strategy is much more challenging expecially for novices** since it lacks a readymade conceptual framework like Strauss and Corbin's coding paradigm. **Experienced researchers with a broad knowledge in social theory** would clearly benefit from the advantages of **theoretical coding** – having at their disposal not only one possible axis of developing theory but being able to construct such an axis by themselves through the combination of theoretical concepts from **different schools of thought."***[294]

2.2.1.2.2 Eisenhardt

Eisenhardt (1989) moved the debate forward for organizational theorists by embracing a catholic approach used by this research design.

> *"Glaser and Strauss (1967) and more recently Strauss (1987) have outlined pieces of the process, but **theirs is a prescribed formula, and new ideas have emerged from methodologists**...."*[295]

> *"A more subtle challenge arises from **confusion about the meaning of 'grounded theory building.'** For some scholars, grounded theory building **simply means creating theory by observing patterns within systematically collected empirical data**. This view often includes some*

[293] Wikipedia: "Grounded Theory".
[294] Kelle, U. (2005), pg. 9.
[295] Eisenhardt, K.M. (1989), pg. 532.

> *notion of* ***recursively iterating between (and thus constantly comparing) theory and data during analysis, and theoretically sampling cases*** *(as described earlier). As Langley (1999) noted, this is a widely held view of grounded theory building.* ***In this view, the quality of the theory and the strength of its empirical grounding are more central to research quality than the specifics of the theory-building process.*** *But for other scholars, grounded theory building has a more* ***precise meaning that stems from the original focus of Glaser and Strauss (1967) on the interpretation of meaning by social actors.*** *For example, Suddaby described grounded theory building as 'most suited to efforts to understand* ***the process by which actors construct meaning out of intersubjective experience****' (Suddaby, 2006: 634).* ***Others go further to emphasize elaborate processes (and terminology) for how researchers should gather field data and discover theory using a hierarchical structure of categories*** *(Corbin & Strauss, 1990). Constant comparison and theoretical sampling take on precise meanings: 'constant comparison' means simultaneous collection and analysis of data, and 'theoretical sampling' means that decisions about which data to collect next are determined by the theory in progress (Suddaby, 2006).* ***In this view, adherence to specific grounded theory building processes is important in judging research quality. But strict adherence can also result in theory with limited generalizability (Langley, 1999) and idiosyncratic path dependence on the particular empirical starting point.*** *As when coping with the multiple meanings of 'qualitative research,' it is often helpful to deal with the multiple meanings of 'grounded theory building' by avoiding the term unless one is actually using the Glaser and Strauss (1967) approach. theory."*[296]

This research uses Eisenhardt's eight-step research process (Eisenhardt, 1989) as a point of departure for building theory from case studies.[297] Below is a brief summary description of the research process planned and/or executed thus far. Note that although this is described sequentially, the approach taken was actually iterative in a "spiral development" process, typical of theory-building or design exercises in general. Each point is explained in more detail in the body of this document.

1. Getting Started

   In order to broadly focus research efforts at the outset, the research question was defined as: determining sources of firm competitiveness and long-term performance.

   In order to provide better grounding of future construct measures, the following main a priori constructs were used at the outset: enterprise *architectural form*, enterprise *competitive dynamics* and the *industrial evolution* of the enterprise's environment.

   In order to retain theoretical flexibility going into the research project, neither theory nor hypotheses connecting constructs were developed at this early stage.

2. Selecting Cases

   In order to constrain extraneous variation and sharpen external validity, the specified population was limited the global duopoly in the large commercial aircraft industry, comprising *Boeing Commercial Airplanes* and *Airbus Industrie*.

[296] Eisenhardt, K.M. and Graebner, M.E. (2007), pg. 30.
[297] Note that although quotation marks have been omitted in this section, the theoretical justification for the use of each of the eight points is taken verbatim from Eisenhardt's paper to ensure sharpness and adherence to her methodology is retained.

More descriptively, the case represents the evolutionary trajectories of one relatively high-performing firm and one relatively low-performing firm. At the beginning of the longitudinally-based research project, *Boeing* was the "market leader", and by the end of the research, they had been overtaken by their rival, *Airbus*.

In order to focus research efforts on theoretically useful cases (i.e. cases that replicate theory by filling conceptual categories), a theoretical (not random) sample was used which covered the diametrically opposed archetypal constructs: *modular* enterprise architecture (i.e. *Boeing*) and *integral* enterprise architecture (i.e. *Airbus*).

3. Crafting Instruments and Protocols

In order to strengthen grounding of theory by triangulation of evidence, multiple data collection methods were used, including: archives, interviews, experiment and observation.

In order to provide a synergistic view of the evidence, both qualitative and quantitative data were combined as typified by the interviews and observations, as well as by the use of numerical archival data used to quantify the performance trajectories.

> *"For while systematic data create the foundation for our theories, it is the **anecdotal data** that **enable us to do the building**. Theory building seems to require rich description, the richness that comes from anecdote. We uncover all kinds or relationships in our hard data, but it is only through the use of this soft data that we are able to explain them."*[298]

In order to foster divergent perspectives and strengthen grounding, evidence surrounding each firm was taken from multiple stakeholder perspectives including: the firm itself, its customers, its suppliers, its employees, and its investors.

Also, multiple investigators were used in the data collection, analysis and theory building. This included an active research group of professors and researchers at MIT's *Lean Aerospace/Advancement Initiative*, which was set up explicitly to tackle this class of problem.[299] In addition, an active and diverse on-site case-study team was assembled for the same purposes.[300]

4. Entering the Field

In order to speed-up the analyses and reveal helpful adjustments to data collection activities, a concurrent (as opposed to sequential) approach was taken in which there was an overlap of data collection and analysis.

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[298] Henry Mintzberg (1979), quoted in Eisenhardt, K.(1989), pg. 538.
[299] The LAI's *Enterprise Architecting* research team was headed by Prof. Deborah Nightingale and Dr. Kirk Bozdogan.
[300] *Boeing's* research team was lead at various times by Sherry Carbary (VP of Strategy), Carolyn Corvi (VP of Airplane Production), Tim Meskill, Adam Kohorn, and Dan Wheeler.

In order to take advantage of emergent themes and unique features of the case, there were flexible and opportunistic data collection methods employed such as: the establishment of an informal and semi-permanent "strategy discovery" discussion series with senior leaders within *Boeing* and its stakeholders. Although the general research topic and timing of the "data-collection" opportunities were held fixed, the participants and themes were kept flexible to attract committed people and issues relevant to the topic at the time.[301]

5. Analyzing Data

   In order to gain familiarity with the data and to generate preliminary theory, analysis of the data was restricted initially *within*-case (i.e. *Boeing-Airbus*).

   In order to look beyond initial impressions and see evidence through multiple lenses, *cross*-case pattern searches were undertaken of theoretical samples using the enterprise archetypes in industries like automotive (*GM-Toyota*) and airlines (*United-Southwest*).

6. Shaping Hypotheses

   In order to sharpen construct definition, validity and measurability, the research design iteratively tabulated evidence for each construct through the longitudinal re-exploration of the constructs with the stakeholders as the hypotheses (i.e. the relationships between the constructs) were evolving. Constructs were continually revisited as hypotheses were emerging, and concurrently, hypotheses were continually revisited as constructs were reviewed.

   In order to confirm, extend and sharpen the theory, replication of observations (as opposed to further sampling for new observations) became the modus operandi as the research progressed, particularly across cases.

   In order to build internal validity, the research searched for evidence for the "why" behind the construct relationships by building simulation models using dynamic causal mechanisms via the system dynamics method.

7. Enfolding Literature

   In order to continue to build internal validity, raise the theoretical level and sharpen construct definitions, an effort was made to compare the theory with *conflicting* literature. Examples include apparent conflicts with the theory of product and supply chain architectural fit (Fine, 1998), the theory of organic-mechanistic firm structures (Burns and Stalker, 1961), and the population ecology theory of firm exit (Hannan & Freeman, 1984).

[301] An important role of the researcher in these settings was to act as the research "gate-keeper" to maintain focus on the research question, and defend a rigor to the methodological approach defined in this document.

In order to sharpen generalizability, improve construct definition and raise the theoretical level, a significant effort was made to compare the theory with *similar* literature. This is described in more detail in the section of this document entitled: "Previous Related Research & Literature Gaps".

8. Reaching Closure

   In order to end the process to ensure "theoretical saturation", the results of iterations were monitored to determine when marginal improvements become small. This tended to occur when the collection of additional supporting and/or dissenting data diminished.

2.2.1.3 Small-N Intra-Case and Medium-N Inter-Case Inference

> *"You cart a pig into my living room and tell me that it can talk. I say, 'Oh really? Show me.' You snap your fingers and **the pig starts talking**. I say, 'Wow, you should write a paper about this.' You write up your case report and send it to a journal. What will the reviewers say? Will the reviewers respond with **'Interesting, but that's just one pig**. Show me a few more and then I might believe you'? I think we would agree that that would be a silly response. A single case can be a **very powerful example**."*[302]

A first-order, architectural (or "special") explanation for high long-term variance in firm performance may be viewed as far-fetched, however the fact that we attempt to demonstrate its feasibility in only one case study (or in fact in a small set of case studies) does not diminish the theory's validity. The small set of case studies, however may be a powerful example, which serves to stimulate other research in this vein.

> *"Research involving **case data** can usually **get much closer to theoretical constructs** and provide a much more persuasive argument about **causal forces** than broad empiricial research can. One should use this advantage. However, one will not be able to say, 'You should believe my theory that A leads to B, because I show you an example here.' That is asking too much of a single case study, or even a few cases. The theory should stand on its own feet. One needs to convince the reader that the conceptual argument is plausible and use the case as additional (but not sole) justification for one's argument."*[303]

Management research has become increasingly positivist and reductionist, relying on large-N statistical samples to prove an existing theory. This fact, however, does not diminish the importance of small-N theoretical samples from which to build theory in an exploratory mode.

> *"Since writers of papers based on **case research** do not have recourse to the canonical statement **'results are significant at p < 0.05'** that helps assuage readers' skepticism of empirical papers, researchers usuing case research often feel they are fighting an uphill battle to persuade their readers."*[304]

While the majority of research using small-N, in-depth case studies, usually claims that the state of existing knowledge is nascent, meriting exploratory research in defining appropriate

[302] Siggelkow, N. (2007), pg. 20.
[303] Siggelkow, N. (2007), pp. 22-23.
[304] Siggelkow, N. (2007), pg. 20.

constructs, this research admits a more naïve, and emergent justification: namely, when the phenomenon was first studied, the researcher entered the field, relatively blind to the existing state of the art of strategic management and organizational theory, and instead, entered equipped with the tools and frameworks of an allied field – architecture and engineering.

> *"The near-ubitiquous claim that **'not much is known, hence we engage in grounded theory building,'** does not seem to me a necessary condition for the justification of **case research**. Moreover, such **claims of existing ignorance at times do not ring true**. It can also get writers tied up in knots about professing to have entered the field with no preconceptions. In my view, **an open mind is good; an empty mind is not**. It is true that one wants to **retain the capacity to be surprised**, but it seems useful (and inevitable) that our **observations be guided and influenced by some initial hunches and frames of reference**."*[305]

As will be discussed in more detail later, this research proposes to build grounded theory both from a small-N theoretical sample with *intra*-case inference (namely the *Boeing-Airbus* duopoly in the large commercial airplane industry), as well as extended to include a medium-N theoretical sample with *inter*-case inference (namely the *GM-Toyota* and *United-Southwest* rivalries in the automotive and airline industries respectively).[306]

The extension to medium-N theoretical sample uses quasi-statistical modes of inference across cases, with pure randomization of a true statistical sample being sacrificed for extreme high-performers of a theoretical sample.

[305] Siggelkow, N. (2007), pg. 21.
[306] MIT ESD and Political Science Professor Ken Oye characterizes such research as "Blue Cluster", as opposed to large-N statistical samples coupled with formal models of the "Red Cluster".

2.2.1.4 *Empirical* vs. *Conceptual* Theory Building

> *"My rule of thumb is that **the grander the theoretical claims, the more free-standing the theory has to be**. In other words, even of the reader were only to read the conceptual part of the paper, he or she would be convinced of the **internal logic** of the conceptual argument."*[307]

As the theory developed in this research has broad ambitions, it will undoubtedly be critiqued as having grand theoretical claims. This, coupled with the fact the theory was grounded in a small-N theoretical sample of comparative case studies, makes the internal logic of the argument, paramount.

Nonetheless, the theory building proposed herein can be categorized both as "empirical" as well as merely "conceptual". Although the very nature of grounded theory building implies theory generated inductively from empirical data, the strategic management community has put a further restriction on the definition of "empirical" theory building – namely that single case studies are insufficient (Saunders and Thompson, 1980). As will be discussed later, this research is based primarily upon in-depth case studies of both firms (and their extended enterprises) in a global duopoly.

> *"...**empirical** papers were **separated from conceptual** papers according to the test that the former had to display an empirically-oriented research design and had to promise (at least) to utilize studies of **a number of organizations**. Papers based on generalized or non-specific experience or evidence and those drawn from **a single case-study** were not deemed 'empirical' under this regimen."*[308]

As an aside, it is interesting to note that one of the most influential pieces of grounded theory building (Penrose, 1959), which ultimately inspired the resource-based view (Wernerfelt, 1984), was based on only one in-depth case study inside the *Hercules Powder Company* (Penrose, 1960).[309] Although Penrose may argue that the origin and purpose of her ground-breaking research was empirically-motivated, by today's definitions, it would be "marginalized" to conceptual theory building due to its focus on one firm.

In addition, the theory building proposed herein can be categorized as "conceptual" as its is also constructed from the aggregation or synthesis of other existing theories and datasets, as was discussed previously under the notion of "logical compound synthesis."

Within both empirical and theoretical bases, the detailed method of theory building includes exploration, concept development and hypothesis generation (Saunders and Thompson, 1980).

> *"**Case-based research** is more at the level of an **existence proof**: Here is one example of how A leads to B. If the reader can reply, 'I'm not really that surprised that you can find in the world at least one example of A leading to B,' the value of the contribution of the paper can be in doubt."*[310]

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[307] Siggelkow, N. (2007), pg. 21.
[308] Saunders and Thompson, (1980), pp. 123-124.
[309] Rouse and Daellenbach, (1999), pp. 489-490.
[310] Siggelkow, N. (2007), pg. 23.

The value of the contribution of the theory developed herein will lie in its explanation of an existence proof, which may be used to guide further empirical research.

2.2.2 *Multi-method*

The goal of the research design is to bridge the more qualitative traditions of case study with the more quantitative traditions of numerical modeling. This inherently requires a multi-method approach.

> *"**Studying variations over time in organ izational forms** requires not only **longitudinal research designs** but also knowledge of **historical trends** and **changes in political systems, modes of economic production, law, patterns of international trade,** and other topics often neglected in case studies and surveys of isolated organizations."*[311]

Solid research methodology in strategic management is based on four important components: (1) mathematical models; (2) statistical data analysis; (3) logical compound synthesis; and (4) in-depth case studies (Itami and Numagami, 1992). This research design proposes to embrace multiple methods, working backward from the qualitative case studies, incorporating logical compound synthesis, and finally due to the high levels of dynamic complexity inherent in longitudinal multi-stakeholder research, ends with the development of nonlinear dynamic numerical simulation models.

> *"I do not believe that formal modeling should be the only style of organizational research. To the contrary, I think the **most successful** literatures are those that **blend detailed description, informal theory and formal modeling**."*[312]

As shown in Figure 108 below, these three methods form an integrated approach toward building and testing grounded theory. The developed framework is grounded *empirically* via comparative case studies, *theoretically* via synthesis of a broad literature of empirical and theoretical research ranging from economics to sociology, as well as being grounded *analytically* via nonlinear dynamic numerical simulation modeling.

[311] Aldrich, H. (2006), pg. xii.
[312] Gibbons, R. (1999), pg. 146.

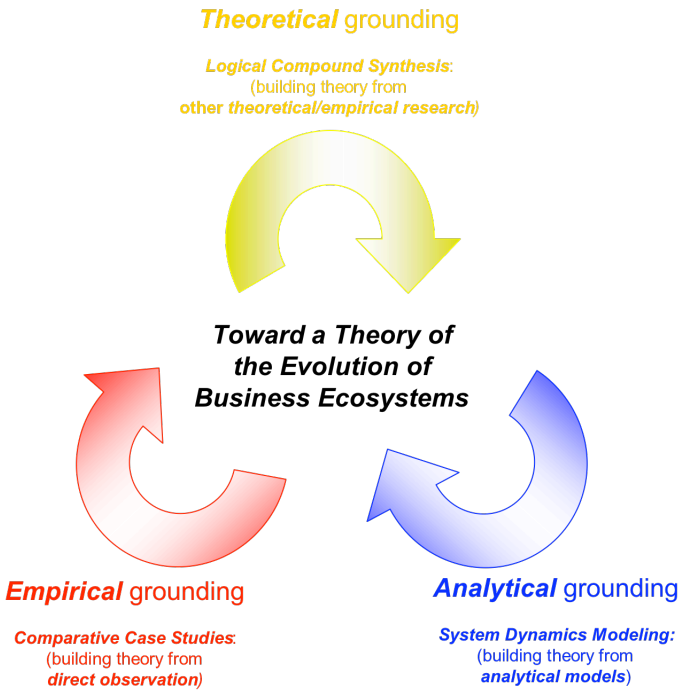

Figure 108: Integrated and Triangulated Research Design

It is important to note that these three approaches were not applied in a purely linear, sequential fashion. In order to capture the rich potential of emergence in grounded theory building, the three approaches were applied integrally, concurrently and iteratively and are therefore mutually reinforcing. Justification of the theory developed solely from any one approach would be incorrect and misleading.

Figure 109 below summarizes conceptually how the three approaches unfold longitudinally, combining a pre-determined linear sequential plan, with superimposed iterative cycles. From this figure, it is observed that although the majority of the impact (not necessarily time spent) from each approach took place within the approach's allotted time frame, time spent iterating both before and after the allotted phase contributed significantly to the final theory developed.

> *"Indeed, after having laboriously worked out for myself what I took to be an important and **'original' idea**, I have often had the **disconcerting experience** of subsequently finding the **same idea better expressed** by some other writer. I try always to mention such earlier expositions; I am sure that there are many that I have overlooked, for which I offer advance apology."*[313]

[313] Penrose, E. (1959), pg. 2, footnote 2.

Finally, note that although the theory developed was generated initially from field-based empirical research, subsequently supported and refined by existing research literatures, and finally refined and extended by analytical modeling, it is estimated that the impact of the three approaches over the life cycle of the theory development is approximately equal (e.g. 33%).

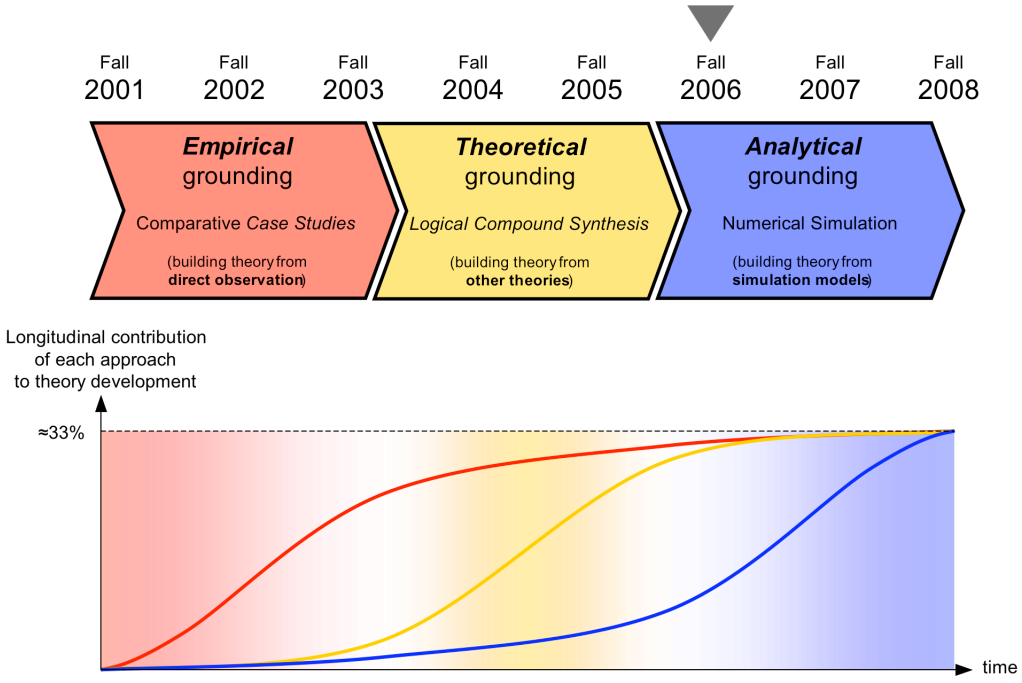

Figure 109: Combining Linear Sequential and Nonlinear Spiral Development Processes

Figure 110 below summarizes the proposed multi-method dissertation in three phases, terminating in the balanced objective of mid-level theory. Note that while this philosophy is broadly inductive, the actual process was certainly iterative between deduction-induction. Each of the phases will be summarized in the following subsections.

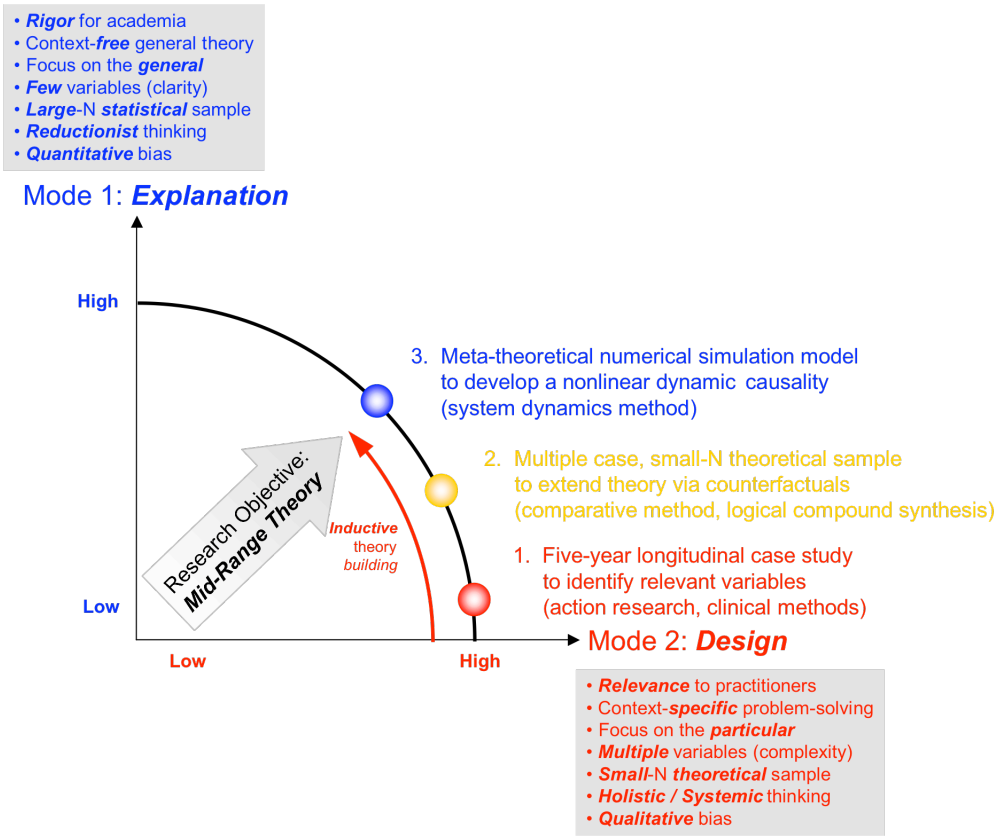

Figure 110: *Multi-Method Research* and the Rigor-Relevance Tradeoff

2.2.2.1 **Case-studies** (Field-based & Historical)

The research plan attempts to initially build grounded theory inductively from the qualitative comparative case study described above (Eisenhardt, 1989).[314] Eisenhardt's research process, which is used as a template for the research design is summarized in Appendix D.

> *"Academic journals have traditionally not accepted or encouraged the deep examination of case studies, but the nature of strategy requires it. The **greater use of case studies** will be necessary for real progress at this stage of the field's development. I am convinced that more research of this type will be needed to address the **dynamics of strategy**."*[315]

[314] Eisenhardt specifically notes the centrality of inductive process and the role of literature in successfully building theory from cases.
[315] Porter, M. E. (1991).

While the purpose of the case studies aim initially at *exploration* and *description*, the ultimate objective is *explanation*, as it attempts to explain how events occurred and predict how they might qualitatively unfold via cause-effect relationships. As the research plan also calls for multiple case studies, this is the most ambitious, comprehensive and potentially rich use of the case study method (Yin, 2003).[316]

Whereas case studies are often dismissed as too qualitative for real science, this is a clear misunderstanding of the reality of grounded theory building is quite different:

> *"**Case histories** of firms and industries that were instrumental to the field's early development are sometimes labeled '**prescientific**' (e.g. Rumelt et al., 1994). However, a renewed interest in historical and **clinical research** is not a sign of regression but of the field's maturity. The **benefits** of such an approach are **too great** to be ignored by strategy researchers."*[317]

> *"Although sometimes seen as 'subjective,' well-done theory building from cases is surprisingly '**objective**,' because its **close adherence to the data keeps researchers 'honest.**' The data provide the discipline that mathematics does in formal analytic modeling."*[318]

The research design is modeled after those that produced some of the most influential and frequently cited works in the strategic management literature, like the longitudinal case studies of Penrose (1959), Chandler (1962) and Lawrence & Lorsch (1967).[319]

> *"Whereas Chandler (1962) conducted **case histories** and classified them to **reveal patterns**, subsequent researchers have measured strategic and structural variables and used statistical variables to test for connections."*[320]

2.2.2.2 Comparative Method

> *"To find answers to our major question, we made a comparative study of **competing organizations** in each of **several industries**."*[321]

Like Lawrence and Lorsch's classic 1967 work, *Organization and Environment: Managing Differentiation and Integration*, this research dissertation uses a comparative approach of studying pairs of competing organizations in each of several industries.

> *"... the **intensive comparative** analysis of a few cases may be **more promising** than a more **superficial statistical** analysis of many cases. In such a situation, the most fruitful approach would be to regard the comparative analysis as the first stage of research, in which **hypotheses are carefully formulated**..."*[322]

The comparative method is one of the basic methods for establishing general empirical propositions, along with experimental and statistical methods. All three methods have been demonstrated to have the objective of scientific explanation, which comprises the establishment of empirical relationship among at least two variables, while all others are

[316] Yin (2003) refers to this as "Type 6" case study research.
[317] Farjoun, M. (2002), pg. 585.
[318] Eisenhardt, K.M. and Graebner, M.E. (2007), pg. 25.
[319] See Ramos-Rodriguez & Ruiz-Navarro, (2004) for a good bibliometric analysis.
[320] Donaldson, (2001), pg. 78.
[321] Lawrence and Lorsch (1967a), pg. 19.
[322] Lijphart, A. (1971), pg. 685.

held constant (Lijphart, 1971).[323] As will be discussed later in the sample selection process, the small-N theoretical sample of case studies, will form the basis of the comparative method to generate the hypotheses.

2.2.2.3 Logical Compound Synthesis

> *"If I have seen farther; it is by **standing on the shoulders of giants**."*[324]

In addition to building theory inductively from the empirical data, this research also builds theory from existing theories and their associated empirical data sets.

> *"Just like chemists synthesize various materials into some chemical **compounds** that are **new to the world**, researchers of this approach pick up various theoretical concepts and empirical findings as materials and **synthesize** them into a **plausible logical story**."*[325]

An important part of the grounded theory building is the supplementing of comparative case studies with a rich survey of theoretical concepts and empirical findings within the strategic management literatures as well as in other academic disciplines, including but not limited to: economics, sociology and architecture. To this end, each of the three essays will commence with a summary of these relevant theories and how they contribute (or conflict) with the theory developed herein.

> *"Gems in isolation are worth far less than when they are strung together in a necklace. They all gain greatly by being **compared and contrasted** in an **orderly fashion**, even if we can not yet weld them together by means of a single, over-arching theory."*[326]

Researchers however have cautioned against the premature and excessive integration of theoretical models – particularly contingency findings – in the quest for a holistic midrange theory of organizations (Moberg and Koch, 1985, pg 110).

> *"This approach derives its plausibility from the **robust coherence** among its component stories and reveals **logical connections among conceptual constructs**."*[327]

One of the most influential publications in the field of strategic management itself, Thompson's 1967 classic, *Organizations in Action* (Ramos-Rodriguez and Ruiz-Navarro, 2004) was not based upon original empirical work, but on the synthesis of a multitude of empirical studies within the contingency theory field. As Thompson, himself noted in the preface to his classic:

> *"I have written this book to call attention to some of [those] developments, which tend to go unnoticed because **we are encouraged to converse within disciplines, while organizations are multidisciplinary phenomena**. A central purpose of this book is to identify a **framework** which*

[323] Note that the method has been criticized for being deterministic in its causality (Lieberson, 1991, 1994; Savolainen, 1994), a charge similarly brought against systems dynamics.
[324] This quotation is taken from my doctoral dissertation committee co-chair, Prof. Charles Fine, who used the reference in his book, Clockspeed (Fine, 1998). The saying was originally attributed to Sir Isaac Newton.
[325] Itami and Numagami (1992), pg. 133.
[326] Landsberger, quoted in Magnusen K. (1973), pg. 17.
[327] Itami and Numagami (1992), pg. 133.

> *might link at important points several of the now independent approaches to the understanding of* ***complex organizations****."*[328]

Thompson's 1967 classic represents a powerful example of what part of this research dissertation aims towards, effective logical compound synthesis, which in Thompson's case led to 100 testable propositions.

> *"This book might be considered a* ***conceptual inventory****. I assume merely that the concepts relevant to important relationships exist, and once having identified some, I hope to generate* ***potentially significant propositions****. We lack the systematic evidence that eventually must come, but there are* ***illustrative studies to indicate that the propositions are plausible****. Illustrations are drawn from a variety of fields; and concepts from a variety of disciplines. I have carried concepts from one discipline into fields not typically studied with those concepts. I have tried to say more, using some concepts, than has typically been said with them. At the same time, I have said considerably less, using those same concepts, than has been said. The economist, sociologist, political scientist, or social psychologist will each find that I* ***overlooked refinements and intricacies in concepts*** *he knows well. I hope, however, that I have* ***avoided outright distortion of concepts.****"*[329]

2.2.2.4 Numerical Simulation Modeling

> *"But how to 'test' that theory, or at least demonstrate its plausibility? The vehicle used in this article is the design and running of a* ***'history-friendly'*** *model. 'History-friendly' models are intended to enhance understanding of particular interesting and important economic phenomena, in this case the* ***swings in vertical integration and disintegration*** *in the American computer industry. History-friendly models generally are* ***simulation*** *models. The aim of history-friendly modeling is* ***not to explain****, in the sense of* ***closely matching*** *through a simulation, the* ***quantitative values observed in the historical episode*** *under investigation, nor in the* ***specification of the model parameters*** *driven by the objective of getting as close as possible to actual empirical values of variables in the actual context being modeled. Rather, the objective is to explore whether the particular* ***mechanisms and forces*** *built into the model can* ***generate****, and in that sense* ***explain the patterns*** *in question. The design of a history-friendly model is guided by the theories, generally* ***verbal****, that* ***informed observers*** *and empirically oriented economists hwo have analyzed the phenomena have put forth as their* ***causal explanations****, and which the model builders find* ***plausible and interesting****. History-friendly modelers believe that much of productive economic theorizing is presented as explanations of particular empirical phenomena by* ***those who know a lot about the empirical details.*** *However, we also believe that it is difficult, sometimes impossible, to check out the* ***logic and the explanatory power*** *of such* ***verbal qualitative theorizing****, without* ***formalizing the argument.*** *A history-friendly model is built on a* ***simplified formal representation*** *of the theory being considered, and aims to test the consistency and power of that theory by exploring the* ***performance of the model****."*[330]

One of the key tenets of theory development in this research is the translation of a qualitative theoretical framework from its qualitative and quantitative empirical grounding to a more precise formal model as Malerba, Nelson, Orsenigo and Winter (2008) argue.

> *"Simulation modeling provides a* ***powerful methodology*** *for advancing theory and research* ***on complex behaviors and systems****, yet it has been embraced more slowly in management than in some associated social science disciplines. Because* ***organizations are complex systems and many of their characteristics are often inaccessible to researchers, especially over time****, simulation can be a particularly useful research tool for management theorists.* ***Simulation is a***

[328] Thompson, J.D. (1967), pg. xxv-xxvi.
[329] Thompson, J.D. (1967), pg. xxvi-xxvii.
[330] Malerba, F., Nelson, R., Orsenigo, L. and Winter, S. (2008), pp. 204 and 205.

> ***legitimate, disciplined, and powerful approach to scientific investigation, with the potential to make significant contributions to management theory.***"[331]

> *"We… position simulation in the* ***'sweet spot'*** *between theory-creating methods, such as multiple case inductive studies and formal modeling, and theory-testing methods. Simulation strengths include* ***internal validity*** *and facility with* ***longitudinal, nonlinear, and process phenomena****. Simulation's primary value occurs in* ***creative experimentation to produce novel theory*** *."*[332]

The meta-theoretic framework proposed by this research is as interested in *states* as it is in *paths* – that is in an enterprise's *architecture* and its complementary *evolution*. As a result, a formal modeling technique is proposed to capture these dual and complementary interests.[333]

Due to the systemic coupling between firm competence and industry competition, the dynamic hypotheses that are generated will be converted into more formal nonlinear simulation models via the *system dynamics* method (Forrester, 1961; Sterman, 2000), in an attempt to bring some *explanatory* power to the theory.[334]

> System Dynamics *"is a quantitative and experimental approach for relating organizational structure and corporate policy to industrial* ***growth and stability****."*[335]

System Dynamics is well suited to representing social change processes of growth and stability, and has already been used for testing macro-sociological theories (Jacobsen, Bronson and Vekstein, 1990).[336] Regarding the use of system dynamics, its originator, Jay Forrester ambitiously called for "courage" in its use:

> *"The solutions to* ***small problems yield small rewards****… One does not* ***achieve innovation*** *and creativity by* ***being timid****… The attitude must be one of* ***enterprise design****. The expectation should be for* ***major improvement*** *in the systems."*[337]

[331] Harrison, J.R., Lin Z, Carroll, G.R. and Carley, K.M. (2007), pp. 1229 and 1243.
[332] Davis, J.P., Eisenhardt, K.M. and Bingham, C.B. (2007), pg. 480.
[333] A similar discussion is given by Farjoun (2002), pp. 575.
[334] Note that due to the relatively small sample sizes employed in this research design, quantitative methods like structural equation modeling may not be appropriate due to low statistical confidence issues.
[335] Forrester, J.W. (1961), pg. 13.
[336] As noted by Sastry A. (1997).
[337] Forrester, J.W. (1961), pp. 449-450.

As shown in Figure 111 below, the tripartite research design is superimposed on a longitudinal time-history of the phenomenon under consideration.

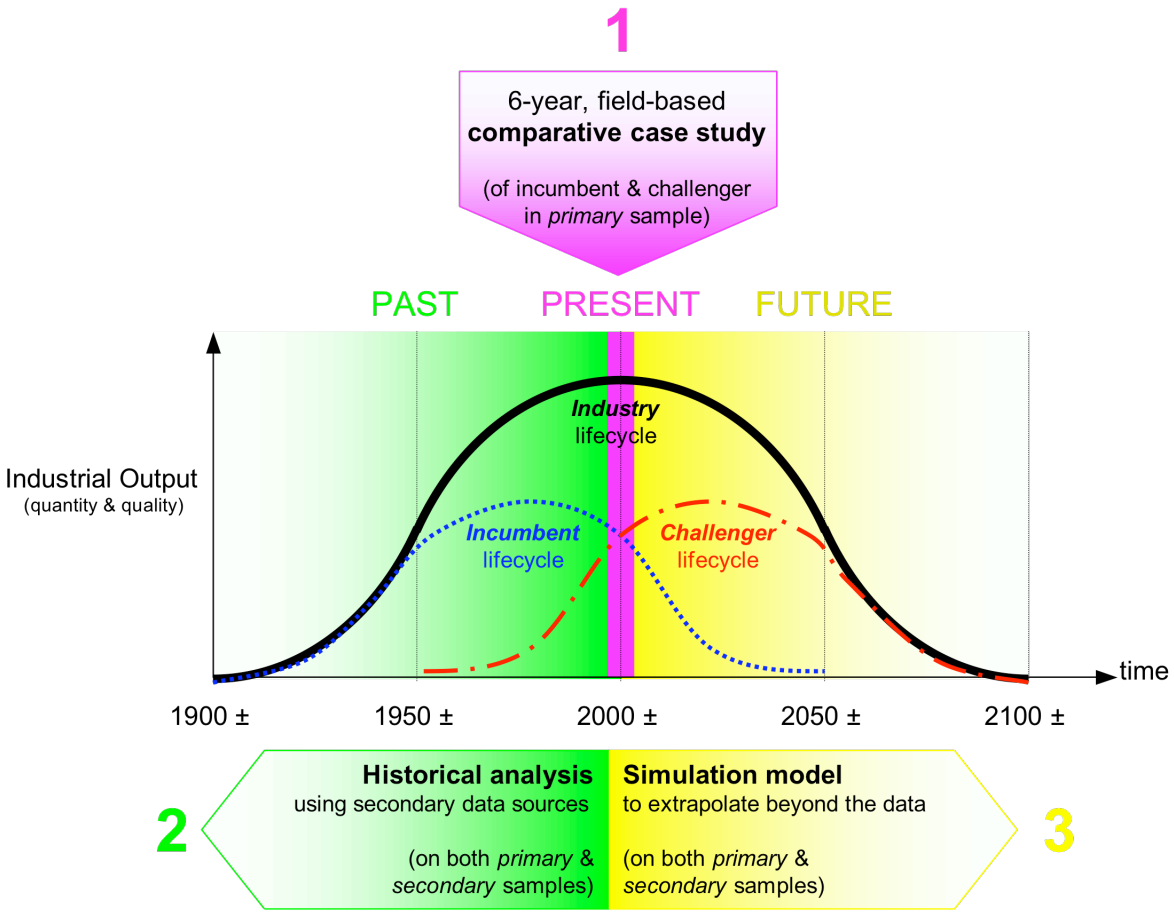

Figure 111: Tripartite Research Design Superimposed on Phenomenon

2.2.3 *Multi-level*

This research draws empirical data from multiple levels: *micro*-level (i.e. individuals alone or in groups), *meso*-levels (i.e. organizational learning, culture, etc.) and *macro*-level (i.e. clusters of organizations, extended enterprise).

2.2.3.1 *Micro*-level

The *micro*-level perspective is developed through the in-depth, qualitative exploration of the decision heuristics of the most senior leaders of each firm. While there are over 70 different terms used to describe individual cognition used in organization studies (Walsh, 1995), the most common are *frames, mental models* or *cognitive maps*.

2.2.3.2 *Macro*-level

The *macro*-level perspective is developed through the modeling of these decision heuristics in the complex dynamic feedback interactions of each extended enterprise as well as their competitive interactions within the ecosystem.

2.2.3.3 *Meso*-level

By investigating the *micro*-level practices of individuals and groups as they perceive, react to, and (possibly) shape *macro*-level environmental change, this research occupies the "*meso*-domain" (Hall, 1995) where action and structure converge.[338]

[338] This aspect of the research design was influenced by Kaplan, S. (2004).

2.2.4 *Multi-lens*

Research within complex socio-technical systems requires a multiplicity of "frames" or "lenses" through which to observe the phenomenon, in order to ensure the internal validity of findings. It is important to note that each researcher has certain ways of look at the world which may bias what they see and how they analyze it. It is equally important to note that each class of research problem is best viewed through a particular "lens" and most often through multiple lenses. As such, this research dissertation is designed first to solve the problem defined in chapter 1, and second to utilize lenses which this researcher has most comfort and skill and to acknowledge the potential associated biases.

Ancona et al., (1999) posits three different complementary theoretical lenses for analyzing organizations: the *strategic design*, the *political* and the *cultural* as shown in Figure 112 below.[339] Additionally, Ancona et al. (2001) more recently posits an additional organizational lens, the *temporal* which encompasses and integrates the others. This section briefly summarizes each, and how they specifically inform the research dissertation.

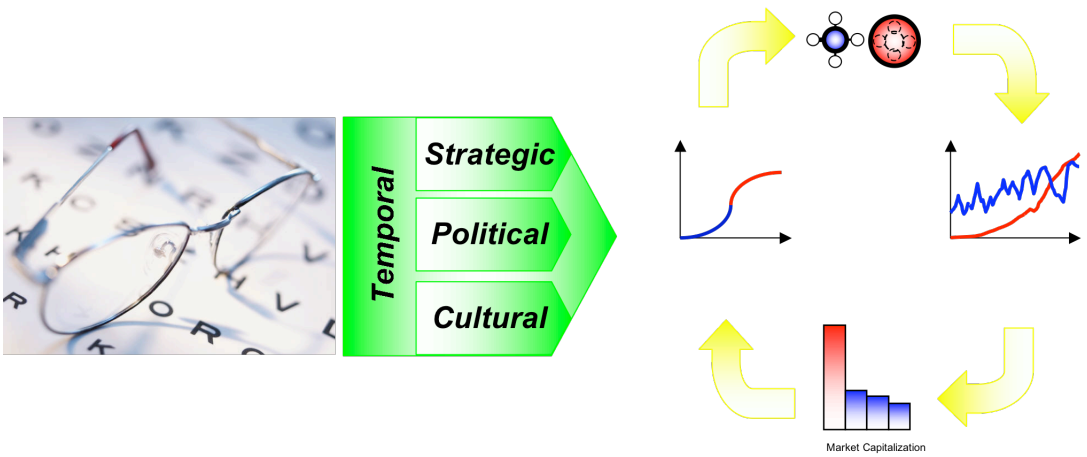

Figure 112: The Three (+ one) Theoretical Lenses

2.2.4.1 The *Strategic Design* lens

> *"This perspective asserts that by understanding the **basic principles of organization design**, by **aligning the organization's design with its strategy**, and by making sure that both strategy and design **fit the environment** in which the organization is operating, managers can make their organizations successful."*[340]

This perspective looks at the flow of tasks, how people are assigned to these tasks, and how the organization can be *rationally optimized* to achieve its goals.

[339] Ancona et al. (2001) actually posit the existence of a fourth lens: the temporal lens. Note that this will be considered in essay #2.
[340] Ancona, D. et al. (1999), module 2, pg. 12.

Within the enterprise architectural framework presented in this dissertation, the strategic design lens helps to define the mechanisms of *differentiation, integration* and *fit* within the organization and between the organization and its environment. However, as the notion of an enterprise architecture embraces a stakeholder view of the firm, it is by definition a power-sharing entity, which explicitly must also take a political view.

As will be discussed later in this chapter, the research methods required to successfully access and analyze the data include traditional desk-studies of company documents and other secondary data sources as well as ethnographic methods.

> *"**If only it weren't for the people**, the goddamned people," said Finnerty, "always getting tangled up in the machinery. If it weren't for them, earth would be an **engineer's paradise**."*[341]

Although the strategic design lens undoubtedly captures the preponderance of observations in the strategic management literature, the following subsections summarize other points of view of at least equal importance dealing explicitly with human and organizational effects.

2.2.4.2 The *Political* lens

The Political lens can be used on both micro- and macro-phenomena (Mintzberg et al., 2008). Micro-politics arises on the individual actor level, while macro-politics arises social aggregates.

2.2.4.2.1 *Micro*-politics

The most important aspect of the research design was to ensure high-fidelity micro-data from the most senior decision-makers of each organizational set. As such, it was imperative to treat each data source as having high behavioral complexity – i.e. as having a local politic.

> *"Fancy what a game of chess would be if all the chessmen had **passions** and intellects, more or less small and **cunning**; if you were not only uncertain about your adversary's men, but a little uncertain also about your own; if your knight could shuffle himself on to a new square **by the sly**; if your bishop, in **disgust** at your castling, could **wheedle** your pawns out of their places; and if your pawns, **hating you** because they are pawns, could make away from their appointed posts that you might get checkmate on a sudden. You might be the longest-headed of **deductive reasoners**, and yet you might be beaten by your own pawns. You would be especially likely to be beaten, if you depended arrogantly on your mathematical imagination, and regarded your **passionate** pieces with **contempt**."*[342]

While the influence of the political lens can dominate the quest for scientific truth in complex enterprises, the exist little academic theory in this domain, and the precious little theory (Machiavelli, 1515) that exists is highly controversial, no matter how influential.[343]

> *"One of the pervasive, really significant reasons for application of Machiavellianism in today's organizations centers around **the ugly problem of loyalty**. Loyalty here refers to dedication or*

[341] Vonnegut, (1952).
[342] From George Eliot's, *Felix Holt, The Radical* (1980, pp. 237), as quoted in Mintzberg, H. et al. (1998), pg. 234.
[343] In fact, one of the building blocks of Williamson's Transaction Cost Economics theory is "opportunistic behavior with guile" (1985).

> *commitment to persons, to task, and to organization. Loyalties today are at odds with one another. Of the various forces affecting loyalty,* ***self-interest is perhaps the most powerful****, influencing both those who employ Machiavellianism and the recipients thereof."*[344]

2.2.4.2.2 *Macro*-politics

> *"A political perspective views an organization as composed of multiple '****stakeholders****' i.e. individuals and groups who contribute important resources to an organization and depend on its success but who also have* ***different*** *interests and* ***goals*** *and bring* ***different amounts and sources of power*** *to bear in organizational interactions."*[345]

This perspective looks at how power and influence are distributed and used within the firm and its constituent stakeholders.

> *"A political perspective defines* ***power as the ability to get things done when goals conflict****."*[346]

As discussed above, the very definition of an enterprise architecture as being a collection of stakeholders, implies that the political lens will have at least as much influence as the traditional strategic design lens.

> *"****Machiavellian concepts*** *are much more germaine to the 'guts' of* ***interactions in business*** *than* ***social scientists and/or management analysts care to recognize****."*[347]

As will be discussed later in triangulation methods to ensure theoretical validity, controlling for "political" effects can be important. To this end it is important to recognized when and how the powerful forces of self-interest may be at play.

As will be discussed later in this chapter, the research methods required to successfully access the data differ from those of the strategic design lens.[348] These methods include clinical methods.

> *"The clinician has the license to ask* ***embarrassing questions****, to elicit* ***confidential information****, and to ask for the airing of* ***organizational 'dirty laundry'****. They are licensed to encourage their informants to* ***'confess'****, to tell what is 'really going on' as they see it, and, in this sense to gain a* ***'deeper' dynamic understanding*** *of what is happening and* ***why*** *it is happening."*[349]

2.2.4.3 The *Cultural* lens

> *"The cultural perspective rejects claims that strictly structural,* ***rational*** *or* ***interest*** *factors best explain human behavior. People are thus more than* ***cogs in a machine or self-interested political actors****. They are also* ***meaning makers*** *and through interaction with one another, they continually create, sustain, and modify organizations."*[350]

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[344] Calhoon, R.P. (1969), pg. 211.
[345] Ancona, D. et al. (1999), module 2, pg. 40. Paul Carlile was acknowledged as developing the material.
[346] Dahl, R. (1957), pg. 203.
[347] Calhoon, R.P. (1969), pg. 205.
[348] References to Machiavelli (1515), are made in management: Calhoun (1969) and Feaver (1984).
[349] Schein, E. (1987), pg. 41.
[350] Ancona, D. et al. (1999), module 2, pg. 64.

This perspective looks at how history has shaped the meanings of different people within an organization.

As discussed above, an enterprise architecture is rooted in both the strategic design and the political lenses. However, as this research endeavors to discover how such rational and yet political systems have evolved over time, as well as the forces which have shaped such evolution, it is important to view such architectures through the cultural lens to determine how history has shaped inertia.

> *"Inasmuch as culture is a **dynamic process** within organizations, it is probably studied best by **action research** methods, **qualitative** research approaches that combine field work methods from **ethnography with clinical** and consulting work."*[351]

As will be discussed later in this chapter, the research methods required to successfully access this data differ from those of the strategic design and political lenses. These methods include action research.

2.2.4.4 The *Temporal* lens

> *"Management science has only begun to deal with the **time dimension in business**."*[352]

As discussed above, researchers (Ancona et al., 2001) have recently posited the need for a fourth lens through which to view organizations: the *temporal* lens. They acknowledge however that such a point of view for research is difficult:

> *"It is hard enough to gain **organizational access**. It is even harder to capture events over time using **multiple measures**. This not only takes time but additional resources and **lots of cooperation**. We are accustomed to **getting in and out of organizations quickly**. These additional considerations preclude the use of a temporal lens. There are also broader, institutional reasons for the lack of focus on time. **Doctoral dissertations are planned around short rather than longer stays**. We* [must] *(1) rethink how we do our research (e.g., we need to create **new 'contracts' with firms** that will let us explore important temporal issues), (2) rethink some of our institutional arrangements, such as encouraging **more time-based research in theses** and journals, and (3) experiment with **new forms of data collection and analysis**."*[353]

[351] Schein, E. (1990).
[352] Forrester, J.W. (1961), pg. 3.
[353] Ancona et al. (2001), pg. 647.

2.2.5 *Multi-temporal (longitudinal)*

> *"Over the last decade, **longitudinal and dynamic analyses** of organizations and populations have come to dominate **empirical work** in organizational sociology."*[354]

As discussed above, researchers (Ancona et al., 2001) have recently posited the need for a fourth lens through which to view organizations: the *temporal* lens. They acknowledge however that such a point of view for research is difficult:

> *"It is hard enough to gain **organizational access**. It is even harder to capture events over time using **multiple measures**. This not only takes time but additional resources and **lots of cooperation**. We are accustomed to **getting in and out of organizations quickly**. These additional considerations preclude the use of a temporal lens. There are also broader, institutional reasons for the lack of focus on time. **Doctoral dissertations are planned around short rather than longer stays**. We* [must] *(1) rethink how we do our research (e.g., we need to create **new 'contracts' with firms** that will let us explore important temporal issues), (2) rethink some of our institutional arrangements, such as encouraging **more time-based research in theses** and journals, and (3) experiment with **new forms of data collection and analysis**."*[355]

This research dissertation therefore attempts to answer the recent calls from reputable academic researchers for a more serious and dedicated research design approach in order to capture the heretofore absent richness of organizations that a temporal lens might provide.

> *"**Longitudinal field studies across several organizations** offer another promising approach. In general these are **large-scale projects**, and the participation of organizations is based on **a close relationship between senior managers and the researchers**."*[356]

As will be discussed in more detail in subsequent subsections, this research dissertation aims to establish new longer-term contracts with closer trust-based relationships with multiple firms which simultaneously occupy the same competitive space.

One of the fundamental characteristics of this research dissertation, therefore is the study of organizations across time, as the causal mechanisms driving long-term performance unfold longitudinally.

> *"... it will be necessary for researchers to place themselves into **the manager's temporal and contextual frames of reference**. Presumably, this would initially involve conducting a retrospective case history to understand the context and events leading up to the present strategy being investigated. However the major focus of the study would entail conducting real-time observations of the events and activities in strategy development while they occur in time, and without knowing **a priori** the outcomes of these events and activities."*[357]

In addition, a longitudinal approach will enable the observation that both change has taken place within the organizations, as well as how such change occurred (Van de Ven, 1992).

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[354] Romanelli, (1991), pp. 99-100.
[355] Ancona et al. (2001), pg. 647.
[356] Daft, R.L. and Lewin, A.Y. (1990), pg. 6.
[357] Van de Ven A.H. (1992), pg. 181.

> *"… there is a need to supplement regularly scheduled data collection with intermittent real-time data. For example, this would involve **observing key committee meetings**, decision or **crisis events**, and **conducting informal discussions with key organizational participants**."*[358]

The research therefore takes a longitudinal approach towards data collection and analysis. This allows the developed theory to take an *ex ante* perspective (i.e. before the outcomes are known). Such a longitudinal approach is important to develop and test theories on organizational change, development or evolution. The *ex ante* perspective allows the opportunity to understand the direction of causality.[359]

> *"… it is widely recognized that prior knowledge of the success or failure of a strategic change effort invariably **biases** a study's findings… it is generally better, if possible, to initiate historical study **before** the outcomes of a strategic change process become known. It is even better to undertake **real-time** study of strategic change processes as they **unfold** in their **natural field settings**."*[360]

[358] Van de Ven A.H. (1992), pg. 181.
[359] This aspect of the research design was influenced by Kaplan, S. (2004).
[360] Van de Ven A.H. (1992), pg. 181.

2.2.6 *Complementary* Qualitative *&* Quantitative *Methods*

Researchers (e.g. Jick, 1979) have advocated the use of "hybrid designs" which embrace both quantitative and qualitative methods in order to achieve triangulation to enhance the internal validity of the theories being developed.[361] The evolution from *qualitative* case studies towards *quantitative* mathematical models requires a rigorous research methodology described herein (Luna-Reyes, 2003).

> *"The **coupling** of* [the **case study**] *and **system models** would preserve the **richness** of* [the case study] *and allow more **generalization** of the findings."*[362]

In particular, as the primary problem with the qualitative case study is generalizing beyond the particular case, many researchers have argued for complementing case studies with computer simulation.[363]

> *"Although system dynamics models are **mathematical** representations of problems, it is recognized that most of the information available to the modeler is not numerical in nature, but **qualitative**."*[364]

Forrester (1994) points out that the progression from the qualitative to the quantitative accesses a different *quantity* and *quality* of data, as shown in Figure 113 below.

> *"The amount of available information declines, probably by many orders of magnitude, in going from mental to written information and again by another similar large factor in going from written to numerical information. Furthermore, the character of information content changes as one moves from mental to written to numerical information. In **moving down** the diagram, there is a **progressively smaller** proportion of information about **structure and policies**."*[365]

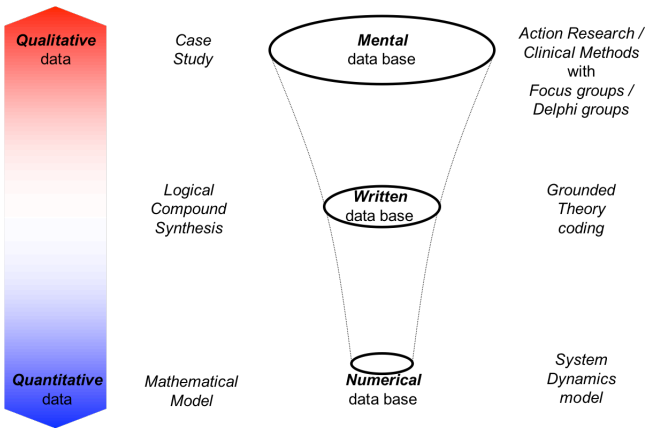

Figure 113: Quantity and Quality of Data[366]

[361] My thanks goes to Prof. Amy Edmondson who pointed this out in her PhD course at the Harvard Business School on the *Design of Field Research Methods*.
[362] Atkinson, G. (2004), pg. 282.
[363] Radzicki, M (1988), pp. 634-637 and (1990), pp. 58-60.
[364] Luna-Reyes and Andersen (2003), pp. 271.
[365] Forrester, J.W. (1994), pp. 72.
[366] Source: Forrester, J.W. (1994).

2.2.7 *Induction-Deduction iteration*

> *"This dialectic of the double-loop learning approach to **building strategy theory** can help in reconnecting strategy theory with the realities faced by managers in dynamic environments."*[367]

In the quest for creating new 'bisociation' (i.e. connecting things that were not formerly seen to be connected), the research aims to use both inductive and deductive reasoning. Using purely deductive reasoning, new theory development is unlikely, while using purely inductive reasoning (i.e. without identifying assumptions, constructs and interrelationships between them), only description of the phenomena might result.

As shown in Figure 114 below, the research attempts to build theory by cycling inductively and then deductively in creating and testing constructs, frameworks (or typologies) and ultimately models. Equally, this process moves between informal correlative models towards formal causal models as it endeavors to move from *descriptive* theory towards normative theory.[368]

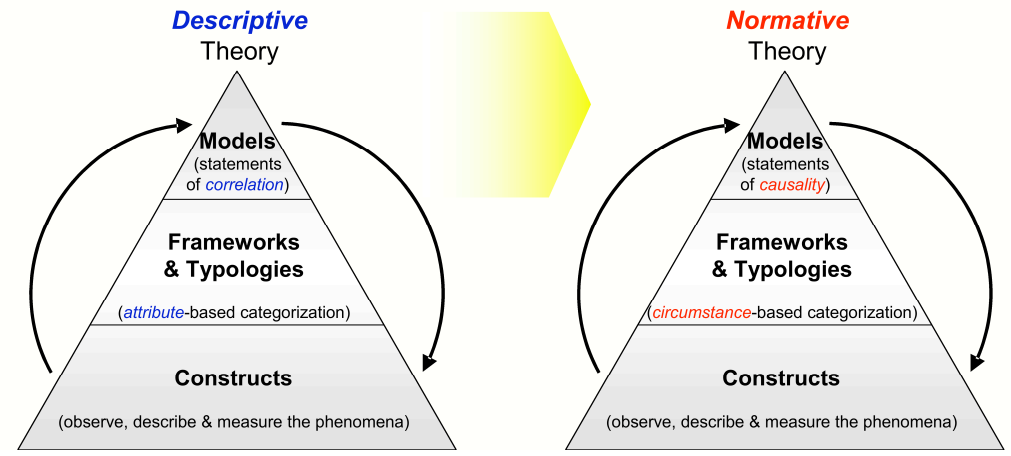

Figure 114: Process used for Theory Building[369]

Regarding the question of what are the sources of hypotheses, this research design is modeled after the approach taken by Penrose for her classic book, "Theory of the Growth of the Firm". In particular, the research aspires to use the same rich sources, namely: interviews with managers pragmatically rooted in real-world problems, conversations with students and professors, research on economic and sociological theories of architecture and growth, studies of business history, research on business literature and annual reports, extended company visits and observations (Kor and Mahoney, 2000).

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[367] Mahoney, J. T. and Sanchez, R. (1997). "Competence Theory Building: Reconnecting Management Research and Management Practice." In Heene, A. and Sanchez, R. (Eds.) *Competence-Based Strategic Management*. Chichester: John Wiley, 43-64.
[368] Carlile and Christensen, (2004).
[369] Source: Carlile and Christensen, (2004).

While the dissertation itself is likely to be written deductively, the logic of discovery comes inductively from managerial practice. Again, as inspired by Penrose, the aim is to connect the reconstructed logic of deductive sociology and economics with the theories-in-use of management (Kor and Mahoney, 2000).

> *"We argue that Penrose's knowledge-creation process can be facilitated if strategic management researchers become engaged in an **interactive, reciprocating process**. Such rich connections are the stuff that **classic management books** and research creativity are made of."*[370]

[370] Kor Y. Y. and Mahoney J. T. (2000).

2.3 Research Metaphysics

> *"All social scientists approach their subject via explicit or implicit assumptions about the nature of the social world and the way in which it may be investigated. First there are assumptions of an **ontological** nature – assumptions which concern **the very essence of the phenomena** under investigation. Associated with this ontological issue, is a second set of assumptions of an **epistemological** nature. These are assumptions about **the grounds of knowledge** – about how one might begin to understand the world and communicate this as knowledge to fellow human beings."*[371]

This section briefly describes the philosophy of the research methodology, including both its underlying *ontological* (philosophy of *existence* or *reality*) assumptions as well as its overriding *epistemological* (philosophy of *knowledge)* assumptions.

> *"The distinction between **methodology** and **method** is not a trivial one. A method is a tool or a technique used in the process of inquiry. In contrast, a methodology may be regarded as an 'intricate set of **ontological** and **epistemological** assumptions that a researcher brings to his or her work' (Prasad, 1997, pg. 2)."*[372]

2.3.1 Positivism *and Organizational Science*

> *"This article describes the **deficiencies of positivist science** for generating knowledge for use in solving problems that members of organizations face. There is a **crisis in the field of organizational science**. The principal symptom of this crisis is that as our research methods and techniques have become more sophisticated, they have also become increasingly less useful for solving the practical problems that members of organizations face."*[373]

This section briefly summarizes the difficult intellectual journey of an avowed positivist (originally trained academically and professionally to understand and design complex technical systems) toward a more interpretivist paradigm, as the nature of the phenomenon to be understood and "designed" (i.e. complex social systems) became more exceedingly more "wicked", rendering my positivist inclinations a hindrance in the quest for the "truth".

> *"**Normal science** is concerned with internal validity, experimental rigor, planning, control of confounding variables, and to a lesser extent, external validity. Understanding the phenomenon beforehand makes for clean, tidy research, but the actual knowledge return will be **incremental**. If a researcher understands the phenomenon well enough to predict and control what happens, why ask the question? The significant discoveries, the best science, require us to be more **venturesome and heretic in research design**, and to explore fundamental questions without knowing the answer in advance. The worth of the research outcome is measured by surprise. The greater the surprise, the more interesting the result, and the greater the new knowledge about organizations."*[374]

Leading organizational scientists have recently called for a break from the straitjacket imposed by normal science (Daft and Lewin, 1990, 1993). They have based their arguments on the fact that the phenomenon of effective organizations is so dynamic and

[371] Burrell and Morgan (1979), pg. xiii.
[372] Mir, R. and Watson, A. (2000), pg. 944.
[373] Susman G.I. and Evered R.D. (1978), pg. 582.
[374] Daft, R.L. and Lewin A.Y. (1990), pg. 7.

complex, that researchers need to explore build theory outside the established confines of the positivist, normal science. This is where this research dissertation takes its que.

> *"**Frameworks** can be challenged because their **complexity** makes it **difficult to falsify** arguments."*[375]

Finally, as this dissertation develops a multivariate framework, this inherently makes positivistic falsification difficult (Popper, 1963).

2.3.2 Constructivist *Methodology in Strategic Management*

> *"While realists conceive of the research process as **excavation**, where the terrain of phenomena is mined for valuable nuggets of naturally occurring insight, constructivists view the process more as an act of **sculpting**, where the theory-base of the artist interacts with the medium of the phenomena to create a model of reality which we call knowledge."*[376]

In the linear causal world of natural science where the *realist* paradigm dominates, researchers (subjects) study natural phenomena (objects) without modifying- or being modified by them. In the nonlinear causal world of organizational science, where the *constructivist* paradigm may begin to dominate, researchers (subjects) reflexively shape and are shaped by the phenomena (objects) they are studying as shown in Figure 115 below.

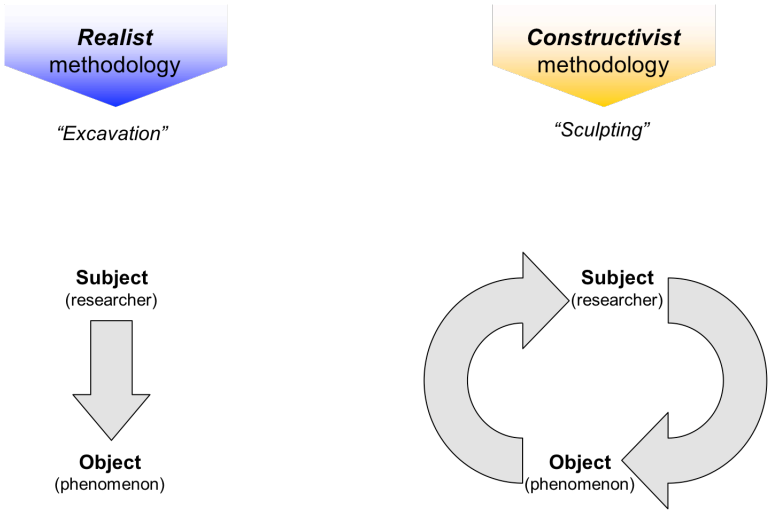

Figure 115: *Realist* vs. *Constructivist* Paradigms

While research in the field of strategic management is currently dominated by the *realist* paradigm, this dissertation takes a slightly different *constructivist* approach, which has been argued to be more logical and appropriate for the field of strategic management (Mir and Watson, 2000).

> *"Constructivism occupies a methodological space characterized by **ontological realism** and **epistemological relativism**. Ontological realism is an important cornerstone of **a field as applied***

[375] Porter, M.E. (1991), pg. 98, footnote 7.
[376] Mir, R. and Watson, A. (2000), pg. 943.

> ***as strategy**, while epistemological relativism helps us explore the constructed nature of the field, where the **researcher is an active participant** rather than a reactor or information processor."*[377]

As shown in Figure 116 below (derived from Mir and Watson, 2000), constructivism is not a polar or binary opposite of realism, but an intermediate form of methodology which is grounded in the reality of realism, while embracing the "messiness" of highly complex social systems, as particularly the higher-level, more "architectural" and power-laden echelons (as will be discussed in a later methods section on "Action Learning / Clinical Methods").

[377] Mir, R. and Watson, A. (2000), pg. 941.

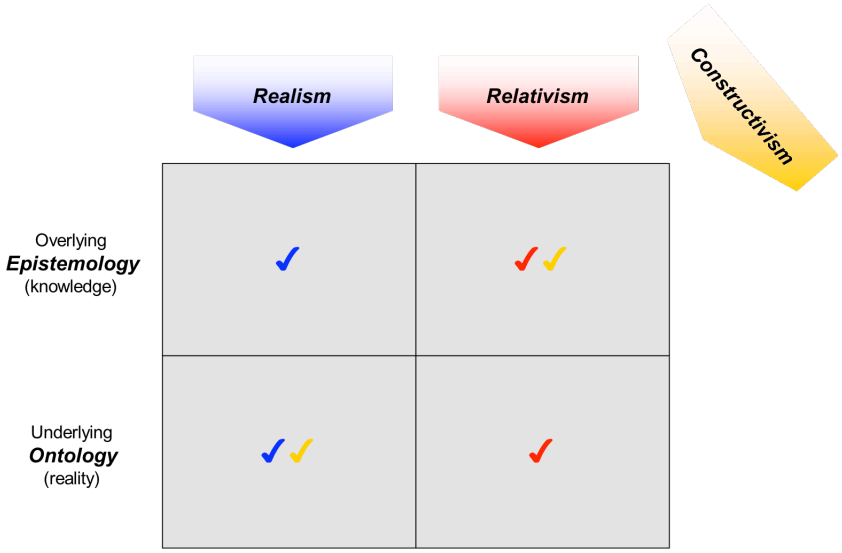

Figure 116: The "Construction" of Constructivism

Such a constructivist approach helps to explain the logic behind the necessity of spending time living, studying and researching in the academic and professional environment of each of the two firms in the primary case study (which will be discussed later in chapter 2). While the *existence* ontologically of an enterprise is not in socially-constructed, the goals, utility etc. of an enterprise is socially-constructed, requiring immersion in and participation with the society a necessary act of creating the knowledge about the phenomenon.

2.3.3 Pragmatist *Epistemology in Strategic Management*

Finally, a note regarding the philosophical and epistemological approach taken to both the research design and the subsequent theory development is warranted. In the spirit of the practical and applied nature of strategic management research, this work supports a *pragmatist* epistemology (Powell, 2001). It therefore stands in contrast to the purely positivist views that no theory can ultimately satisfy its demands, and the purely anti-positivist views that any theory would satisfy its demands. The criterion used for evaluation is the theory's capacity to solve human problems.

> *"Truths in strategy are neither certain nor final. The better theory is the* ***one that stimulates better research, better teaching, better practice****."*[378]

Under this pragmatist epistemology, the hypotheses developed will be justified through the method of 'abduction' (O'Hear, 1989), which acknowledges the ability to withstand competition among rival theories.

[378] Powell, T. (2002), pg. 879.

2.4 Research Settings

The research setting(s) were selected to strengthen the *internal* and *external* validity of the theory developed. As will be discussed in the following sections, internal validity was strengthened by using multiple lenses (i.e. those of different enterprise stakeholders) through which the case study firms were observed. External validity was strengthened by applying the theory developed in multiple industrial settings.

2.4.1 Primary *Sample Selection*

> *"Examining **outliers** departs from accepted methods because the range is restricted and outliers may represent sampling error, a misspecified model, or measurement error. This view of errors of course is based on a premise that **normal science 'proof' is the research goal**. But outliers are a powerful source of new ideas. **Significant insights** can arise from studying the **best or the worst of a population**."*[379]

> *"A particularly important theoretical sampling approach is **'polar types,'** in which a researcher samples **extreme (e.g. very high and very low performing) cases** in order to more easily observe contrasting patterns in the data."*[380]

Given that the primary focus of this research is on building grounded theory, a *theoretical* sample is created.[381] The theoretical sampling was designed to build theories of relative competitive performance based on in-depth field-based research of "polar" types of enterprise architectural forms, representing different "strategic groups" within the same industry (Porter, 1981).

> *"Industry-specific groups create **heterogeneity**. Firms in different strategic groups within an industry may **react differently to environmental disturbances** and competitive patterns."*[382]

Although the typical model for much of the strategic management research consists of selecting a large 'N' *statistical* sample consisting of many firms competing within a given industry, this research centers on a small 'N' *theoretical* sample which consists of the remaining two large firms in a mature global duopoly.[383] This duopolistic situation presents a unique opportunity to control for industry effects by empirically investigating the strategic trajectories of all (i.e. both) the firms within their industry (Dess, Ireland and Hitt, 1990).[384]

Multiple firms will be used as data sources however, as the sample will embrace the stakeholders in the extended enterprise of each of the two main members. This is done to give a rich systemic view of the firm's competing enterprises.

The theory developed herein attempts to understand and predict the competitive dynamics of firms throughout the lifecycle of an industry, from birth to maturity. As a result, the

[379] Daft, R.L. and Lewin, A.Y. (1990), pg. 6.
[380] Eisenhardt, K.M. and Graebner, M.E. (2007), pg. 27.
[381] With small 'N' theoretical samples, "plausible rival hypotheses" (threats to validity) must be ruled out which make research findings tentative and ambiguous.
[382] Dess, G.G., Ireland, R.D. and Hitt M.A. (1990), pg. 20.
[383] See March, J.G. et al. (1991) on learning from samples of one or fewer.
[384] Firm "survivor bias" is present as the data set contains only those firms that survived during the time period.

theoretical sample is designed to contain an early entrant firm (which is now the incumbent) and a late entrant firm (which is now the challenger). By definition therefore, the theoretical sample focuses on large, mature firms.[385]

As this research attempts to understand the co-evolution of firms and industries, datasets in which industries have gone through most of their lifecycle are important. In addition, as industries mature, they tend to shake-out towards oligopoly. By definition, therefore, a large-n statistical sample of the firms in a mature industry becomes difficult. In addition, in the SCP paradigm, firm *conduct* is deemed to govern over industry *structure* in oligopoly settings. This fact allows us to examine the highly important firm conduct in oligopoly settings (as shown in Figure 117 below), provided that a set of well-conceived theoretical samples can be assembled.

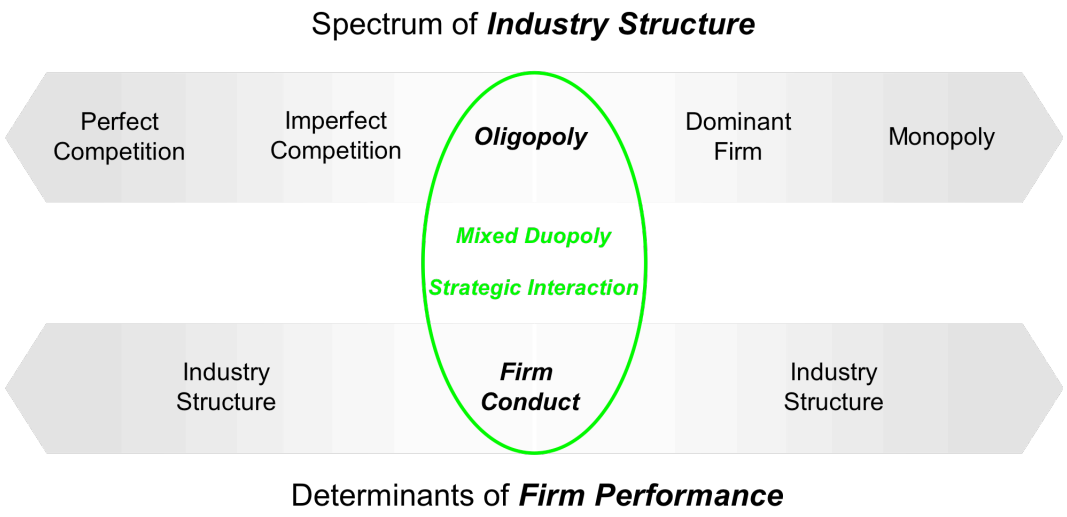

Figure 117: Influence of Industry *Structure* and Firm *Conduct* on Sample Selection[386]

The above discussion specified the constraints for the selection for the primary theoretical sample:

- Oligopolistic industry *structure* to ensure relevance of firm *conduct* (preferably duopoly).
- Mature (post-dominant design) stage of industry evolution with clear *incumbent* and *challenger*.
- Firm objective functions representing both *shareholder value* and *stakeholder surplus* focus (i.e. "mixed duopoly").
- Enterprise architectural forms representing both *modular* and *integral*.
- Firms belonging to different "strategic groups" with strategies representing both *differentiated* and *cost-leadership*.

Given these constraints, only one industry and one firm set met all of the above criteria.

[385] The focus on large, mature firms is also found in Penrose (1959) and Porter (1980).
[386] Source: Saloner, G., Shepard, A., and Podolny, J. (2001).

2.4.1.1 *Spatial* setting

2.4.1.1.1 *Industrial* setting

Spatially, the primary research is confined to a particular global industry: the large commercial airplane industry[387].

2.4.1.1.2 *Incumbent* and *Challenger*

> *"The distinction between **entrants and incumbents** is critical to future studies of performance variation within and across industries."*[388]

After nearly 100 years of intense competition in this industry, the population of competing firms has gone through the various evolutionary stages of variation, selection and retention, resulting in a global duopoly comprising: the US incumbent, *Boeing Commercial Airplanes*, and the EU challenger, *Airbus Industrie*.

For parsimony, the incumbent firm will be referred to as "Firm α", while the challenger will be referred to as "Firm β" in all industries.

2.4.1.1.3 Firms and their *Extended Enterprises*

Beyond the two firms in the large commercial airplane industry, this research will additionally study their extended enterprises – on multiple dimensions. While there will be tendencies to draw conclusions about the two firms based on the historical trajectories of their respective ownership structures, this research will attempt to enrich this description.

> *"Airbus was a 'groupement d'intérêt économique', a form of commercial partnership established in French law in the mid-1960's, which was mainly intended to help wine growers. A GIE, as it is known, is a **flexible** and user-friendly **form of corporate structure**, although it tends to baffle Anglo-Saxons – and Americans in particular – used to the **rigid structure of the limited company**."*[389]

As shown in Figure 118 below, it is tempting to declare that *Airbus* possesses a modular enterprise architecture based on the observation that it is a loose collection of national companies[390], while *Boeing* is largely a monolithic or integral enterprise architecture which designs and manufacturers more within the confines of one nation's borders and within one company's logo.

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[387] Standard Industrial Classification, SIC as follows: Division D: Manufacturing; Major Group 37: Transportation Equipment; Industry Group 372: Aircraft and Parts; Industry 3721: Aircraft. "Large" airplanes being defined as those having over 100 seats.

[388] Walker, G., Madsen, T. L., and Carini, G. (2002). "How does Institutional Change Affect Heterogeneity Among Firms?" *Strategic Management Journal*, 23: 89-104.

[389] Lynn, M. (1997), pg. 113.

[390] *Airbus* is the collection of French (*Aérospatiale*), German (*DASA*), Spanish (*CASA*) and UK (*BAE Systems*) companies.

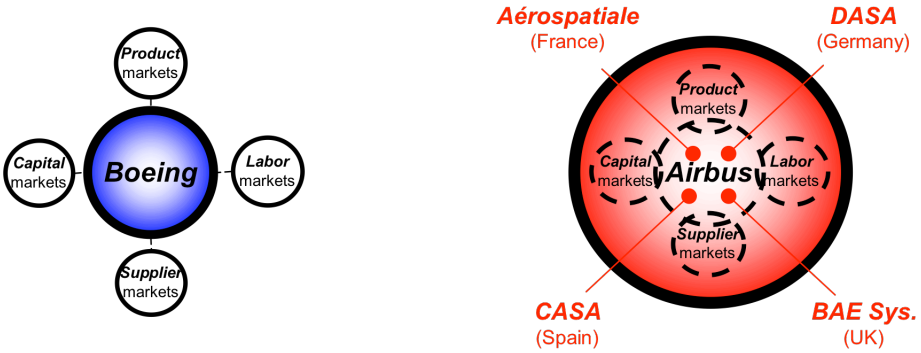

Figure 118: *Modular* or *Integral* Enterprise Architectures?

As will be discussed in greater detail in Essay #1, systems or enterprises require both differentiation and integration, with effective enterprises having: a) levels of structural differentiation which are suitable to the demands of the environment, and b) levels of structural integration which match the levels of differentiation.

All complex systems are de-composed in to parts, whether visible or not. Just because one enterprise (*Airbus*) is composed of four visible "modules", namely French, German, Spanish and British companies, does not mean that the enterprise has a "modular" architecture – it depends on the quality of interaction between modules. Conversely, just because another enterprise (*Boeing*) is composed of one visible "module", does not mean that the enterprise has an "integral" architecture.

As will be defined and discussed later, we will need much richer definitions to extract structure from behavior – definitions that transcend the low-level explanations of geographical location and asset ownership. Once these are established, one can then proceed to posit relationships between organizational architectures and the architectures of the products and services they produce.

2.4.1.2 *Temporal* setting

2.4.1.2.1 Industry Clockspeed

> *"Fruit flies are what I call a fast-clockspeed species. That is, they have an extremely brief life cycle. Mammals, such as elephants and humans live by much slower clockspeeds. They measure their lives in decades, not days. Even slower are reptiles. The hardy sea turtle, whose life span can exceed a century, has evolved little since its terrestrial cousins, the* ***dinosaurs*** *roamed the earth... But my work* [on researching business evolution], *focused primarily on the* ***dinosaur-like metal bending industries, proceeding slowly – painfully so****... For all the supply chain dynamics on view, I might as well have been* ***watching glaciers advance****... At the slowest end of the clockspeed scale – up there with the sea turtles and the California redwoods – are the* ***manufacturers of aircraft****."*[391]

Recently, researchers have begun to study the dynamic and simultaneous evolution of products, processes and organizations in terms of their "clockspeeds" (Fine, 1998). In an effort to dramatically increase the productivity of such research, Fine cleverly compressed time by choosing to focus his research on the study of those industries and portions of value chains having fast-clockspeeds. In this way he could observe their evolution over a large number of lifecycles, and develop theories which may extend to a more generalizable range of clockspeeds.

While he laments the difficulties of studying corporate "dinosaurs", like *Boeing* (i.e. those having slow product, process or organizational clockspeeds), he recognizes the merit of doing so in order to validate the "dynamic laws of the extended enterprise" that he derived from the fast-clockspeed species. This research dissertation represents one such effort.

The benefit of researching a slow-clockspeed firm like *Boeing* is that one can slowly and carefully observe, dynamically develop and test hypotheses and analyze in real time the movements of the species, as it is locked in a competition with another slow-moving species, *Airbus*. While the benefits are apparent, the costs are high in terms of required resources (e.g. time, money, access, etc.). In addition, the long, extended periods of field observation must inevitably be supplemented and complemented with historical research methods, as even a 5-7 year field-based participatory research program captures only a small fraction of the lifecycle of the products, processes and organizational lifecycles inherent in the industry.

2.4.1.2.2 Time span

Temporally, the longitudinal *quantitative* research spans the 36-year period from the birth of the challenger, *Airbus* in 1970 up to today, where it has recently overtaken the incumbent, *Boeing*.[392] In addition, the longitudinal *qualitative* field-based research is designed to occur over six years. The past four-and-a-half years, spanning from January 2002 to June 2006, documented the managerial cognitive frames of *Boeing* and its enterprise stakeholders. In the three years from 2005-2008, the managerial frames of *Airbus* and its enterprise stakeholders are being researched and documented.

[391] Fine, C.F. (1998), pp. 4-7.
[392] As measured by annual airplane deliveries (in 2003-2005) and annual airplane orders (in 1998-2005).

The historical milestones of the main competitors within the primary case study industry are shown in Figure 119 below.

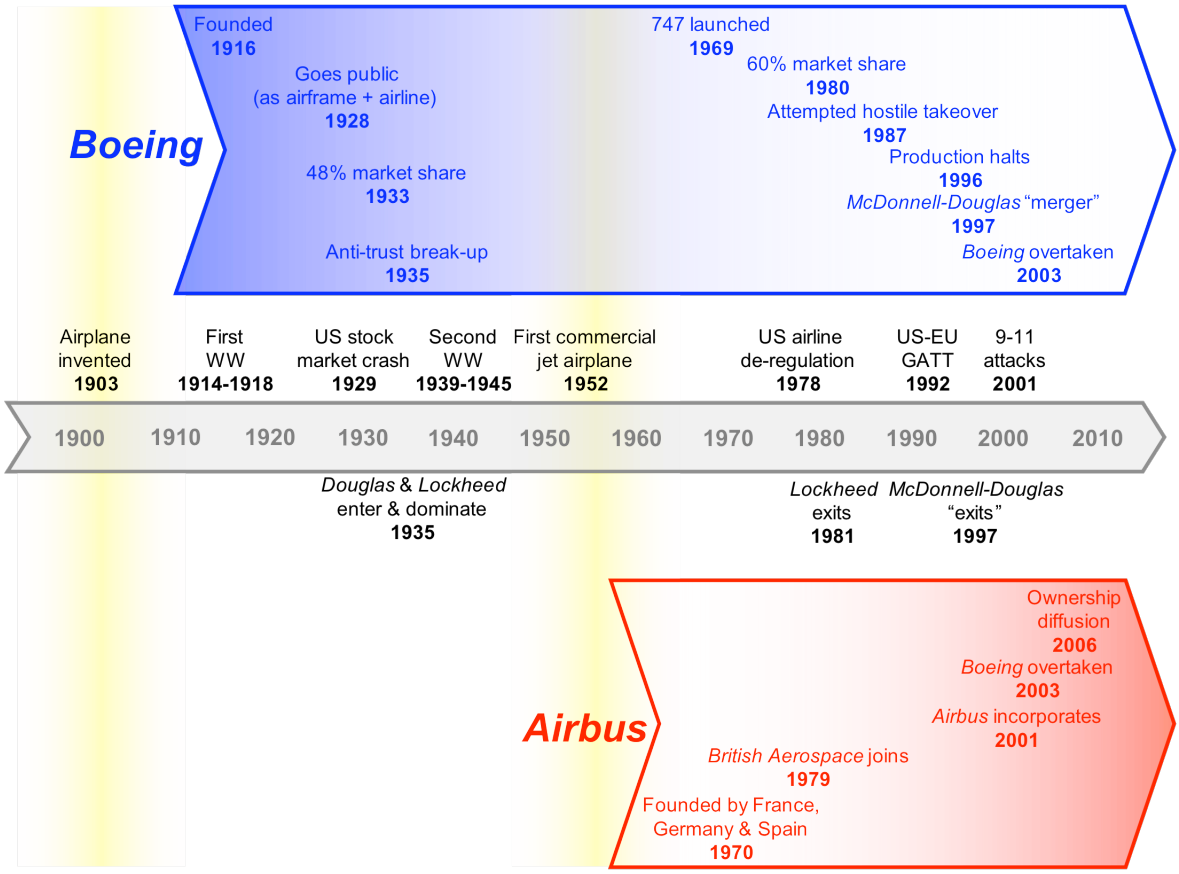

Figure 119: Historical Milestones of Main Competitors in Commercial Airplane Industry

2.4.1.2.3 "Critical Event" / Temporal Discontinuity

> *"If there was ever a **stress test for a good business**, this is it."*[393]

In addition, this research uses the exogenous industry discontinuity of the September 11, 2001 terrorist attacks in the US as a "critical situation" within which to examine firm strategic response.

[393] Presentation by Kevin Murphy, airline industry analyst for *Morgan Stanley* at MIT Sloan School of Management, October 2001 (as reported in Hoffer-Gittell, 2003, pg. 236).

2.4.1.3 Industrial idiosyncrasies

2.4.1.3.1 "Wicked" problems

The industry chosen for the primary case study has a high degree of complexity measured on two distinct (but coupled) dimensions: *dynamic* complexity, and *behavioral* complexity (Ackoff, 1974; Roth and Senge, 1995). As shown in Figure 120 below, each will be discussed briefly in the following subsections.

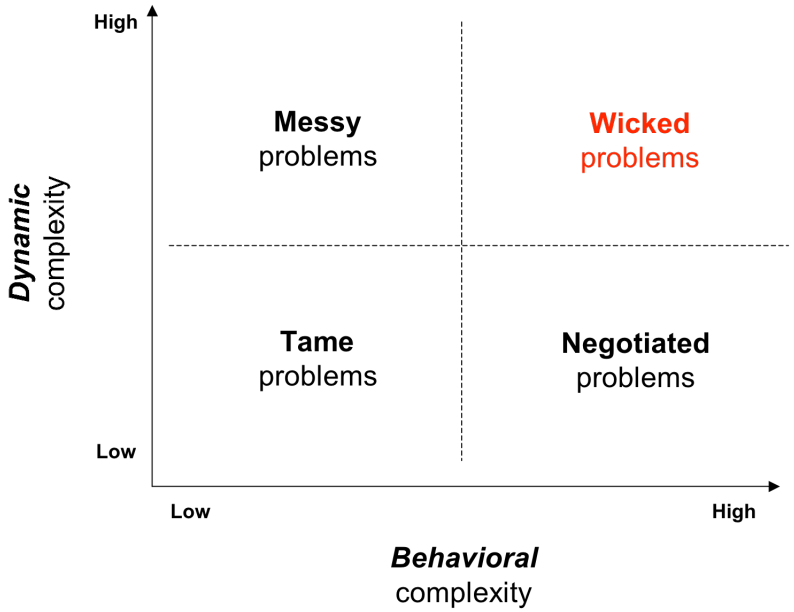

Figure 120: *Dynamic* and *Behavioral* Complexity

2.4.1.3.1.1 *Messy* problems: high *dynamic* complexity

Dynamic complexity occurs when cause and effect are distant in space and time (Senge, 1990, pg. 71). This tends to arise within integral enterprise architectures. Ackoff (1974) refers to such problems as "messes". Sterman (2000, pg. 22) notes that such problems tend to be nonlinear, whereby effect is not proportional to cause.

> *"The real leverage in most management situations lies in lies in understanding **dynamic** complexity, not **detail** complexity."*[394]

Senge (1990) differentiates *dynamic* complexity from *detail* complexity, which is merely the existence of many variables.[395] Focus on *detail* complexity often results in "laundry lists"[396] of important variables, but does not reveal sources of *dynamic* complexity. Later in chapter 3, a multitude of plausible explanations for long-term firm performance (or lack thereof) will reveal a focus on detail complexity, and a lack of understanding of dynamic complexity.

[394] Senge, P. (1990), pg. 73.
[395] Sterman, J. (2000), pg. 21, refers to detail complexity as "combinatorial complexity".
[396] Senge, P. (1990), pg. 130.

2.4.1.3.1.2 *Negotiated* problems: high *behavioral* complexity

Behavioral complexity arises when many diverse agents (or stakeholders), each with conflicting goals and or values have decision-making power. Solution of this class of problem tends to require negotiation, as various zero-sum behavioral games are played among stakeholders, whereas positive sum results would benefit all as in the case of integral enterprise architectures.

2.4.1.3.1.3 *Wicked* problems: Examples

The classic example of the "mildly wicked" problem is the Beer Game or the simple stylized supply chain. Here cause and effect are distant in space and time, and various agents have conflicting local goals and behave as if locked in a zero-sum game. Note that the problem is "wicked" even in the presence of low detail complexity.

As will be argued later, the global commercial airplane industry is "clearly wicked", as cause and effect are very distant in space and time due to the reasons explained below (e.g. high fixed costs, economies of scale, strong learning curve-experience effects, long-development times, long-lived products, etc.).

Finally, "extremely wicked" problems include the Cold War, the Israeli-Palestinian conflict, the U.S. war on terror, etc.

2.4.1.3.2 *Intelligent Design* to Solve Wicked Problems

Architectural Leadership is required to 'intelligently design" solutions to the above "wicked problems."

2.4.1.3.2.1 Intelligence Generates *Knowledge*

2.4.1.3.2.2 Emotional Intelligence generates *Courage*

2.4.1.3.3 Economies of Scale & Barriers to Entry

Other industry structural factors include the tend towards *natural monopoly*, i.e. the minimum efficient scale is rather large, given the high fixed production costs, the relatively small annual volumes of sales and the high inherent market and technological risks associated with launching a $10 billion project, for which there will only be around 1,000 units sold over 20 years (i.e. 50 units per year).[397] In most natural monopoly settings, such an environment makes regulation an expected part of the competitive enterprise dynamics.

As competition tends more and more towards cost-leadership as the modus operandi, production volumes and therefore economies of scale and learning curve effects are a crucial source of cost leadership. It is for these reasons that market share (i.e. delivery share) is an unusually, important metric or proxy for long-term competitive performance.

> *"**International high-technology industries** are typically characterized by structural mobility barriers such as irreversible commitments and product differentiation; static and dynamics economies of scale, scope and learning that create increasing returns to scale; and path dependencies and R&D races with high uncertainty and potential first mover benefits. These structural characteristics are viewed as creating **imperfectly competitive markets** in which supernormal profits or rents, may be possible, and in which **time** becomes a **fundamental dimension of competition**."*[398]

Various research studies have investigated the commercial aircraft industry, including *The MIT Commission on Industrial Productivity* (Dertouzos et al., 1989).

> *"The argument in the **MIT study**, that many of the difficulties of American firms are having are **self-inflicted**, is quite persuasive."*[399]

2.4.1.3.4 Increasing Returns & Imperfect Competition

> *"**Aerospace** is afflicted with many of the classic cases of **market failure**."*[400]

Economist Paul Krugman (1987) argued for free-trade in all but a few rare instances, notably where increasing returns and imperfect competition dominate (e.g. in commercial airplanes).

> *"If **increasing returns** and **imperfect competition** are necessary parts of the explanation of international trade, however, we are living in a second-best world where **government intervention can in principle improve on market conditions**."*[401]

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[397] This point was recently reiterated in *The Economist*, June 25th, 2005, pg. 89.
[398] Braham, R. (1995), pg. 73.
[399] Nelson, R.R. (1991), pg. 63.
[400] Neven, D. Seabright, P. and Grossman, G.M. (1995), pg. 316.
[401] Krugman, P. (1987), pg. 134.

2.4.1.3.5 Strategic Trade (Industrial) Policy

> *"As businessmen have always said and economists have usually denied, a protected domestic market can – **under some circumstances**! – **promote** rather than discourage **exports**, and possibly **raise national income**."*[402]

Industrial policy has had long implications a both *Boeing* and *Airbus*.

[402] Krugman, P. (1987), pg. 136.

2.4.2 *Secondary Sample Selection: Counterfactuals*

> *"This work was carried out in **two distinct, but related phases.** The first was a detailed study of…firms operating in one industry. The second phase was a study of a **highly effective organization** (by conventional economic and commercial standards) and a **less effective competitor in each of two other industries**."*[403]

Like Lawrence and Lorsch's classic 1967 work, *Organization and Environment: Managing Differentiation and Integration*, this research dissertation uses a two-phase comparative approach between highly effective and less effective competitors in three different industry settings. The first phase was described in the previous section. The second phase covering competitors in two other industries will be presented in this section.

In an attempt to extend the generality of the proposed theoretical framework (i.e. to ensure external validity of the theory), the research will test from a longitudinal quantitative perspective using panel datasets, the applicability of the theory to *archetypal* competitive spaces in both manufacturing and services: *General Motors* and *Toyota Motors* in the global automotive industry from 1970-2005 and *United Airlines* and *Southwest Airlines* in the US airline industry from 1970-2005.

> *"Since accurate evidence is not so crucial for generating theory**, the kind of evidence, as well as the number of cases, is also not so crucia**l. A single case can indicate a general conceptual category or property; a few more cases can confirm the indication."*[404]

The following subsections briefly describe how the theoretical sample will be selected to "control" for various variables by seeking counterfactual case studies.

2.4.2.1 Control for *Industry* effects

> *"**Adequate controls** for potential industry effects have **not been used** in many **strategic management** studies."*[405]

Many of the most influential empirical studies in strategic management have been demonstrated not to use sufficient controls for industry effects, resulting in erroneous conclusions (Dess et al., 1990). For example, it was observed that firms sampled across multiple industries that use related diversification performed better than firms that used unrelated diversification (Rumelt, 1974). Careful re-analysis of this research revealed that the high firm performance was due to the high profitability of the firm's industries, and those successful industries tended toward related diversification (Rumelt, 1977 and 1982).

> *"**Single industry studies** are a relatively straightforward approach to **control for industry effects**."*[406]

[403] Lawrence and Lorsch (1967a), pg. 19.
[404] Glaser, B.G. and Strauss, A.L. (1967), pg. 30.
[405] Dess, G.G., Ireland, R.D. and Hitt, M.A. (1990), pg. 7.
[406] Dess, G.G., Ireland, R.D. and Hitt, M.A. (1990), pg. 20.

The logic of the sample selections therefore is to use *single industry studies* (Dess et al., 1990) which investigate an incumbent and its primary challenger. However, to extend the generalizability of the theory while maintaining control for industry effects, the sample will be expanded to include a collection of single industry studies.

As more industries are added, the logic of the sample selection is to use *stratified samples by industry* (Dess et al., 1990), in which the samples are consistent with the variables and relationships being measured. All industries investigated would therefore share fundamental characteristics: (e.g. high consolidation, high entry/exit barriers) as well as share fundamental environmental characteristics (e.g. mature stage).

2.4.2.2 Control for *Environmental* effects

> *"Use of a **single dimension** of an industry's environment to **build theory** and to test proposed relationships empirically may result in a **failure** to investigate alternative plausible explanations of observed relationships."*[407]

Even though a set of firm pairs operating in the same industry will be analyzed, it is important that the environmental state is controlled. The study therefore proposes to look at firm pairs (an incumbent and challenger), each having been established in different environmental regimes (e.g. emerging and maturing industries), and both competing in an industry that has run its full course to maturity. As will be described later in essay #3, the environment will be characterized using multiple dimensions (e.g. quantity and quality of output) to capture the essence of the environmental state (e.g. munificence, dynamism, and complexity).

2.4.2.3 Control for *Sector* effects

In addition, the sample is intended to begin to control for sector effects, i.e. to determine if the methodology can apply to both manufacturing as well as service industries. It is for this reason that a world-class manufacturing firm (i.e. *Toyota Motors*) and a world-class service firm (i.e. *Southwest Airlines*) are used.

2.4.2.4 Control for *International* and *Socio-Economic* effects

Finally, these two case studies, taken together with the primary case study of *Boeing* vs. *Airbus*, form a collection of three cases each representing an incumbent US firm against a challenger representing the three "triad" economic powers: the US (*Southwest Airlines*), EU (*Airbus*) and Japan (*Toyota*). In other words, they were selected to begin to control for national and socio-economic effects - to determine if integral enterprise architectures, which tend to dominate in the mature industries, are not just a product of "socialist societies". The small theoretical sample is not intended to be statistically robust, but merely to present a counterfactual example.

[407] Dess, G.G., Ireland, R.D., and Hitt, M.A. (1990), pg. 16.

2.4.2.5 Selection Criteria for *Incumbent* and *Challenger*

As the primary sample comprises an industry in a state of duopoly, having a clear incumbent (firm α) and a clear challenger (firm β), the selection criteria need not be very explicit. However, in the secondary and tertiary theoretical samples, clearer definitions are required.

The incumbent (firm α) is defined as the acknowledged leader in the industry, typically measured as having the largest market share at one time in its history.

The challenger (firm β) is defined as having been founded sometime after the current incumbent, and on a clear and sustained trajectory towards displacing the incumbent – regardless of whether or not it has surpassed the incumbent.

2.4.3 Tertiary *Sample Selection*

Finally, in an effort to further extend the validity and generality of the theory, other case studies are recommended for future in-depth analysis. These are meant to control for other effects like industry clockspeed, and state of industrial evolution. Figure 121 below summarizes the key attributes of the theoretical sample used in this research.

		Independent variable $X_1(t)$	***Independent*** variable $X_2(t)$	***Independent*** variable $X_3(t)$	***Dependent*** variable $Y(t)$	
	Industry (Sector)	**Incumbent / Challenger**	**Enterprise Architecture**	**Structural Dynamics**	**Industrial Evolution**	**Firm Performance**
Primary Case for theory building	Com. Airplane (manufacturing)	*Boeing* (US) *Airbus* (EU)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent overtaken
Services *Archetype* Case	Airline (services)	*United* (US) *Southwest*(US)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent overtaken
Manufacturing *Archetype* Case	Automotive (manufacturing)	*GM* (US) *Toyota* (JPN)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent being overtaken
Control for ***Clockspeed***	Computer (manufacturing)	*IBM* (US) *Dell* (US)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent overtaken & exits
Control for ***Industry Maturity***	Comp. Chip (manufacturing)	*Intel* (US) *???*	Modular		*Pre-* dominant design	Incumbent leads
	Com. Airplane (manufacturing)	*Bombar.* (CN) *Embraer* (BR)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent being overtaken
	Air Cargo (services)	*Fedex* (US) *UPS* (US)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent being overtaken
	Retail (services)	*Walmart* (US) *Costco* (US)	Modular Integral	Incumbent less stable	*Post-* dominant design	Incumbent being overtaken

Figure 121: Proposed *Theoretical* Sample

2.4.4 *Addressing Sample Selection Bias*

This dissertation must address the charge that the cases were chosen to fit the result we wanted. Sampling on the dependent variable.

2.5 Data *Sources*

Both qualitative and quantitative data were gathered from both primary and secondary sources which allowed the establishment of construct validity.

As summarized in Figure 122 below, in light of the three essays of this proposed research, both primary and secondary data sources are important to define the *structure* of enterprise architectures (Essay #1); primary data sources, in terms of cognitive mental models of the most senior decision makers, gathered longitudinally are important in Essay #2 in order to define how the enterprise architectures *function*; finally secondary data sources, in terms of archival documents are important in Essay #3, in order to define how enterprise architectures *evolve*.

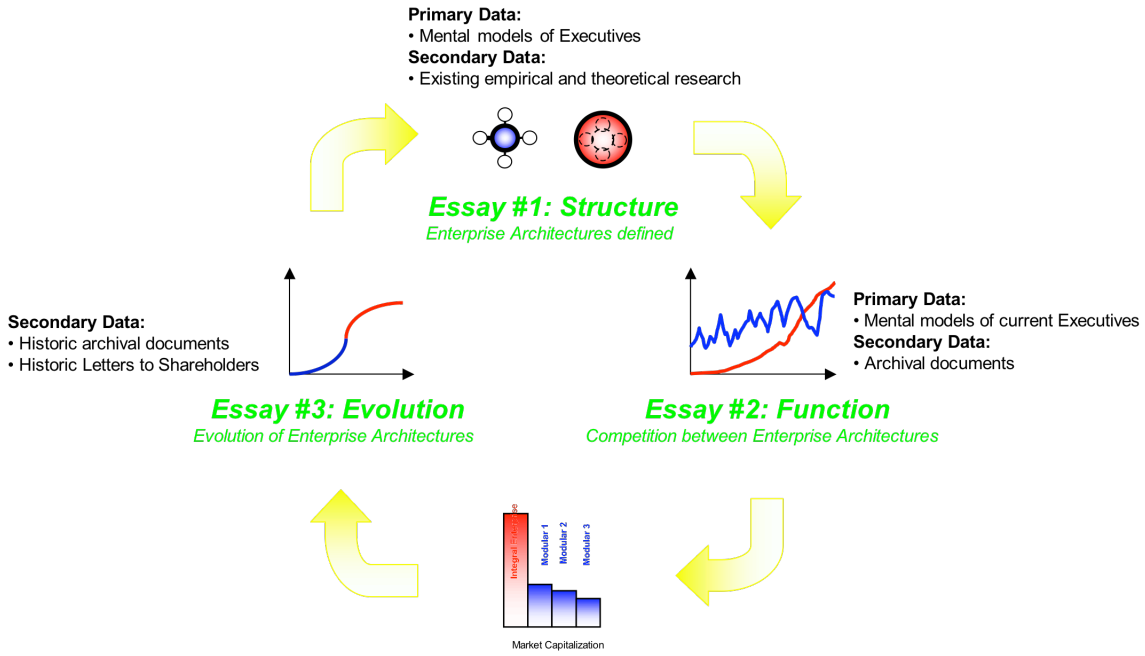

Figure 122: Important Data Sources for each part of the Framework

2.5.1 Primary *data sources*

As will be discussed in more detail in the subsequent sections, the primary data sources consisted of senior decision makers (informants) at each stakeholder within a given firm's extended enterprise, namely the firm, its customers, suppliers, investors, unions and competitors. The data collection methods and techniques will be discussed in the following section.

2.5.2 Secondary *data sources*

Examples of secondary data sources included archival documents including published company annual reports as well as interview transcripts from published trade and news journals.

By way of example, longitudinal analysis of *The Boeing Company* alone required the acquisition and review of over 75 years of annual reports totaling over 2,200 pages of text.

Additionally, review of the ongoing dynamics of the *Boeing-Airbus* rivalry included analysis of over 20 news sources per day (from sources like *Factiva*) over the past four years, totaling over 2,400 pages of text.

In order to begin to piece together the respective histories of *Boeing* and *Airbus*, numerous texts documenting their development were consulted (e.g. Lynn, 1997).

2.6 Data *Collection* Methods and Techniques

2.6.1 *Executive Summary*

The plan is simply to work with the most senior leaders of both competitor firms as well as the leaders of their key stakeholders to solve their most difficult strategic problems using whatever methods and techniques are most effective for the situation at hand. Repeat this process periodically over time until theoretical saturation occurs and/or financial and temporal resources expire. Beyond that, there is no more specific plan - there can not be - as the nature of the problem that one is asked in "solving" is continually changing, as well as the composition of the leadership in the enterprises.

2.6.2 *Methods*

The best way to describe the data collection process is the author led an intensive 6-year longitudinal group model building, critiquing and testing exercise primarily with the senior leaders of the major stakeholders of both enterprises in a global duopoly. The purpose of the model (or grounded theory) development focused on understanding the competitive dynamics within the industry. The resulting model is ultimately then transformed into a more formal simulation model.

> *"The specific methods appropriate for this kind of research do exist but are relatively rarely applied to strategy process research* ***- longitudinal studies, action science, the ethnographic approach, and clinical methods****."*[408]

As shown in Figure 123 below, the approach taken to data collection is highly pluralist and full-cycle (Chatman and Flynn, 2005), and the primary methods of data collection span the spectrum of researcher presence, ranging from "invisible" ethnographic techniques (Van Maanen, 1988) to the more "visible" techniques of participatory action research (Heron and Reason, 1997), and in particular, *action learning* (Clark, 1972; Pedler, 1991; Revans, 1980, 1982) and ultimately *clinical methods* (Schein, 1987). These will be compared and contrasted in the following sections and implications will be drawn for this research plan.

> *"We advocate a* ***full-cycle*** *approach to conducting organizational behavior research. Full-cycle research begins with the observation of naturally occurring phenonema and proceeds by* ***traveling back and forth between observation and manipulation-based research settings****, establishing the power, generality, and conceptual underpinnings of the phenomenon along the way. Compared with more traditional approaches, full-cycle research offers several advantages, such as* ***specifying theoretical models****, considering actual and ideal conditions, and promoting* ***interdisciplinary integration****."*[409]

[408] Stacey, R. (1995).
[409] Chatman, J.A. and Flynn, F.J. (2005), pg. 434.

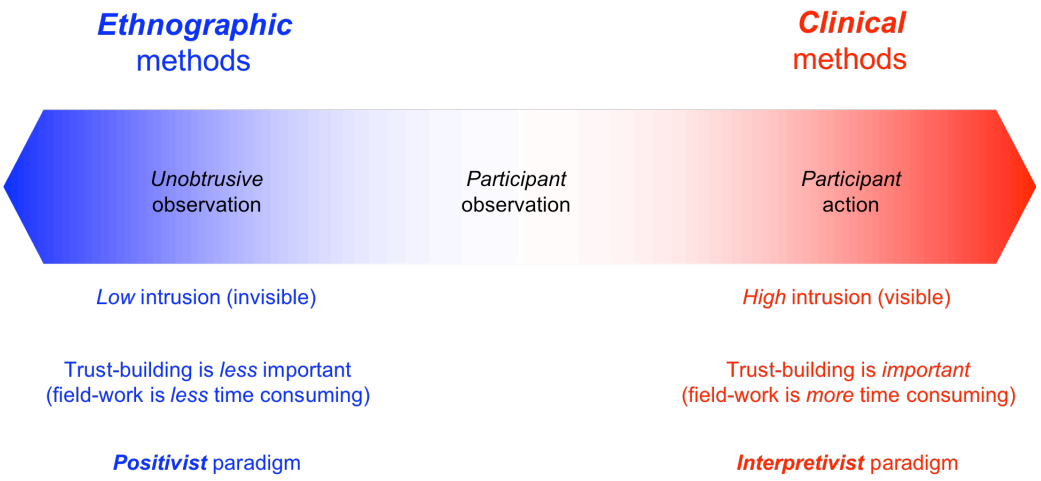

Figure 123: Researcher Intrusion Spectrum

> *"As the **relationship with the organization develops**, it is perfectly possible, indeed quite likely that* (ethnographic and clinical) ***roles will merge** more and more. Clinicians find opportunities to 'wander around' and 'observe'...and thus are able to gather the kind of data that the ethnographer is seeking. Ethnographers are likely to be thrust increasingly into clinical roles as they come to be taken for granted and build up trust."*[410]

As we transition the discussion of the research methods used in this dissertation from the more passive towards the more active role of the researcher, it is important to observe the *continuity* of theoretical legitimacy not *discontinuity*.

> *"**Open-ended interviews and participant observation**... are ways of discovering how economic participants think about the world. They are means, in other words, of identifying toe model of that portion of the socioeconomic world which the participants themselves use in making decisions. The conventional interpretation is captured in what at **MIT** is called Robert Hall's law: You can never believe the answer to a direct question about behavior, or more crudely, **'businessmen always lie.'** This intrpretation, however, suggests that this law misses the point: what interviews can reveal is not a set of specific answers to specific questions, individual bits and pieces of information. What they reveal are **patterns of responses**. Each answer, whether true or false, is a piece of that pattern. Individual responses cannot be interpreted in isolation. But the **responses grouped together, and taken as a whole**, are clues to the mental processes of the economic participants."*[411]

[410] Schein, E. (1987), pg. 24.
[411] Piore, M. (1979), pg. 566.

Finally, it is instructive to compare this approach to methods with those from previous influential researchers in the intellectual domains that this research aims to contribute, for example the original contingency theorists. This description of Burns & Stalker's research method bears a strong resemblance to the methods employeed herein.

> *"The methods of study we have followed are those common to what is called* ***field sociology*** *and to* ***social anthropology***. *These are simply directed towards* ***gaining acquaintance, through conversation and observation, with the routines of behavior current in the particular system being studied****, and trying thereafter to reach an appreciation of the* ***codes of conduct*** *which are supposed by the members of the system to* ***underlie behaviour***. ***All this emerged fairly slowly in the course of the interviews, meetings, lunch-time conversations,*** *and the like. At the same time we, as outside observers, have tried to construct some systematic explanatory description of what we have been told and have observed.*
>
> ***All this is very far removed from any method of investigation which could possibly be called scientific****. It does not share the principal advantage of anthropological field method, which lies in* ***a lengthy period of residence in the community being studied****. Everything has had to depend on what* ***ability we had to appreciate the significance of the things and happenings*** *we saw during out spells inside factories, and to* ***elicit information in interviews and conversations****. We had also to learn to* ***distinguish the tones and additives which were occasioned by our roles as outsiders, as academic people, as confidants, as critics****.*
>
> *Our usual procedure, after the first* ***interview with the head of a firm, was to conduct a series of interviews with as large a number of persons as possible*** *(some 300 persons)* ***in managerial and supervisory positions****.* ***Such interviews lasted anything from one hour to a whole working day****.*
>
> *It was during this stage that it proved possible* ***to create a more productive relationship*** *than can be constructed on the basis of one person's seeking information from another. The* ***conventions*** *governing such interviews and the limits of of information regarded as admissible or relevant are* ***nowadays prescribed fairly strictly****. To go beyond these limits, it is not enough to demonstrate interest or even sympathy; in the writers' experience,* ***an informant will get to the point of formulating and presenting his experience, beliefs, opinions, anxieties, and criticisms only when there has been established a relationship which is reciprocal in some genuine sense****; when there is some point for the informant in going further than the needs of courtesy, and compliance with an undertaking by the firm to* ***co-operate with the researcher****, seem to require of him. Thus the researcher has to* ***make the relationship 'real'****; one in which he is prepared to behave on his side as what he declares himself to be. This can be done only by showing how he is* ***making use of the information he is receiving****; by the occasional* ***interpretation of a situation*** *in terms which are both derived from his perception of the situation as an outsider and as a sociologist or psychologist, and which are also appropriate to his informant's ability or preparedness to comprehend it. From then on, whether the interpretation is accepted or not, there is a* ***freer, more satisfactory quality about the interview, a stronger desire to recruit and present facts, examples and views. There are no interpretations and appraisals contained in any part of this report which have not been communicated at some time or other to persons involved in the situations at issue. Invariably, also, we have found our own ideas being amended, extended or corrected by such traffic****.*
>
> *After we had become acquainted with the general* ***structure*** *and* ***functioning*** *of the organization, we sought opportunities of observing how people dealt with each other, and also of pursuing, by further interviews, some of the problems of description and interpretation which by this time had appeared. In their simplest and most significant form,* ***these problems were presented as discrepancies between the account of the same*** *functions or* ***parts of the organization given us by different people concerned in them. Such discrepancies, in our experience, are always present, and provide the most direct introduction to the analysis of a situation or social system in sociological terms****."*[412]

[412] Burns, T. and Stalker, G.M. (1961), pp. 12-15.

2.6.2.1 Ethnographic Methods

> *"The goal is to reveal the **underlying structure** that is out there, and the assumption dominates that if the ethnographer had **sufficient time** to **observe passively** it would eventually **reveal itself**."*[413]

Nearly all of the initial fieldwork began as a series of unobtrusive ethnographies at multiple enterprise stakeholder sites. Various techniques such as observation, participant observation, archival documentation review, unstructured, semi-structured and structured interviews, and focus groups[414] were employed in order to build empirically valid, albeit relatively shallow data sets.

Within strategic management, recent interest in studying firm heterogeneity with an industry via the resource-based view tradition, has lead to calls from academic to employ more obtrusive methods (Rouse and Daelenbach, 1999).

> *"Ethnographic methods include those that range from the low-intrusion types such as semi-structured and unstructured interviews, and unobtrusive observation, to high-intrusion methods such as participation observation… Generally speaking, **the higher level of intrusion, involvement or participation in an organization, the higher level of understanding, the greater the degree of sense-making, and the richer the descriptive and analytical possibilities for the data**. Participant observation, because it permits **trust** relations to develop, allows the researcher to collect data that are different in kind and quality from data produced by any other method. It is hard to imagine survey respondents, for example providing sensitive, confidential, or highly consequential data. Similarly, interviewers who do not **spend sufficient time** within an organization are unlikely to gain access to data that would be exchanged only among **trusted insiders** within the culture."*[415]

As the next step for the research problem, therefore was to gain focus and sharpness, the opportunity began to slowly emerge to evolve the data collection towards more depth via clinical methods described next.

> *"It may be true that until the ethnographer becomes '**helpful**', he or she will not truly be accepted into the group and given **access to the data** he needs."*[416]

[413] Schein, E. (1987), pg. 30.
[414] Luna-Reyes, L.F. (2003), pp. 281-282.
[415] Rouse and Daellenbach (1999), pg. 490.
[416] Schein, E. (1987), pg. 28.

2.6.2.2 Action Research / Clinical Methods / Policy Research

> *"The **relationship between the analyst and the client** has significantly evolved with the analysis being more often used as a **platform for dialog between stakeholders** with **very different objectives** and problem views, rather than a simple delivery of a best solution."*[417]

> *"While the analyst him/herself may not be neutral, the analysis must be with extensive tradeoff analyses and even game playing to show the interrelationships between different objectives. We are just beginning here but this is a **major paradigm shift** from the analyst, problem definer and solution provider to the analyst aiding in a **complex stakeholder consensus building process** providing neutral information and convening – but not dominating – the debate."*[418]

Academics have begun to question the role of analysts in research (Marks, 2003), leaning toward a more clinical approach, employing action research methods.

> *"This article describes the **deficiencies of positivist science** for generating knowledge for use in solving problems that members of organizations face. **Action research is… a method for correcting these deficiencies**. When action research is tested against the criteria of positivist science, action research is found not to meet its critical tests. The appropriateness of positivist science is questioned as a basis for judging the scientific merits of action research. Action research can base its legitimacy as science in philosophical traditions that are different from those which legitimate positivist science."*[419]

In order to capture the depth and complexity of the phenomenon under study, this research dissertation aims to complement the traditional low-intrusion methods of ethnography with the higher-intrusion methods of action research.[420] In order to understand *how* strategic change processes occur, Argyris (1968, 1985) has argued that significantly new research methods of action science are required.

> *"…it implies **significant researcher commitment and organizational access**, which few researchers have achieved to date. As a consequence, very few developmental studies of **strategy formulation and implementation** have been conducted. One reason why gaining organizational access has been problematic is because researchers seldom place themselves into the manager's frame of reference to conduct the studies."*[421]

> *"Pettigrew's book is based on **eight years of research**. In fact, **two of the eight years** of research were **funded directly by ICI**. In the worst case, organizations that pay the costs of becoming the subject of advanced research will **try to manipulate the researcher, either by socializing him or her into their value systems or by making cooperation dependent on 'useful' results** or at least the display of a 'reasonable' attitude. It is a disturbing proposition that the theory of organization may have finally approached a point where methodological requirements make further advances **dependent on the good will of powerful insiders**."*[422]

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[417] Marks, D.H. (2003), pg. 2.
[418] Marks, D.H. (2003), pg. 5.
[419] Susman G.I. and Evered R.D. (1978), pg. 582.
[420] I am indebted to Prof. Sarah Kaplan for coaching me through the use and validity of clinical methods research, and in particular for pointing me towards the work of Prof. Ed Schein.
[421] Van de Ven, A. H. (1992), pg. 181.
[422] Streeck, W. (1986), pg. 92.

Action research is known under various names with slightly different meanings in a variety of contexts. These include: "clinical methods" (Schein, 1987), "policy research" (Etzioni, 2006), and "Collaborative Interactive Action Research" (Rapoport et al., 2002).

> *"**Policy research** requires a **profoundly different methodology** from that on which basic research relies, because policy research is always dedicated to changing the world while basic research seeks to understand it as it is."*[423]

The following subsections each briefly discuss the focus of action research on: strategic capability-building, organizational change and theory building.

2.6.2.2.1 Focus on *Strategy Process* (not *Content*)

> *"In the **clinical** model, an important distinction is between **process** consultation that highlights helping the client solve his or her own problems, and **expert** consulting that puts the clinician into a doctor or expert role from which he or she prescribes solutions."*[424]

As previously discussed, this research is designed to establish long-term trust-based relationships with the most senior leaders of both *Boeing* and *Airbus* as well as with the most senior leaders of their respective key stakeholders, namely their customers, suppliers, investors and employee unions.

> *"I have learned much from my **teachers**, even more from my **colleagues**, but I have learned the most from my **students**."*[425]

The primary stance of the researcher is as an independent in-house strategy *process* consultant[426] and executive education provider to the most senior leaders of firms comprising both enterprises. The stated objective of the researcher is to build each enterprise's strategic thinking capabilities, which is broadly achieved by facilitated group model-building exercises, with representatives of each enterprise's key stakeholders. The concurrent participation with both enterprises has been acknowledged a priori, with the obvious stipulation that there would be no exchange of sensitive or proprietary information.[427] As will be discussed later, the data collection methods range from action learning/clinical methods to ethnography.

> *"To understand architecture and its impact one needs to understand the **political and cultural** dimensions of leadership and architecting, as Ted Piepenbrock described. [When considering] Ted Piepenbrock's efforts at Boeing, the audience is the Board of Directors, who are trying to make architectural decisions about the Boeing enterprise. **Ted's role is not to be an outside architect; rather he is operating as a kind of facilitator in the board's own thinking about its architecture.** He does, however, carry out his own research in the firm – this gives him*

[423] Etzioni, A. (2006), pg. 833.
[424] Schein, E. (1987), pp. 37-38.
[425] From the Talmud / Book of Proverbs.
[426] As opposed to a strategy content provider, which implies no exchange of sensitive or proprietary information.
[427] Non-disclosure agreements (NDA) as well as non-compete agreements (NCA) without express written consent, were obviously part of the research contracts.

> *credibility with the audience and helps him elucidate the key choices and consequences facing them in their architecting (i.e. modular versus integral enterprise).*"[428]

In order to integrate information from across intra-firm functions as well as external inter-firm stakeholders, the organizational development literature has acknowledged the importance of boundary-spanning "boundary objects". In this tradition, the process consulting described above resembled a "boundary object" – in as much as a conversation, or a trust-based relationship can be seen as an invisible boundary object.

2.6.2.2.2 Focus on *Intervention and Change*

> *"One can not **understand a human system** without trying to **change it**. The **essential dynamics of the system** are assumed to remain **invisible to the passive observer**."*[429]

Unlike, the ethnographer who takes great care not to disturb or contaminate the human system that they are observing, the clinician's aims are the opposite – to purposefully disturb the human system via an intervention designed to change and ultimately improve the organization. While clinical data tends to be deeper and richer than ethnographic data, it may suffer from experimental validity. The research design recognized these trade-offs, and was customized to fit the situation as described below.

> *"Clinical fieldwork demands a **long-term, open-ended, give-and-take commitment** to bringing about **organizational change**."*[430]

The use of clinical methods, focused on organizational change requires special characteristics of both the researcher as well as the organization itself. Sterman notes that the researcher requires a unique multidisciplinary set of skills:

> *"You have an **ethical responsibility** to carry out your work with rigor and **integrity**. You must '**speak truth to power**', telling the clients that their most cherished beliefs are wrong… even it if means you will be **fired**. If your client's minds are closed…you must **quit**. Get yourself a better client.* [This requires] *both first-rate analytical skills and excellent **interpersonal** and **political** skills."*[431]

Throughout this intensive longitudinal field study, in order to maintain ethical responsibility and integrity, I opted to terminate the fieldwork on multiple occasions. This served to maintain the appearance objectivity in the relationship with the informant organizations, as well as to counter the claims from academics in the ethnographic tradition (but not in the clinical methods tradition) who are concerned with the observer "going native".

The use of clinical methods varied from across firms in the case study depending upon the firm's perceived needs or organizational change. For example, *Boeing*, the incumbent under attack from the challenger, *Airbus,* felt more urgent need at high organizational levels to initiate organizational change. For this reason, clinical methods emerged from initial ethnographic methods at *Boeing*, while the ethnographic methods were more appropriate at

[428] Comments and critiques of this framework by graduate students in the Spring 2006 MIT ESD class, *Enterprise Architecting*.
[429] Schein, E. (1987), pg. 29. Also in Starbuck and Nystrom (1981).
[430] Schein, E. (1987), pg. 5.
[431] Sterman, J. (2000), pp. 85 and 105.

Airbus. In the quest for sharp methodological fidelity, the clinical phase at *Boeing* was a long-term[432], open-ended endeavor with "pull" coming from the highest levels of management.

> *"The **clinician**, unlike the ethnographer, is welcome in the halls, meeting rooms and corner offices occupied by those in **high position**."*[433]

Finally, Schein (1987) differentiates between *process* consultation and *expert* consultation in clinical fieldwork.[434] As process consultation focuses on helping the client to solve their own problems (as opposed to expert consultation, which solves the client's problems), this research design focused primarily on the use of process-oriented clinical methods. In this way, managerial frames were more readily revealed through the process of guided joint-discovery or co-creation of knowledge. To this end, the primary technique used was the development of scenarios as strategic conversations (van der Heijden, 1996; Hodgkinson and Wright, 2002).

2.6.2.2.3 Focus on *Theory Development*

> *"The clinical perspective is oriented towards the **dynamics of change and improvement**. It is therefore **normative** in its orientation and requires **underlying theories** that provide normative direction – concepts of health, **effectiveness, growth**, innovation, **integration**, and the like."*[435]

As clinical methods tend to generate normative theory, it fits well within the aims of strategic management scholarship.

> *"The **best use** of clinical data is in the construction of variables and **theoretical models**. The clinician learns about some of the **most fundamental dynamics** that operate in an organization, and it is often **very clear, even though not provable**, what those dynamics are."*[436]

As will be discussed later, in the *analytical techniques* section, the use of nonlinear dynamic numerical simulation via the system dynamics method relies greatly on clinical data for the development of solid theories and the subsequent robust policy design.

> *"The power of clinical work… under the label of **'action science'**…is that such work provides **better variables and better understanding** of the **system dynamics** than other research methods and thus must be utilized more in **building useful and parsimonious theory**."*[437]

One of the more influential theories developed in organizational science is Contingency Theory as developed by researchers like Lawrence and Lorsch (1967). While numerous criticisms of the theory abound, particularly surrounding the adequacy of their concepts and measures (Aldrich, 2006: 126), Lawrence and Lorsch defend their theory by noting the inherent qualitative, clinical nature of their methods.

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[432] A brief survey of recent field-based doctoral research in management reveals that duration of field-based data collection ranges from approximately 6-12 weeks (e.g. W. Orlikowski, 1990; S.Kaplan, 2003).
[433] Schein, E. (1987), pg. 5.
[434] Schein, E. (1987), pp. 37-38.
[435] Schein, E. (1987), pg. 40.
[436] Schein, E. (1987), pg. 54.
[437] Schein, E. (1987), pg. 55.

*"As Lawrence and Lorsch (1973) pointed out in reply to their critics, they conducted a **clinical study rather than a highly quantitative, rigorously-controlled field study**, and their conclusions owe as much to their **clinical and professional insight** as to the **rudimentary data analysis** presented."*[438]

[438] Aldrich, H. E. (2006), pg. 127.

2.6.3 *Techniques*

2.6.3.1 Temporal (longitudinal)

The research program is designed to span the social, economic, cultural, institutional and academic environments within which the two enterprises of the case study are embedded. As the theoretical construct of "enterprise architecture" compares the efficiency-based mass production *firm* (e.g. *Boeing*) and its counterpart, the value-infused lean *institution (*e.g. *Airbus)*[439] the research program is based out of two leading universities in the US and Europe, with their notable strengths rooted in each tradition: MIT and the University of Oxford.

As shown in Figure 124, the research was designed to take place over a six-year period, being broken down roughly into the following three two-year periods:

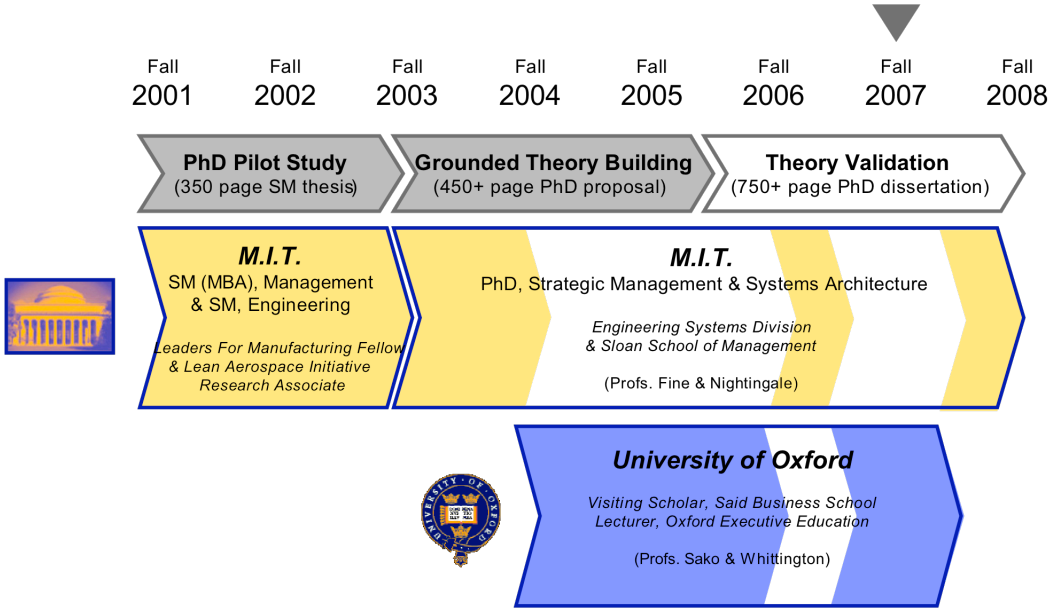

Figure 124: *Research* Timeline

- Phase I consisted of an initial two-year pilot study was conducted at (*Boeing*) the primary case study site under the academic auspices of the joint MBS/MS *Leaders for Manufacturing* program of the *Engineering Systems Division*. The purpose of the pilot study was to clearly define the research problem, develop preliminary grounded theory and secure a platform (e.g. doctoral funding, doctoral committee, industrial commitment and access) for a doctoral research plan. The results of this pilot study is summarized in the document, "Enterprise Design for Dynamic Complexity: Architecting and Engineering Organizations using System and Structural Dynamics" (Piepenbrock, 2004).

[439] The "Organization-Institution" dichotomy was first discussed by Selznick, 1957.

- Phase II consisted of another two-year block which was designed to more fully develop grounded theory from empirical field-based case studies by establishing and validating theoretical constructs and propositions.

- Phase III will consist of a final two-year block which is designed to validate and extend the theory developed using two means: first, an via analysis of other firms and industries; second, via extensive multidisciplinary review of theoretical literature. If Phase II built theory grounded in empirical data, Phase III will build meta-theory from existing theories, as well as extend and validate the theory.

As shown in Figure 125, the field-based data collection has been executed from January 2002 to December 2005. Typically, three-month visits were conducted every twelve months for over four years at *Boeing* and the sites of its constituent stakeholders. The total field contact time thus far exceeds 2,000 hours, including approximately 500 hours of action learning based interviews and discussions with stakeholders described below.

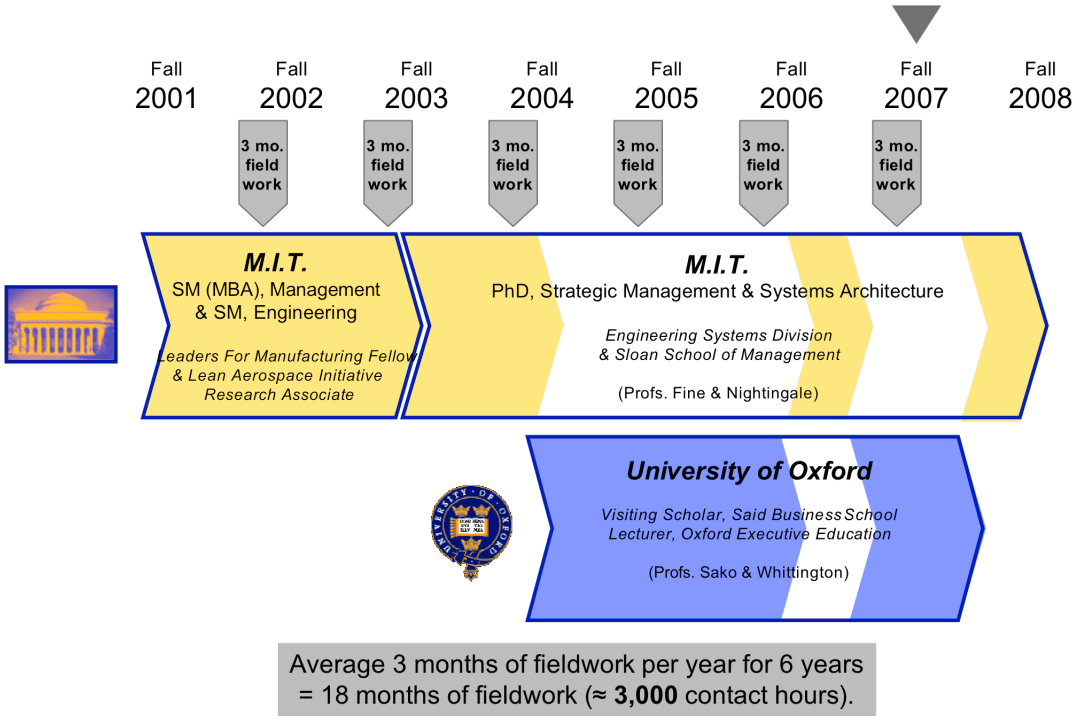

Figure 125: *Fieldwork* Timeline

Also as is shown in Figure 126 below, the 3,000 hours of fieldwork at both competitors in the global airplane duopoly took place over the time period that the incumbent (*Boeing*) was overtaken by the challenger (*Airbus*). This was an opportune time to capture the complex dynamics of managerial cognitive frames as the reality changed for the first time in such a slow clockspeed industry.

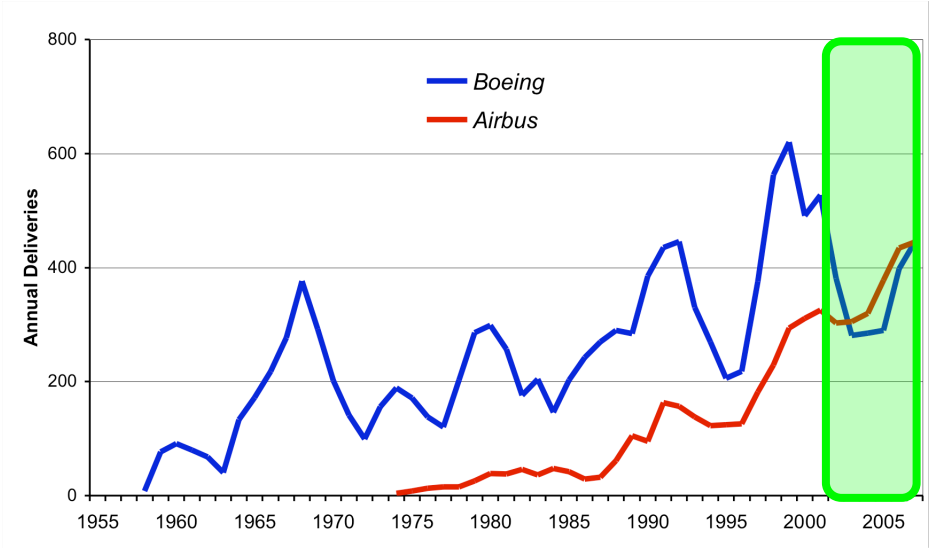

Figure 126: Fieldwork Timeline & *Competitive Duopoly* Dynamics

In addition, as the industry produces capital goods, it is subjected to well-known oscillations (Sterman, 2000), having a period of approximately ten years. As shown in Figure 127 below, The research therefore took place over one full-cycle in order to capture the dynamics first during the downturn, where integral enterprise archiecture was expected to outperform the modular enterprise architecture, as well as during the upturn, where the converse was expected to happen.

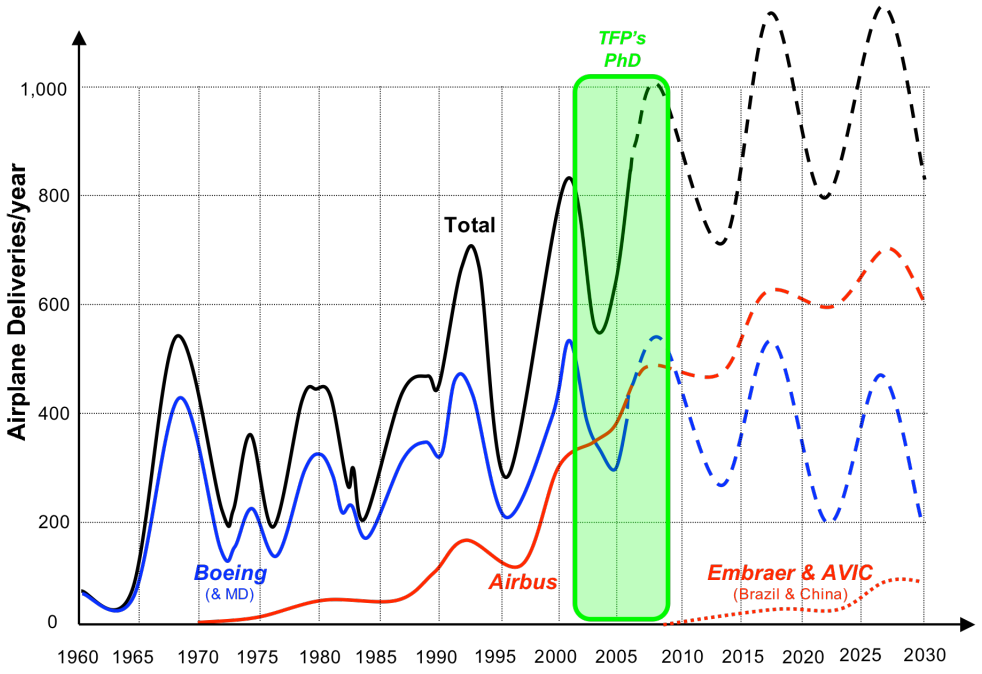

Figure 127: Fieldwork Timeline & *the Business Cycle*

2.6.3.2 Spatial (triangulation)

> *"**Interviews** often provoke a 'knee-jerk' reaction that the **data are biased** in which **impression management [by image-conscious informants]** and **retrospective sensemaking** are deemed the prime culprits. The challenge of interview data is best mitigated by data collection approaches that limit bias. A key approach is **using numerous and highly knowledgeable informants who view the focal phenomena from diverse perspectives**. These informants can include organizational actors from **different hierarchical levels, functional areas, groups, and geographies, as well as actors from other relevant organizations and outside observers such as market analysts**. Another approach to mitigating bias is to **combine retrospective and real-time cases** (Leonard-Barton, 1990)."*[440]

In addition to the collection of data temporally across time, this research plan calls for spatial collection of data both "horizontally" across the key stakeholders of the enterprise, as well as "vertically" within each stakeholder's hierarchical structure. In this sense, the goal is to map the *micro*-frames of key decision makers across the *macro*-enterprise of key stakeholders.

2.6.3.2.1 *Horizontal* (*Inter*-firm) triangulation

> *"The theory that we are developing together represents the **exact opposite** way we that currently see our strategy…* [it] ***challenges the conventional wisdom and power structure** of the highest levels of this company. Having relentlessly discussed* [it] *over and over again over the past few years, with people who have a **strong vested interest in disproving it**, has been given the theory a 'baptism by a hundred fires' – it certainly has been **'pressure-tested'**".*[441]

In order to ensure internal validity of the theory, the research design included triangulation of the data sources. To this end, the above-described data collection techniques were applied internally within *Boeing* at senior leadership levels across multiple functions such as marketing, engineering, manufacturing and supplier management as well as externally to *Boeing's* stakeholders such as its customers, suppliers, labor unions, etc., as shown in Figure 128 below.

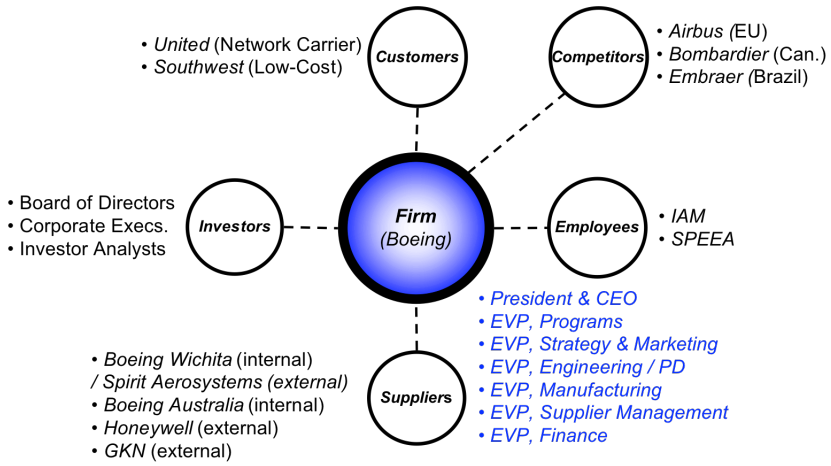

Figure 128: Empirical "Triangulation" of *Boeing* Case Study

[440] Eisenhardt, K.M. and Graebner, M.E. (2007), pg. 28.
[441] Quotation from *Boeing* director, Summer 2005.

The research was designed to sample a number of the 'internal" functional problems. Examples of the types of intra-firm research studies performed for the functional leaders are shown below in Figure 129.

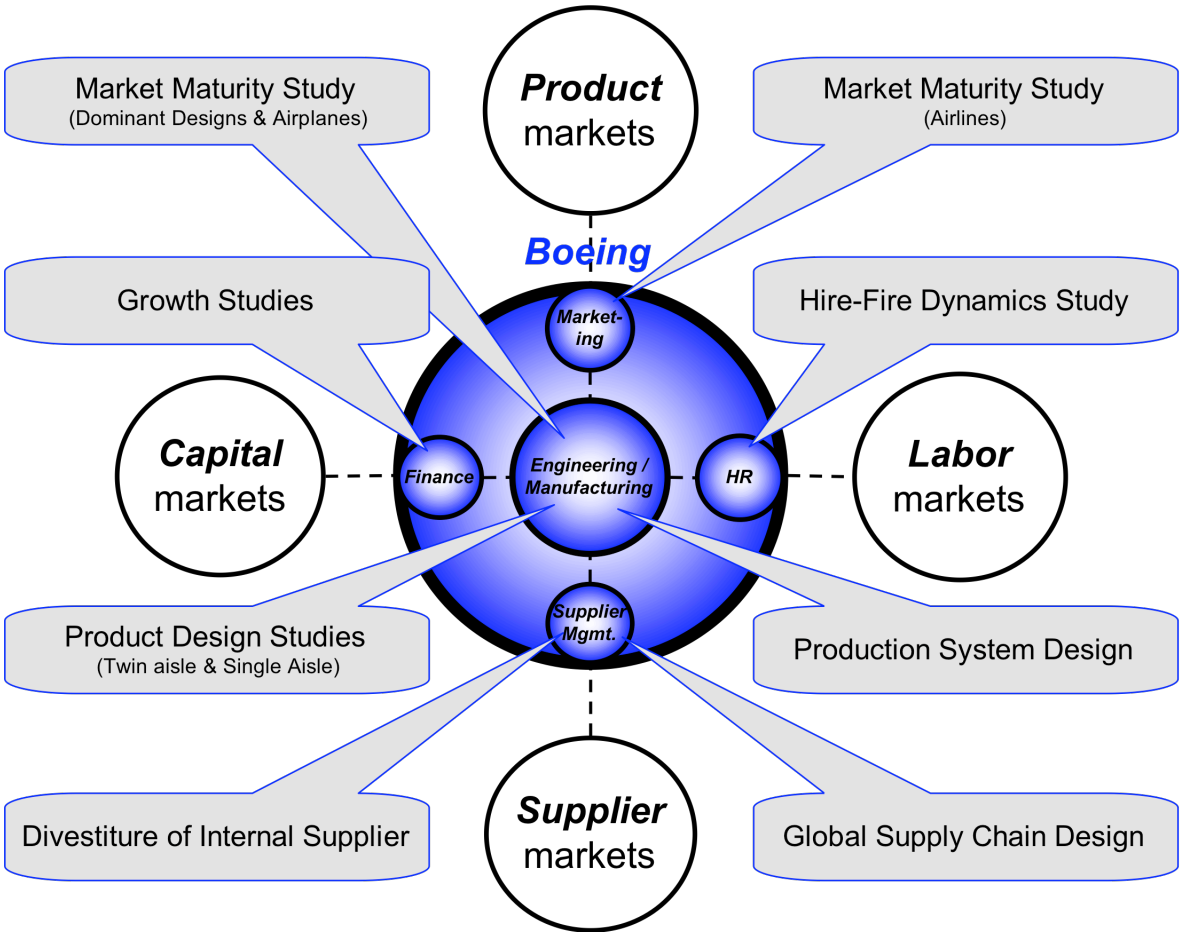

Figure 129: *Intra*-firm Research "Projects"

For the second phase based out of the University of Oxford, a similar schedule and approach is envisaged for *Airbus* and its constituent European stakeholders. In this way, triangulation of data from interconnected sources can begin to paint a systematic picture of the global commercial airframe industry ecosystem which may share common stakeholders like customers or suppliers as shown in Figure 130.

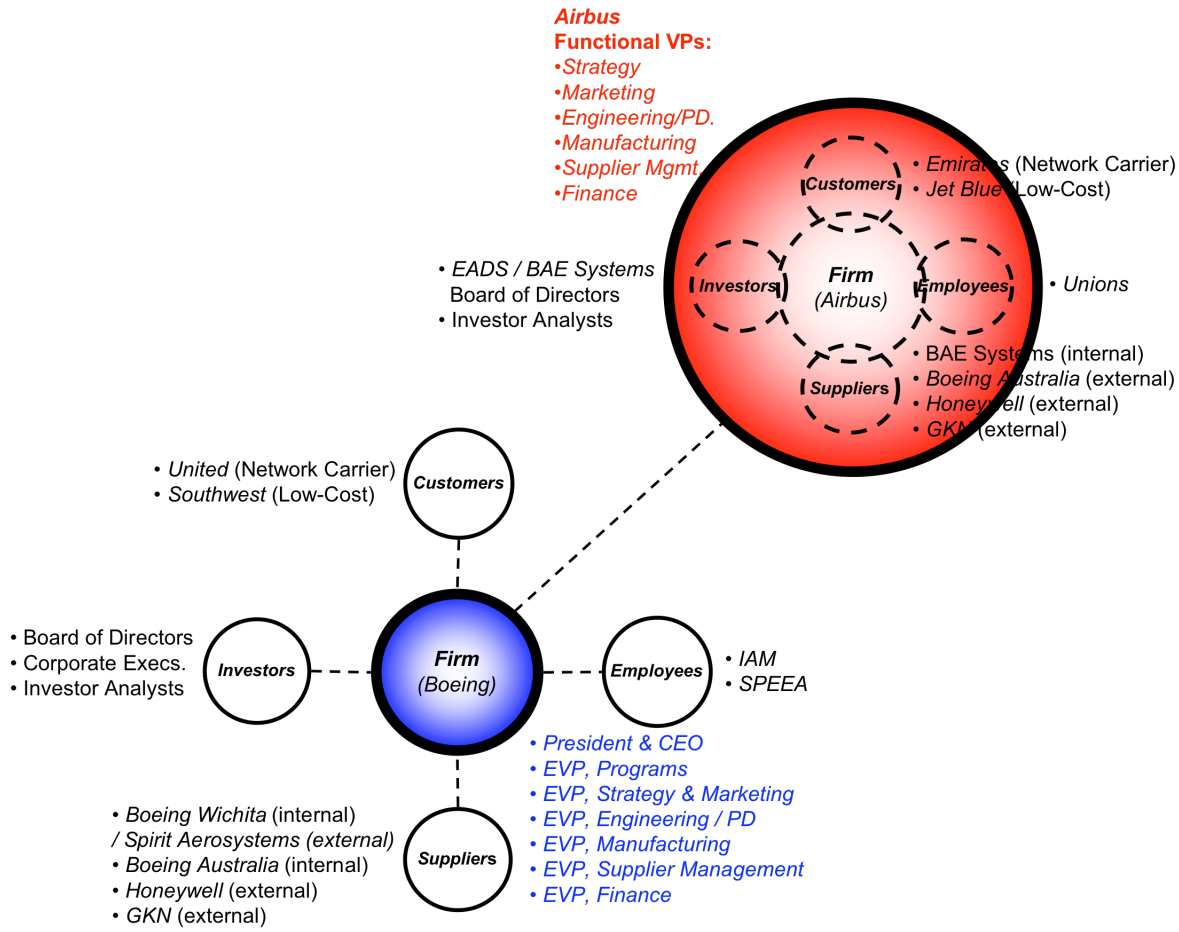

Figure 130: Empirical "Triangulation" of the *Commercial Airplane Industry*

2.6.3.2.2 *Vertical* (*Intra*-firm) triangulation

> *"I have the **biggest risk profile** and the **broadest time horizon** in the company. I can bring to bear the right risk-taking and time horizon **trade-offs**."*[442]

In order to further increase internal validity, data collection methods took place a multiple levels with each stakeholder organization. As shown in Figure 131 below, as one ascends an organization vertically, the level of power, control and integration (or "architectural design authority") increases, facilitating the need for different approaches in accessing reliable data. At these levels, as meaning and reality are more socially-constructed, this makes accessing the data more difficult via conventional positivist methods, and easier via more constructivist methods.

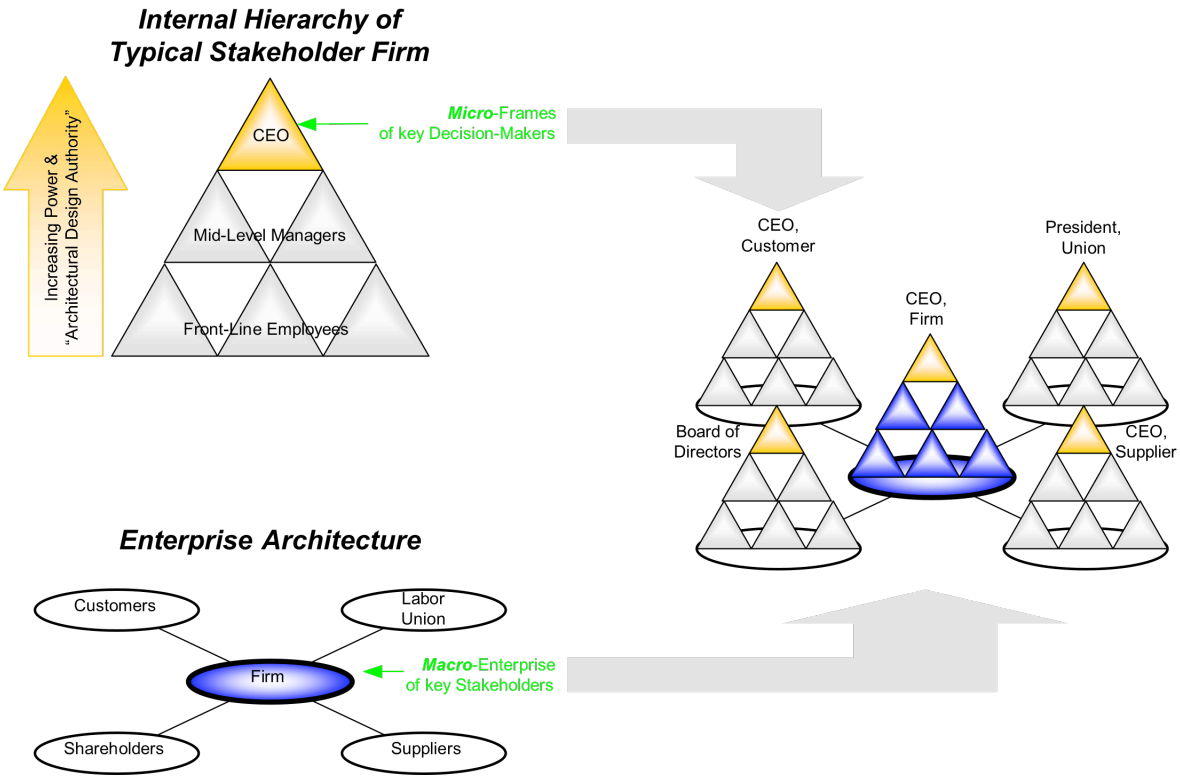

Figure 131: Mapping *Micro*-Frames Across the *Macro*-Enterprise

Note that this vertical triangulation within the organization's hierarchy is supported by Thompson's (1967) claims that organizations operate more like closed-systems (i.e. rational, strategic design lens) at lower levels and more like open-systems (i.e. satisficing, political design lens) at higher levels. Thompson refers to three levels: *technical, managerial* and *institutional*. While this research engages all three levels, it particularly emphasizes the open-systems institutional levels where the formal design authority of the "architect" resides.

[442] *General Electric* chairman and CEO, Jeffrey R. Immelt, interviewed by Thomas A. Stewart in the *Harvard Business Review*, "Growth as a Process," June 2006, pg. 69.

2.6.3.2.3 *Political*, *Cultural* and *Temporal* triangulation

Research designs dominated by the *strategic design* lens, view organizations as objective, rational optimizers. As such research methods like survey questionnaires are deemed as logical vehicles to access valid data. The researcher is able to treat the data sources and the data itself as "commodities" in that precious research time and resources are not "wasted" nurturing long-term, trust-based relationships with the data sources, the answers received represent truths or valid data, and that any researcher (given a proper specification of how the original data was collected) can go back to the same data sources, issue the same surveys and get broadly similar "truths" (controlling obviously for longitudinal effects).

This approach may in fact be valid for research in organizations under certain conditions. However, as this research dissertation aims to access data across multiple external stakeholders as well as across multiple internal functions, divisions and levels, as well as longitudinally across multiple time frames, it is by definition crossing important political, cultural and temporal boundaries, requiring the research lenses to incorporate these points of view.

> *"You have an **ethical responsibility** to carry out your work with rigor and **integrity**. You must **'speak truth to power'**, telling the clients that their most cherished beliefs are wrong… even it if means you will be **fired**. If your client's minds are closed…you must **quit**. Get yourself a better client.* [This requires] *both first-rate analytical skills and excellent **interpersonal** and **political** skills."*[443]

Viewed from these lenses, the researcher sees that the data and data sources can not be treated as commodities in that research time and resources must be spent nurturing long-term, trust-based relationships with the data sources, understanding their local objectives and conflicts of interest both within the firms and between firms. In addition to time and resources, this requires specific skill on the part of the researcher to build these relationships with the data sources. As failure to consider these organizational complexities could result in invalid data.

The following examples taken from early phases of this research dissertation illustrates that failure to control for such political, cultural and temporal effects results in significantly different data and theoretical models. Figure 132 below illustrates the significance of not controlling for "political effects" when collecting and analyzing data from the customer stakeholder group.

[443] Sterman, J. (2000), pp. 85 and 105.

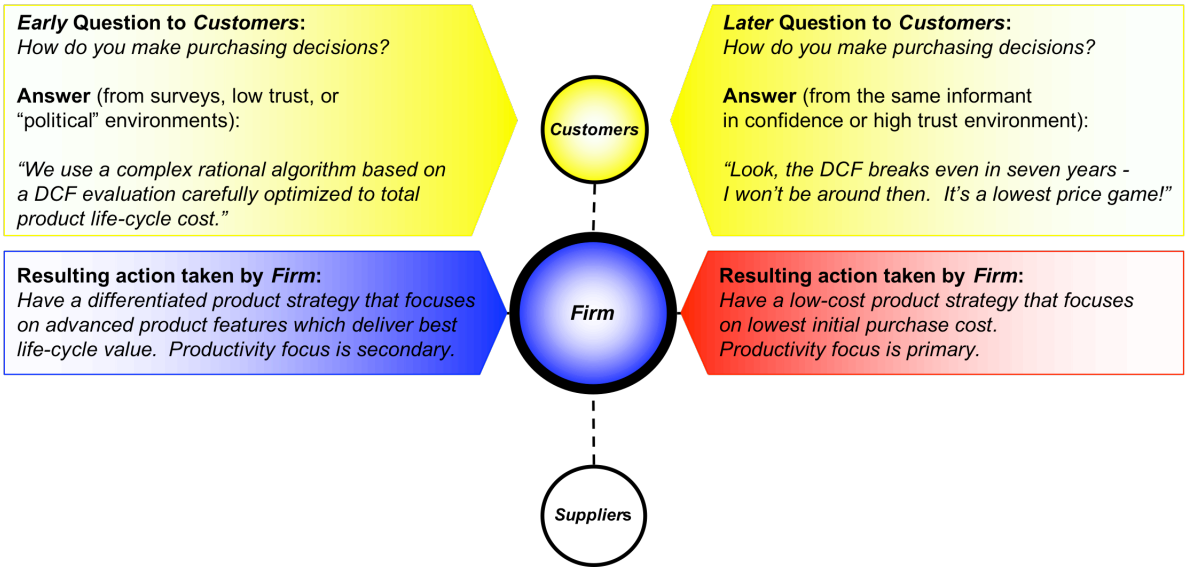

Figure 132: Data from the *Customer* stakeholder with and without "political controls"

As can be seen, the conventional wisdom of the firm, of the research community at large, and in fact from the initial data acquisition exercises from the research program described in this document, is that customers for the firm's products make purchasing decisions base on complex, yet rational decision algorithms which minimize total long-term costs to the customer. It is interesting to note that this answer from senior managers from the customer stakeholder triangulated consistently with senior managers in the firm and by senior leaders within the investor stakeholder group. This "truth" led the firm, to launch differentiated high-performance products which could balance the initial purchase cost of their product with the long-term operations costs of owning the product.

After spending over three years and over 1,500 hours of research time with the firm and its key stakeholders, and importantly building long-term trust and political capital, when the same data sources were sampled again for longitudinal validity checks, the data was found to be significantly different. This time, in a high-trust, apolitical environment, the same customer informant indicated that although company policy was as he had initially indicated, he was not at liberty to share "the truth" of how he really made decisions, which were ultimately based on lowest initial acquisition costs. This "truth" would lead the firm to precisely the exact opposite product strategy (in fact to that of its competitor) which focused on maximizing productivity so that initial price could be minimized, even at the expense of lower product capabilities and life-cycle costs.

What had changed in this dramatic turn-around in the quality of the data? It appears that the quality of the relationships with the data sources matter significantly. As will be discussed later in Essay#1, there may be a fundamental systemic characteristic of the architecture of the enterprises under study (including the academic community) that encourage short-term, arms length commodity treatment of data sources to make decisions.

Another one of dozens of potential examples is shown below in Figure 133 regarding the supplier stakeholder group.

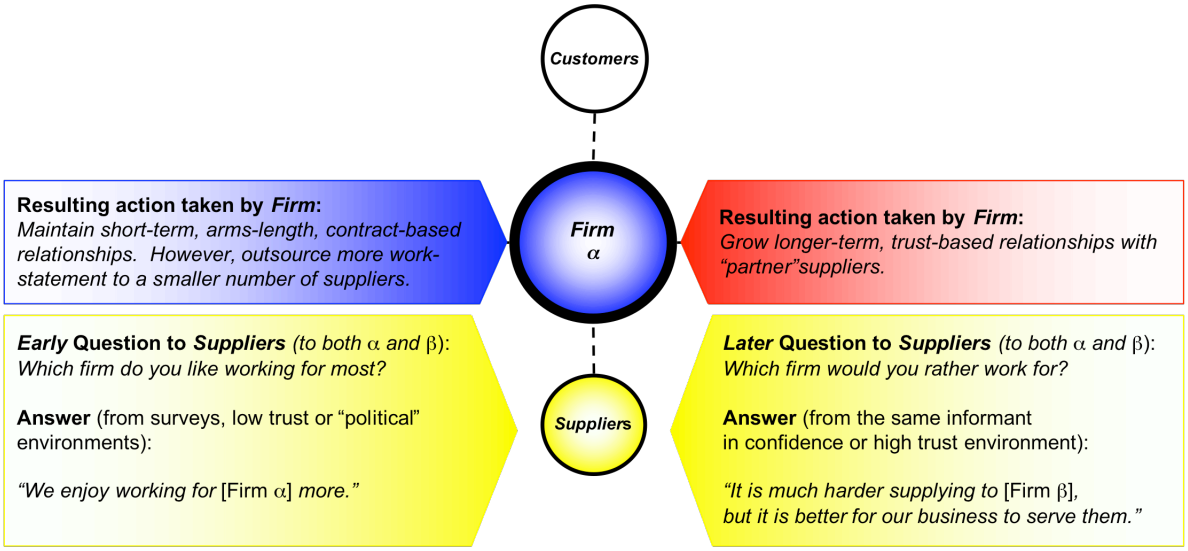

Figure 133: Data from the *Supplier* stakeholder with and without "political controls"

2.7 Data *Analysis* Methods and Techniques

Having discussed the techniques for data collection, this section briefly summarizes the techniques for the analysis of the data. That is, the process in taking written data and transforming it into numerical data suitable for numerical simulation.

> *"Since **'linking'** is at the heart of **system dynamics, grounded theory** speaks to the same goal of drawing relationships among factors in a targeted system."*[444]

Two primary methods (and associated techniques) for analyzing data are briefly discussed: grounded theory and simulation modeling. While these have occasionally been seen as complementary (Burchill and Fine, 1997; Perlow, Okhuysen and Repenning, 2002; Luna-Reyes and Andersen, 2003; Laws and McLeod, 2004), it is the purpose of this section – and in fact this research design – to integrate them into a unified method contributing in a coherent way to the broader research design.

> *"We used a **combination of ethnography and causal loop diagrams**. The resulting model is both tightly grounded in our data and provides a logical and internally consistent explanation of how the **micro-level interactions** involved in decision making combined to create the more **macro-level changes** we observed. The utility of our approach lies not in the direct transferability of our findings, but in the ability to produce grounded theory that could not be identified with a broader-brush data-collection method. Further, by using causal loop diagrams to specify our emerging theory, we have made it easier for scholars to mathematically formalize and empirically test our results."*[445]

[444] Luna-Reyes and Andersen (2003), pp. 284-285.
[445] Perlow, Okhuysen and Repenning (2002), pg. 932 and 934.

2.7.1 *Qualitative* Analysis Methods

The primary two broadly qualitative analysis methods used for data analysis were: grounded theory and linguistic analysis. Each will be discussed in turn.

2.7.1.1 *Grounded* Theory

Grounded theory consists not only of a set of techniques to identify major concepts across texts, but more importantly it links the concepts together to generate meaningful theories.

The "texts" used in this research range from first-hand interview transcripts, to second-hand magazine interviews and letters to shareholders. Through the process of "memoing", the concepts and categories that arise through textual analysis are likely to become the stocks and flows of the system dynamics model, described in the next section.

For this research thus far, memos were composed each night summarizing the emerging themes of the day's interview, meetings and discussions. Approximately two hours of off-site work was spent coding and analyzing the field data for every one of the approximately 500 hours of facilitated action-learning / group model building exercises.

Based on this information, a conceptual model was built by inferring hypotheses from the field data about causal structural relationships that led to observed patterns of behavior.

> *"**Accurate description and verification are not so crucial** when one's purpose is to **generate theory**. This is especially true because evidence and testing never destroy a theory (of any generality), they only modify it. A theory's only replacement is a better theory."*[446]

2.7.1.2 *Linguistic* Theory

> *"**The linguistic turn in the social sciences** prompted calls for **more complex understandings of organizations** that would emphasize **language not only as enabling information exchange** but also as **constructing social and organizational reality** (Dandridge, Mitroff & Joyce, 1980; Pondy & Mitroff, 1979). This linguistic approach has led to increased interest by organization theorists in such issues as **the intimate relationship between language and organization** (Daft & Wiginton, 1979)."*[447]

Linguistic analysis has taken an increasing role in the analysis of organizations (Heracleous and Barrett (2001). Multiple methods have emerged which capture the richness of organizational exchange (Suddaby and Greenwood, 2005). This research focuses on using two such accepted approaches: *discourse* analysis and *textual* analysis.

> *"**Semiotics** (Barley, 1983), **hermeneutics** (Philips and Brown, 1993), and **discursive** (Kilduff, 1993) and **narrative analyses** (Boje, 1995) have each been introduced as a **method for understanding organizational phenomena**."*[448]

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[446] Glaser, B.G. and Strauss, A.L. (1967), pg. 28.
[447] Heracleous and Barrett (2001), pg. 755.
[448] Suddaby and Greenwood (2005), pg. 39.

At the core of the theory presented herein, is an organizational (or relational) construct, namely, are enterprise architectures modular or integral. In order to observe this empirically, the chances for success in arriving at a truth (to the extent that such a quest is epistemologically possible) is to observe such relational quantities as "trust" and "patience." This is not a trivial activity. Can one observe these quantities, and if so, how can one communicate these observations as "truths".

> *"There is a tradition in the analysis of social life that treats the social world as an **independently perceivable phenomenon**, something that observers delineate, describe, and make coherent. **Observation and the observer stand removed**. **Recent trends in social philosophy challenge this subject-object distinction, viewing as isomorphic the seer and the seen, the knower and the known** (Ryan, 1970). The correspondence theory of thuth is rejected, for within a **phenomenological perspective**, there is no single 'correct' reading of the 'external world.' The problem of **qualitative analysis based on fieldwork** is that of **avoiding solipsism** on the one hand and **avoiding positivism** on the other. One approach to this problem is to **make language the locus of analysis** and not to confuse the language system used to 'explain' or formulate the world with the objects of study."*[449]

2.7.1.2.1 *Discourse* Analysis

> *"The concept of '**deep structures**' is essential to a fuller understanding of **social and natural systems** at all levels of analysis (Gersick, 1991; Light, 1979). Deep structures can be defined as **relatively stable, largely implicit, and continually recurring processes and patterns that underlie and guide surface, observable events and actions**. Accounts of deep structure vary indifferent theoretical domains. In the **domain of discourse**, we hae approached deep structure as **persistent features of discourse that transcend individual texts, speakers, authors, situational contexts, and communicative action as a whole and over the long term**."*[450]

This research seek to reveal the underlying "deep structures" within the discourse of competing enterprise architectures.

2.7.1.2.1.1 *Rhetorical* Analysis

Within the analysis of deep structures in discourse between stakeholders within an enterprise architecture, this research focuses on a particular type of discourse, that of rhetoric, which focuses on political or interest-laden discourse between stakeholders. A table with the chronological listing of the inter-stakeholder discourse (for primary and secondary firms in the theoretical sample) is given in Appendix I.

> *"**Rhetoric, or the art of persuasion,** has a long history in the humanities (Richards, 1936; Burke, 1969, Aristotle, 1991) and, **at one time, supersceded logic as a mode of assessing truth** (Zald, 1993)... Rhetorical analysis shares this interest in **the role of language in structuring social action** but is distinguished by a very **specific focus on suasion and influence**. In this context, **rhetoric forms a subset of discourse analysis**.. Rhetoric restricts its focus to **explicitly political or interest-laden discourse** and seeks to identify genres or **recurrent patterns of interests, goals, and shared assumptions that become embedded in persuasive texts** (Freedman and Medway)."*[451]

[449] Manning (1979), pg. 660.
[450] Heracleous and Barrett (2001), pg. 758.
[451] Suddaby and Greenwood (2005), pp. 39-40.

2.7.1.2.2 *Textual* Analysis

Although much of the linguistic analysis in this research captures stakeholder discourse broadly, it focuses also on capturing language used in texts in more formal texts, like annual reports to shareholders.

2.7.2 *Quantitative* Analysis Methods

2.7.2.1 Simulation Modeling

> *"**Grounded theory** approaches are used to develop variables which have **significant explanatory power** and are **intimately tied to the data**. The **cause and effect relationships** among these variables are then shown using causal-loop diagramming techniques from the field of **system dynamics**."*[452]

Having transformed the empirical case data into concepts and categories via memoing, the concepts and categories are then assembled into a causal model with multiple feedback relationships in a method recently described as *Inductive System Diagrams* (Burchill and Fine, 1997).

> *"The Inductive System Diagram method builds on the strengths of accepted coding practices for **variable development** and causal-loop diagramming for **variable integration**."*[453]

This causal model is then transformed into a nonlinear dynamic simulation model via the identification of state variables (stocks or levels) and decision heuristics (flows or rates) which change the states of the system. This method is known as system dynamics (Forrester, 1961, Sterman, 2000).

> *"Unlike many **formal models** in the social science literature, ours was not deduced from general principles but, using the methods of **grounded theory**, was **induced from a range of domains**. While commonly used to build theory from raw data using qualitative analysis, the grounded theory approach is not limited to this activity. **Strauss and Corbin (1994) advocated the development of formal (or general) theories grounded in previously generated domain-specific (what they call substantive) analyses**. They remind the reader that Glaser and Strauss (1967) not only urged the use of grounded theory in conjunction with **quantitative** analysis but also recommended its use to **generate theory from theory** ."*[454]

2.7.2.2 Philosophical Stance on Modeling Complex Enterprises

> *"**Chaos theory** provides a useful theoretical framework for understanding the **dynamic evolution of industries** and the complex interactions among industry actors… which exhibit **both unpredictability and underlying order**."*[455]

When modeling complex socio-technical enterprises, this research takes the epistemological view that the range of behavior in question can be best understood via nonlinear dynamic deterministic methods (including, but not limited to chaos theory).

> *"All **nonlinear feedback systems**, including **human organizations**, can be expressed in terms of **lawful rules** and relationships: that is, such systems are **deterministic** in the same fundamental sense as Newton's laws or the laws of supply and demand in neoclassical economic theory."*[456]

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[452] Burchill and Fine (1997), pg. 469.
[453] Burchill and Fine (1997), pg. 476.
[454] Rudolph, J.W. and Repenning, N.P. (2002), pg. 3.
[455] Levy, D. (1994), pg. 167.
[456] Stacey, R.D. (1995), pg. 481.

While Beer (1959) classified the firm or the economy as an "exceedingly complex, probabilistic system", this research takes its philosophical queue from one of Beer's contemporaries in feedback thinking, Forrester (1961) who believed that firms and economies could be modeled as "exceedingly complex, deterministic systems", a space that Beer deemed pointless.[457]

> *"**Patterns** of… the **evolution of industries** can be depicted but there is **novelty** in each… industry."*[458]

System dynamics does not model in order to predict, but in order to understand the underlying structure driving dynamic behavior. It is a pattern-modeling process.[459]

2.7.2.3 Modeling Epistemology

A note of clarification is warranted regarding the use of simulation methods to simulate nonlinear dynamic structure-behavior relationships. As the problem being posed in this research contains high degrees of dynamic complexity[460], conventional methods of *positivist* science are challenged. A different epistemology is necessary - one rooted in *generative* science is better suited.[461] As Sterman (2000) points out, this is not without its caveats:

> *"Engineers and econometricians have long struggled with the problem of **uniquely identifying** the **structure and parameters** of a system from its **observed behavior**. In practice the data are too scarce and the plausible alternative specifications are too numerous for statistical methods to discriminate among competing theories."*[462]

The structure and parameters may be *sufficient* to describe the observed dynamics, but may not *necessarily* be the right structure and parameters.

2.7.2.4 Developing Causal Structures form Empirical Data

> *"**Interview data is rich**, including descriptions of **decision processes**, **internal politics**, attributions about the **motives and characters of others**, and theories to explain events."*[463]

Sterman (2000, pg. 141) notes the importance of ensuring that correlative relationships are not mistaken for causal structures. In addition, Sterman (2000, pg. 157) also notes that the ability of gathering rich contextual data is important in developing system dynamics models. Therefore survey data tends not to be as effective as semi-structured interviews.

> *"The modeler must **triangulate** by using as many sources of data as possible to gain insight into the structure of the problem situation and the decision processes of the actors in it… People have*

[457] Richardson, G.P. (1990), pp. 170-171.
[458] Atkinson, G. (2004), pg, 282.
[459] Radzicki, M. (2003), pg. 151.
[460] Senge, P. (1990), pp. 71-72.
[461] Epstein, J.M. (1999).
[462] Sterman, J.D. (2000), pp. 26.
[463] Sterman, J.D. (2000), pg. 157.

> *only a local, partial understanding of the system, so you must* ***interview all relevant actors****, at* ***multiple levels****, including those* ***outside the organization (customers, suppliers, etc.)****"*[464]

Finally, Sterman (2000, pg. 157) notes that interviewees have the potential to share much less as well as much more than they really know, making the development of internally consistent causal structures extremely difficult requiring both scientific rigor as well as artful skill.

[464] Sterman, J.D. (2000), pg. 157.

2.7.2.5 Model Complexity

Regarding model complexity, Repenning (2003) notes that there are two interdependent considerations: the state of the existing theory, and the modeler's ability to develop their audience's intuition for how the model's structure drives its behavior.

> *"For areas of inquiry where there have been few attempts to understand dynamics in a systematic fashion, **simple models are needed**, not because the phenomenon is simple, but because there is little on which to build."*[465]

In the field of strategic management, while many calls have been to understand the dynamics, relatively little has been done. Therefore, simple models utilizing "generic structures" (Senge, 1990) are expected to be the most effective, and will therefore be the focus of this research plan. Such simple models can be rigorous provided that the underlying assumptions for the relatively few variables used are justified using field data.

> *"In almost every field of science, a tension has existed constantly between the experimentalists and the theorists. Certainly some of the difficulties between the two groups stem from basic misunderstanding on both sides, of the **nature and function of mathematical models**. Models are too often considered simply as predictors, and any inability to predict accurately is accepted as prima facie evidence of the uselessness of the technique. Actually, only those engineering models designed to fit a particular set of circumstances are even moderately successful as predictors. The more general models of theoretical biology are used to **deduce the form of the possible solutions, rather than to predict future states** of the system being modeled."*[466]

2.7.2.6 Proposed System Dynamics Modeling within Framework

Having defined the conceptual properties of the archetype enterprise architectures in Essay #1, it is envisaged that high-level system dynamics models would be built or adapted for each of the remaining two essays in order to capture different dynamics aspects behavior implicit in the framework.

As shown in Figure 134 below, Essay #2 would focus on the medium-term competitive dynamics between two firms in a "mixed" duopoly setting where each firm had diametrically-opposed objective functions, enterprise architectural forms, structural dynamic strategies. In this model, the architectures are assumed to remain constant throughout the simulation i.e. while there may be evolution in the market environment, there will be no "disintegration" and exit of incumbents or re-integration and appearance of new entrants. It is envisaged that the model would take on a simplified version of existing market growth and competition models in the system dynamics literature (Sterman, J.D. 1991; Paich, M. and Sterman, J.D. 1993; Sterman, J.D., Henderson, R. Beinhocker, E.D. and Newman, L.I. 1995; Langley, P., Paich, M. and Sterman, J.D., 1998).[467]

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[465] Repenning, N. (2003), pg. 314.
[466] Wangersky, P.J. (1978), pg. 189.
[467] These system dynamics models are all centered around the core "B&B Enterprises" model of Mark Paich's MIT PhD.

> *"As a **maturing industry** adjusts to **slower growth**… companies' orientations towards adding capacity and personnel must fundamentally shift…these **shifts in perspective rarely occur** in maturing industries."*[468]

Finally, Essay #3 would focus on the higher-level, more abstract, long-term competitive dynamics in a market in which firms can enter and exit. Here competition occurs primarily between competing technologies serving a mass market, as individual competitor firms are aggregated. In this model, dominant designs form tipping points between archetypal strategic groups. "Mixed" duopoly therefore occurs at an aggregated "strategic group" level. The enterprise architectures are permitted to "evolve" throughout the simulation i.e. there could be "disintegration" and exit of incumbents or re-integration and appearance of new entrants. It is envisaged that the model would take on a simplified version of existing industrial evolution models in the system dynamics literature (Weil and Utterback, 2005; Sterman, J.D., Henderson, R. Beinhocker, E.D. and Newman, L.I. 2005).[469]

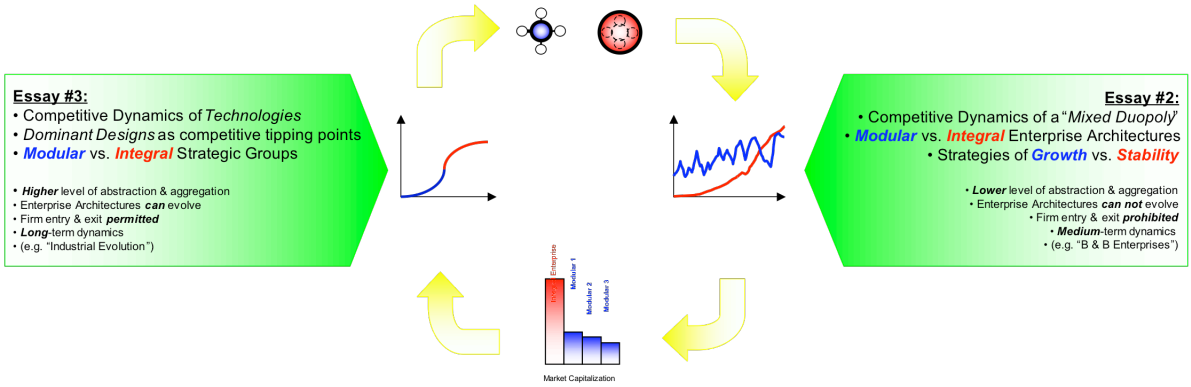

Figure 134: Proposed System Dynamics Models of Framework

[468] Porter, M.E. (1980), pg. 239.
[469] Note it is possible that a high-level conceptual model synthesizing the models in Essays #2 and #3 could be added to Chapter 7.

2.8 Research Dissertation Critique

> *"Your doctoral proposal is rather **ambitious** – it is what a senior tenured faculty member would propose at the end of a long and distinguished career.'"*[470]

> *"This is **just a doctoral dissertation**. It's not like you are Charles Darwin, **trying to develop a theory of evolution**..."*[471]

This work aims to develop a theory of evolution - not of organisms, but of organizations – which although ambitious, will inevitably fall short of the classic work of Charles Darwin. Like Darwin's field research while aboard the *HMS Beagle* from 1831-1836, this research involved intensive longitudinal field work, documenting, analyzing and theorizing about a variety of species in their natural habitats.

> *"'It is **simplistic** in its obsession with a few types, it's **dogmatic** in style, and it **contains not one shred of empirical evidence**. **Reputable academics will hate it**.'"*[472]

The following briefly summarizes some of the major perceived strengths and weakness of the research design which are evaluated against the perceived norms established within the academic fields that the research aims to impact, namely strategic management and engineering systems.

2.8.1 *Research Tradeoffs*

As this dissertation aims to build theory, it will inevitably come up against the "postulate of commensurate complexity" (Thorngate, 1976), which asserts that social theories cannot simultaneously maximize the goals of generalizability (external validity), accuracy (internal validity) and simplicity.

> *"As noted by Weick (1979), the research process involves the **inevitable tradeoffs** among generalizability, accuracy and simplicity."*[473]

It is clear that by design, the theory generated by this dissertation will differ from the norm of most research in the strategic management literature. If well executed, the theory is likely to be above the norm on *accuracy*, near the norm on *simplicity* (relative to the level of complexity of problem addressed), and below the norm on *generalizability*.

By way of an example of one such tradeoff, due to the high level of detail and effort expended on the study of two firms (a duopoly) in one industry, the gains in accuracy come at the inevitable cost of generalizability and potentially parsimony.

> *"Given growing interest in the evolution of organizational communities, some scholars have also deployed a multi-population census, which tracks a number of interdependent populations*

[470] Comment on research from a senior Professor at a renowned university (2004).
[471] Comment on research from a senior Professor at a renowned university (2007).
[472] Miller, D. (1996), pg. 505. Quotation is feedback that Miller received from an SMJ reviewer on his paper on 'configurations'. Note that ten years later, Miller writes: "It was therefore a wonderful surprise to win the 1995 Strategic Management Society SMS Award for my article."
[473] Dess, G.G., Newport, S. and Rasheed, A.M.A. (1993).

> *simultaneously.* ***Resource limitations*** *may require* ***limited temporal coverage*** *and* ***less precise measurement of vital events*** *(Ruef, 2000).'*[474]

2.8.1.1 Accuracy (internal validity)

Merriam (1998, pp. 204-205) notes that internal validity can be strengthened by a number of strategies that have been incorporated in this research design: triangulation in time, space and organizational level (Denzin, 1970); long term observation of the same phenomenon, continuously and at discrete intervals; peer examination in which comment on findings is solicited among both academic and practitioner groups; and participative or collaborative modes of research in all phases of the research design.

These and other strategies are employed to ensure that the theory built by this research is empirically grounded in the data, which has been studied intensely through multiple lenses over considerable spatial and temporal variables. To this end, the accuracy is anticipated to be relatively high and therefore above the norm.

2.8.1.2 Generalizability (external validity)

> *"No useful theory can rest on the assumption that everything is unique. It is probably inevitable that the early history of a scientific endeavor will be characterized by the opposite assumption, and by the search for universals. I believe it is a sign of relative maturity when a field begins to focus on* ***patterned variations****."*[475]

This proposed research, like that of contingency theory, acknowledges partial uniqueness in theory development. It recognizes the relative maturity of the strategic management field and therefore seeks "patterned variations" and not fully generalizable universals.

The fact that a theoretical sample of multiple case studies were used across a variety of industry and geographic settings, establishes some initial degree of external validity. This is however far from the traditional statistical sample approaches to the positivist branches of both the strategic management and engineering systems fields. As such, it is likely that external validity would be deemed below the norm – a consequence of the high internal validity tradeoff.

Recall also, that this research does not make claims for grand theory, and aims only for the contingent modes of explanation that can be expected when building theory on complex socio-technical systems.

2.8.1.3 Simplicity (parsimony)

> *"Construction of a simulation model involves a* ***tension between simplicity and elaboration****. We we give talks on our simulations, a frequent (perhaps the most frequent) question we get is 'Why don't you add variable X to the model?' For theory development purposes, the objective is to* ***construct a model based on a simplified abstraction of a system*** *– guided by the purpose of the*

[474] Aldrich and Ruef (2006), pg. 268.
[475] Thompson, J.D. (1967), pg. xxv.

> *simulation study – that retains the key elements of the relevant processes without unduly complicating the model (Burton & Obel, 1995).*"[476]

Finally, although this research aims to cover multiple variables, across multiple strategy domains, covering the inputs of multiple levels of multiple stakeholders in the quest for building *configuration* research in strategic management, the resulting theory is potentially very simple at the highest level of abstraction – which is the level at which this research intends to be evaluated.

Of course, more internal validity is gained by using the lower levels of abstraction into the mechanics of architectural properties, structural dynamics, financial valuation and industrial evolution as this research strives to do, which necessarily makes the work far from parsimonious. As such, it is likely that the simplicity would be at or near the norm on aggregate.

> *"**Artful simplification** is the **hallmark of skillful modeling**."*[477]

2.8.2 *Research Strengths and Limitations*

Due to the nature of this research design, which uses case-based theoretical sampling, the resulting theory, although potentially rich in accuracy and ecological validity, is bound to be limited both in its generalizability and the confidence in its causality (Hammersley, 1990).

2.8.2.1 Accuracy (internal validity)

Due to the robustness of the research design, particularly with respect to the longitudinal primary case study, the constructs and propositions generated are likely to have relatively high internal validity.

Determination of causality in complex systems is by definition, problematic, particularly if some of the main "input" causal variables are difficult to observe and measure directly (e.g. enterprise goals, boundaries, interfaces). The "output" variables (e.g. enterprise production output) tend to be easier to observe and measure. Simulation modeling is used therefore to lend indirect support to claims of difficult to measure and specify variables.

> *"**Even if some variables in the computational model cannot be easily observed, the output variables often can be**. Empirical confirmation of a simulation's predictions provides indirect support for the theory embodied in the model of the underlying (unobserved) processes."*[478]

2.8.2.2 Generalizability (external validity)

> *"One strength of building theory from cases is its likelihood of generating **novel theory**…* [a weakness is that it] *may result in narrow and **idiosyncratic theory**. Such theories are likely to be*

[476] Harrison, J.R., Lin, Z., Carroll, G.R., and Carley, K.M. (2007), pg. 1238.
[477] Nelson and Winter (1982), pg. 402.
[478] Harrison, J.R., Lin, Z., Carroll, G.R., and Carley, K.M. (2007), pg. 1238.

> *testable, novel and empirically valid, but they do lack sweep…they are essentially theories about specific phenomena."*[479]

While the creation of a theoretical sample, which consists of *single industry studies* does avoid the problems inherent in much strategic management research of controlling or industry effects, it does suffer from generalizability of the results (Dess et al., 1990).

> *"Generalizability is based on the* ***uniqueness of the industry's environment****…clearly the more unique the environment, the less generalizable the results."*[480]

The theoretical sample selected was a *collection* of single industry studies, designed to extend the generalizability of the theory. However, it is important to characterize the uniqueness common to of all the industries studied, which share among other traits relatively high industry concentration, entry/exit barriers, and some degree of product and service differentiation – the imperfect competition of oligopolies.

As the research was not designed to cover the cases of perfect competition for commodities, but to focus on firms in oligopolies where firm conduct is more relevant, the resulting theory is not expected to extend to such a general class of firms.[481]

2.8.2.3 Simplicity (parsimony)

> *"A surprising challenge can arise from readers who are disappointed by parsimonious theory. Single cases can enable the creation of more complicated theories than multiple cases, because single-case researchers can fit their theory exactly to the many details of a particular case. In contrast,* ***multiple-case researchers retain only the relationships that are replicated across most or all of the cases****. Since there are typically fewer of these relationships than there are details in a richly observed single case,* ***the resulting theory is often more parsimonious (and also more robust and generalizable)****."*[482]

The use of multiple-cases (i.e. the primary and secondary cases) in this research allowed for a more parsimonious (as well as more generalizable) theory to emerge than would have been generated from only one case, due to the removal of "degrees of freedom" inherent in theorizing across phenomena.

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[479] Eisenhardt, K. (1989), pp. 546-547.
[480] Dess, G.G., Ireland, R.D. and Hitt, M.A. (1990), pg. 13.
[481] An independent survey-based sample of critiques of this research is summarized in Appendix J. It is the result of teaching the material to senior executives in the *Wharton-Oxford Gateway to Strategic Leadership* program from 2005-2006.
[482] Eisenhardt, K.M, and Graebner, M.E., (2007), pg. 30.

2.8.3 *Towards "Good" Theory*

> *"We suggest that if the field is serious about producing **stronger theory**, journals need to reconsider their empirical requirements. We argue that journals ought to be more receptive to papers that **test part rather than all of a theory** and **use illustrative rather than definitive data**."*[483]

The goal of this research of developing grounded theory is hoped to be evaluated against criteria as established by writers and evaluators of theory in organizational theory (Sutton and Staw, 1995; Weick, 1995).

> *"People's natural inclination is to require greater proof of a **new or provocative idea** than one they already believe to be true. Therefore, if a theory is particularly interesting, the **standards** used to evaluate how well it is tested or grounded need to be **relaxed, not strengthened.** We need to recognize that major contributions can be made when **data are more illustrative than definitive**."*[484]

> *"Not everything discussed in the introduction of a manuscript need be **operationalized** in the method section nor show up in a set of **regression equations**. If theory building is a valid goal, then journals should be willing to publish papers that really are stronger in theory than method. Authors should be **rewarded** rather than punished for developing **strong conceptual arguments that dig deeper and extend more broadly than the data will justify**."*[485]

> *"We have even **counseled our graduate students** to **leave out portions of their theory** that are not measured well and to **delete otherwise interesting data** that did not directly relate to their theoretical argument. The result of these omissions is that the craft of manuscript writing becomes an art of **fitting concepts and arguments around what has been measured and discovered**."*[486]

> *"Consider whether the evidence provided by people such as **Freud, Marx,** or **Darwin** would meet the empirical standards of the top journals in organizational research. When theories are particularly interesting or important, there should be greater leeway in terms of empirical support. A small set of interviews, a demonstration experiment, a pilot survey, a bit of archival data may be all that is needed to show why a particular process **might be true**."*[487]

2.8.4 *Future Research*

> *"We need perhaps **contingent theories** of explanation…we would not expect a single unified theory to emerge from such efforts, because such a unified explanation is clearly a long way off, even if it is a desirable goal, but we would expect that it would produce fruitful and novel generalizations."*[488]

Therefore, in the quest to discover the deep underlying foundational nature of long-term firm competitive performance and the evolutionary systemic interactions between the firm's capabilities and its environment, this research will necessarily be bounded by contingent theories of explanation, however novel and fruitful they may aim to be.

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[483] Sutton, R.I. and Staw, B.M. (1995), pg. 371.
[484] Sutton, R.I. and Staw, B.M. (1995), pg. 382.
[485] Sutton, R.I. and Staw, B.M. (1995), pg. 382.
[486] Sutton, R.I. and Staw, B.M. (1995), pg. 381.
[487] Sutton, R.I. and Staw, B.M. (1995), pg. 383.
[488] Henderson R. and Mitchell W., (1997).

> *"Perhaps 'grand' theory requires **multiple case studies** – an accumulation of both theory-building and theory-testing empirical studies."*[489]

In order to more deeply validate and extend the generalizability of the mid-range theory developed by this research plan, another concurrent doctoral research plan has been proposed (and is being undertaken by the author) which is grounded in more traditional, deductive, correlative, statistically quantitative, hypothesis-based, theory-testing methods.

[489] Eisenhardt, K. (1989), pg. 547.

Part II: THEORETICAL CONSTRUCTS & PROPOSITIONS

Chapter 3 Understanding *Long-Term Firm Performance*

> *"I have sat through more than 20 presentations and discussions of this same framework over the past couple of years and two things have struck me. First, the framework was* ***different each time*** *I saw it, because the participants* [stakeholders] *in each session were different. Second,* ***the simplicity of the framework is so deceiving****, that I didn't get it until recently. The penny dropped for me - it finally just hit me what we were saying all along."*[490]

3.1 *Share*holders vs. *Stake*holders: The Counterintuitive Puzzle

> *"How do firms that have a* ***stakeholder approach*** *differ in competitiveness, commitment, and strategic flexibility from firms that maximize* ***stockholder wealth****?"*[491]

The primary purpose of this investigation is to explore the sources of firm competitive advantage and specifically on the relatively narrow metric of maximization of shareholder value.

3.1.1 *Market Value*

As shown in Figure 135 below, the market capitalization of two "world-class" firms, one representing manufacturing (*Toyota Motors*) and one representing services (*Southwest Airlines*) greatly exceeds that of the sum of their major competitors. And yet as will be argued in chapter 4, this is a not metric which they are trying to maximize, while ironically it is the prime goal of their competitors.

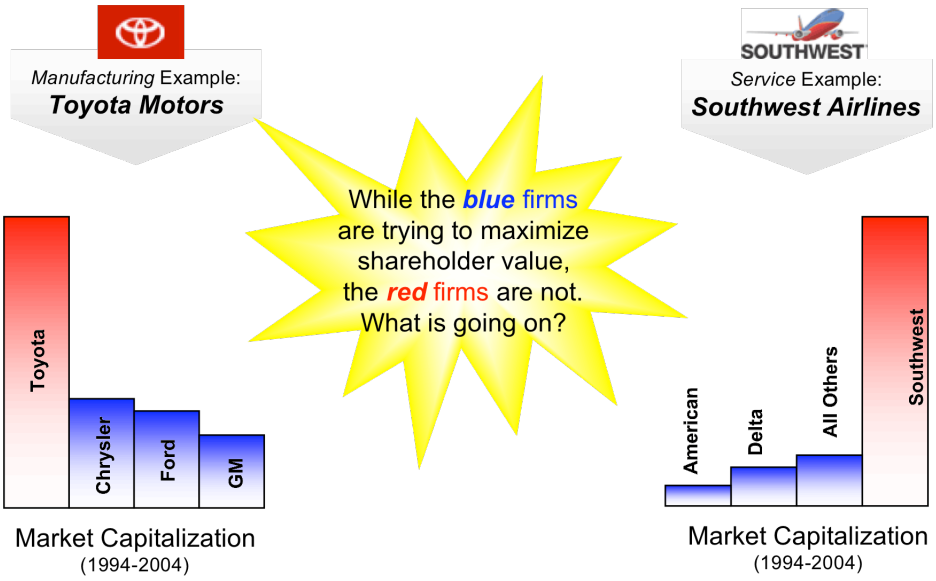


Figure 135: *Dominant* Firm Performance

[490] From knowledge co-creator, a senior director of strategy at a large global Fortune 100 firm.
[491] Rugman, A. M. and Verbeke A. (2002).

Instead of illustrating the shareholder value performance as a static or averaged snapshot as shown above, we will explore most dependent and independent variables in this research as longitudinal time histories. Figure 136 illustrates the trajectories of market capitalization for the incumbent-challenger pairs in the global automotive industry.

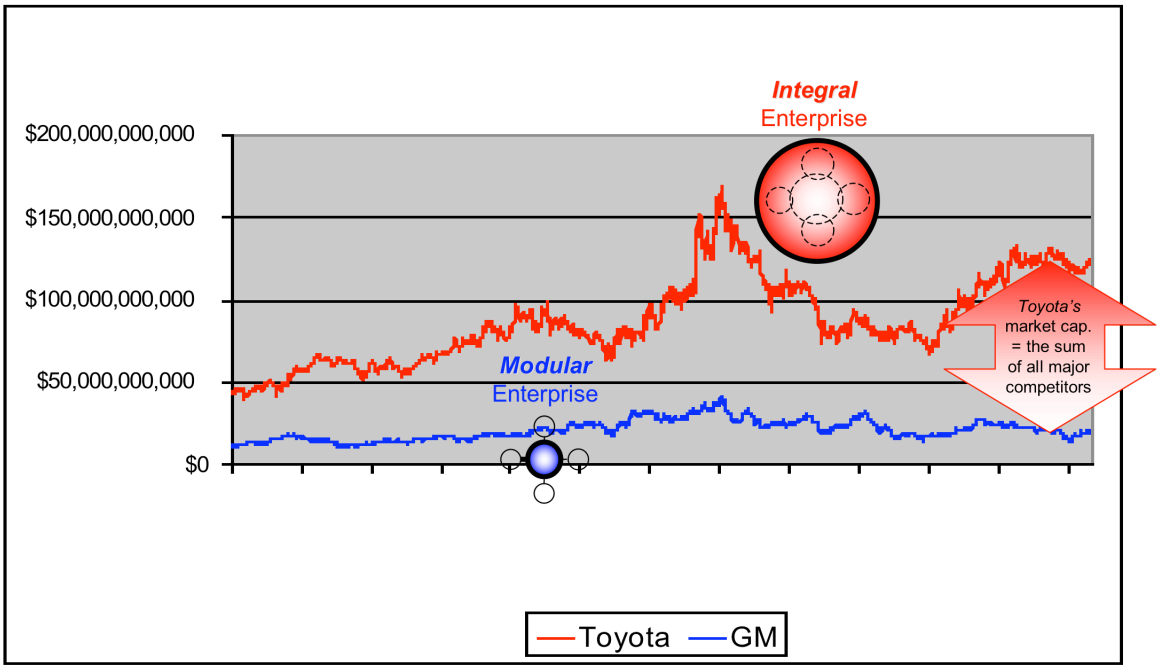


Figure 136: *GM* vs. *Toyota* Market Capitalization Trajectories

Similarly, Figure 137 illustrates the trajectories of market capitalization for the incumbent-challenger pairs in the US airline industry.

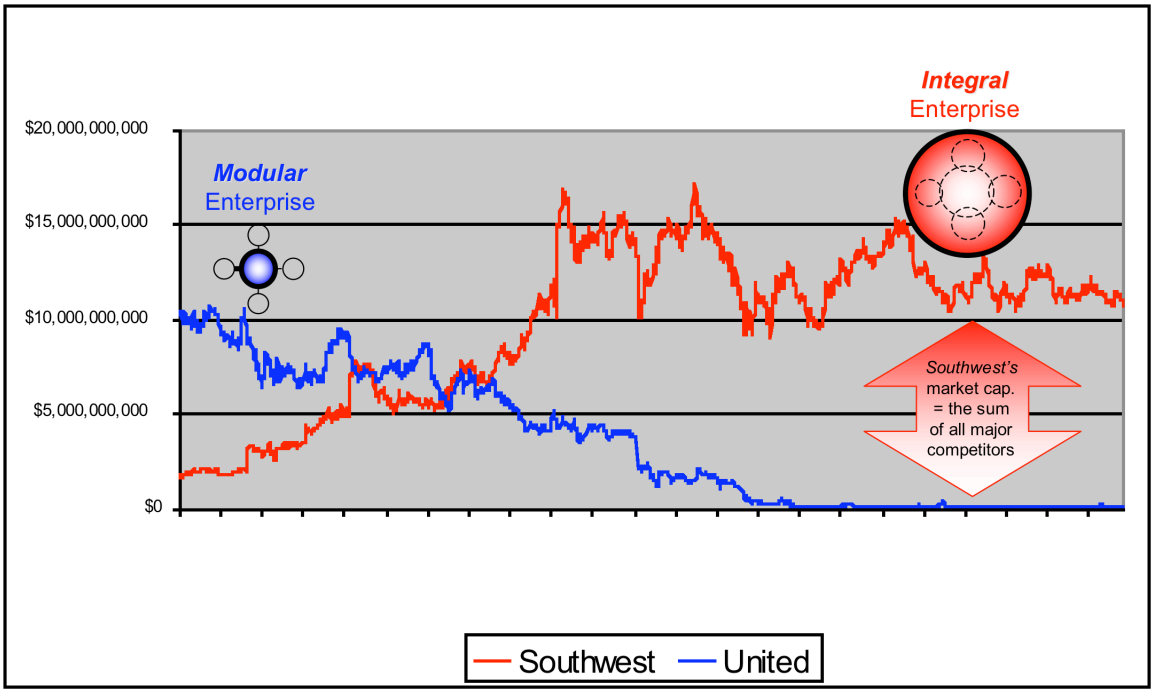


Figure 137: *United* vs. *Southwest* Market Capitalization Trajectories

While *Toyota* is the archetypal example of the successful Japanese firm, this research attempts to show that while such success is indeed based on "having organized a different system", it is not necessarily endemic to Japanese (or even German) macroeconomic environments, as the US-based *Southwest Airlines* case illustrates.

3.1.2 *Market Value Decomposition:* The Income Statement

One of the determinants of stock market value is the firm's past performance, as is evidenced by the residual cash flows which are deconstructed on the firm's income statement: i.e. its *top-line* revenues, its *bottom-line* net income or profits and the hypothesized *enabling system properties* which feedback to transform top-line revenue growth into bottom-line profit growth and then back into top-line revenue growth again.

This dissertation will therefore review the performance of dominant incumbent "market-makers" (growth *and* productivity) as being top-line driven, and the challenger "market-takers" (growth *through* productivity) as being bottom-line driven as shown in Figure 138 below. In the following subsections, we will examine evidence of each type of enterprise architecture as revealed on the income statements.

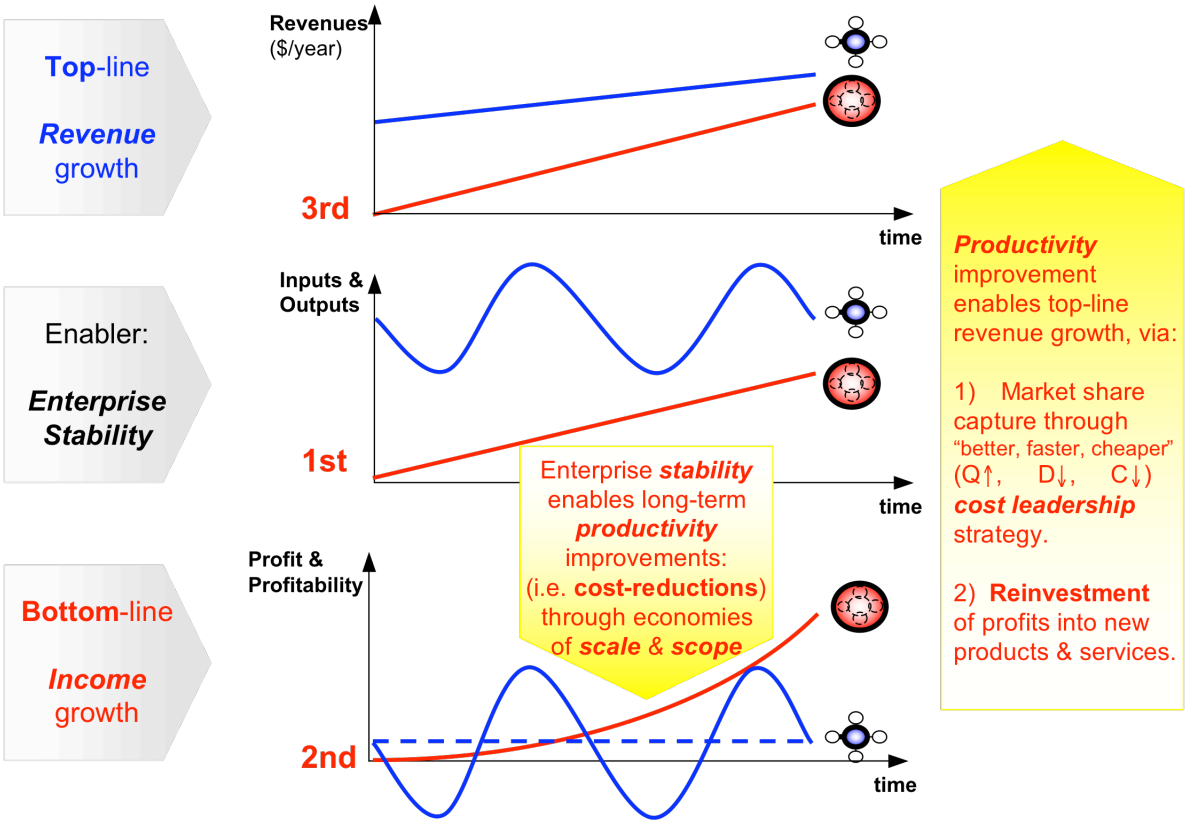


Figure 138: Architectural Imprint on the Income Statement

3.1.2.1 *Top*-line Revenues

> *"The goal GE has set for **sustained organic growth** – two to three times the growth of global GDP – translates to about 8% today. **Few companies have achieved the kind of growth** GE is seeking, and none on a revenue base of $150 billion."*[492]

3.1.2.1.1 *Auto* Industry

As shown in Figure 139 below.

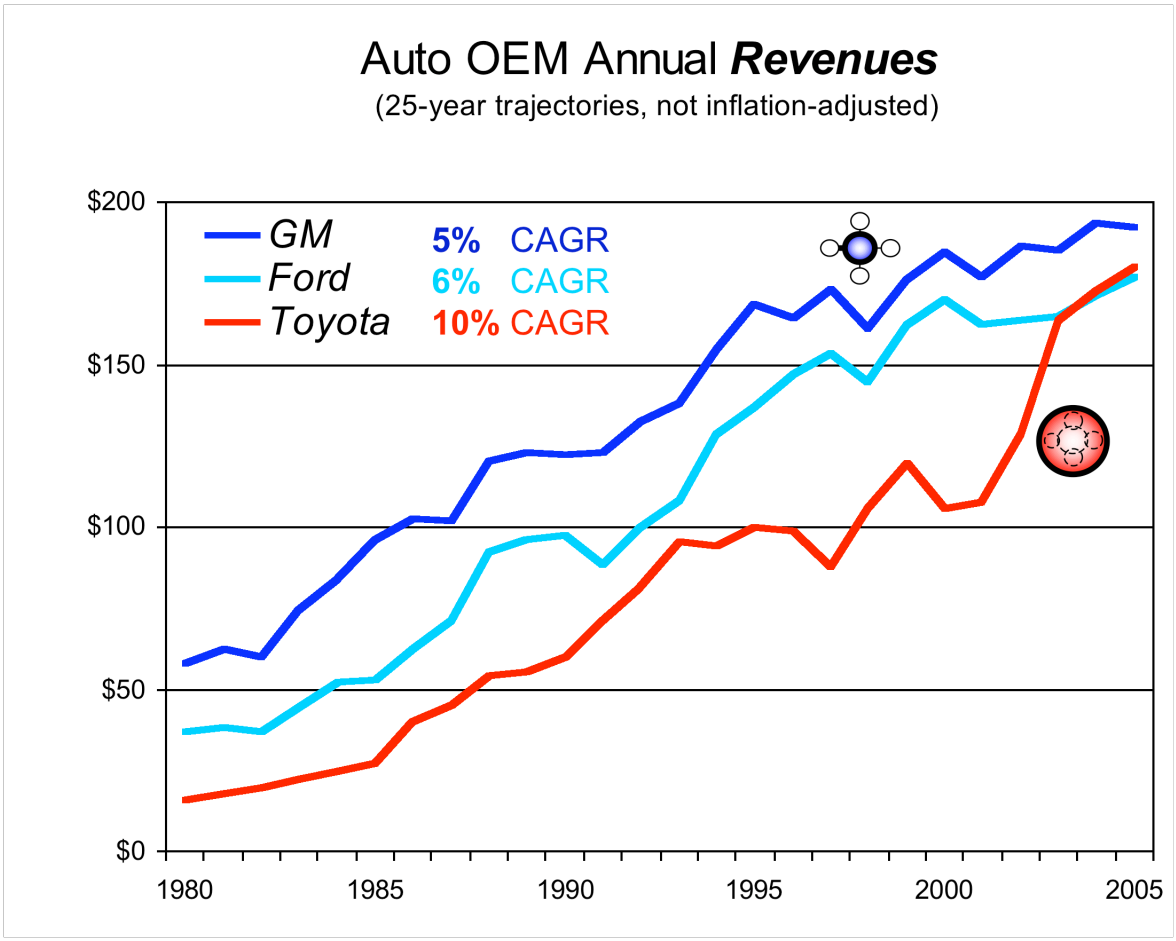


Figure 139: *Top*-line Revenues: *Auto* Industry

[492] Stewart, T.A. and Immelt, J. (2006), pg. 62.

3.1.2.1.2 *Airline* Industry

As shown in Figure 140 below.

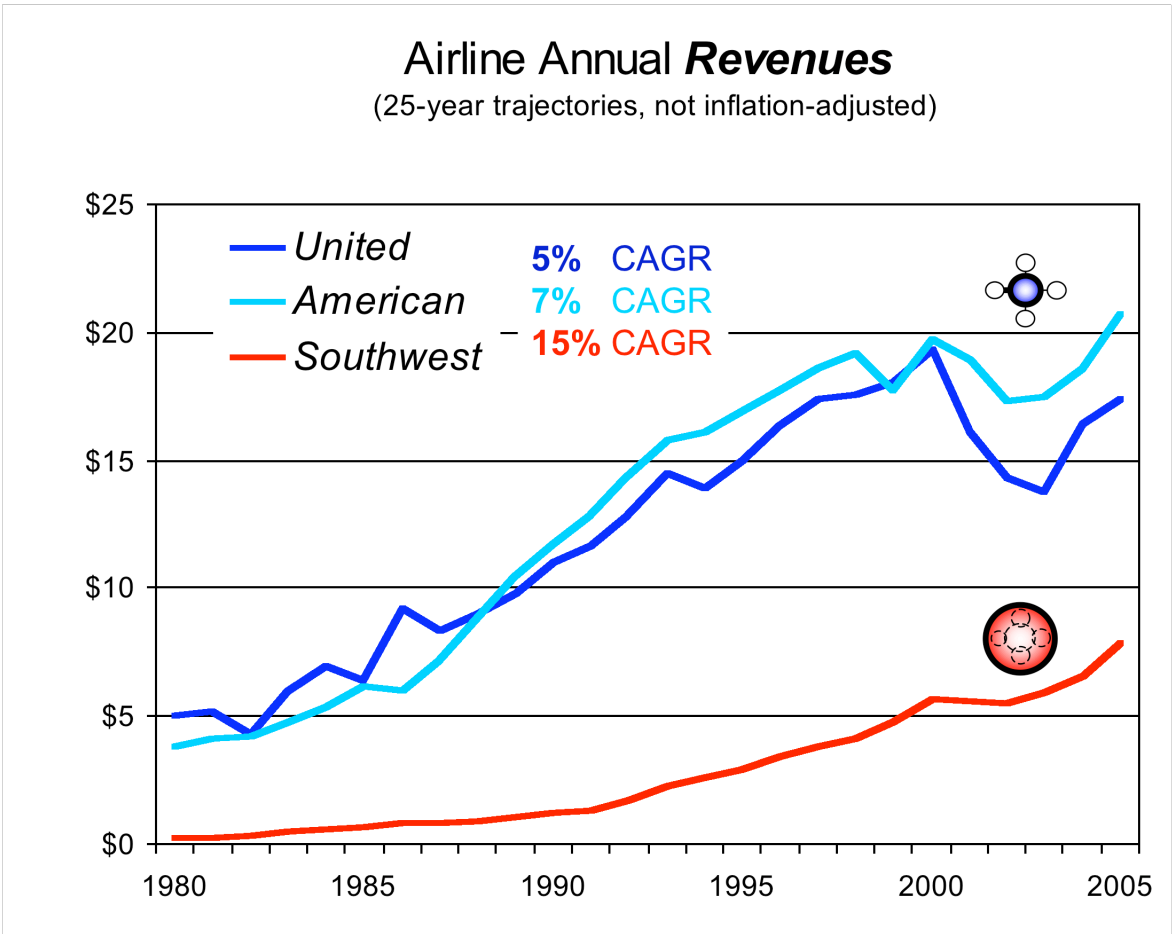


Figure 140: *Top*-line Revenues: *Airline* Industry

3.1.2.1.3 *Airplane* Industry

As shown in Figure 141 below.

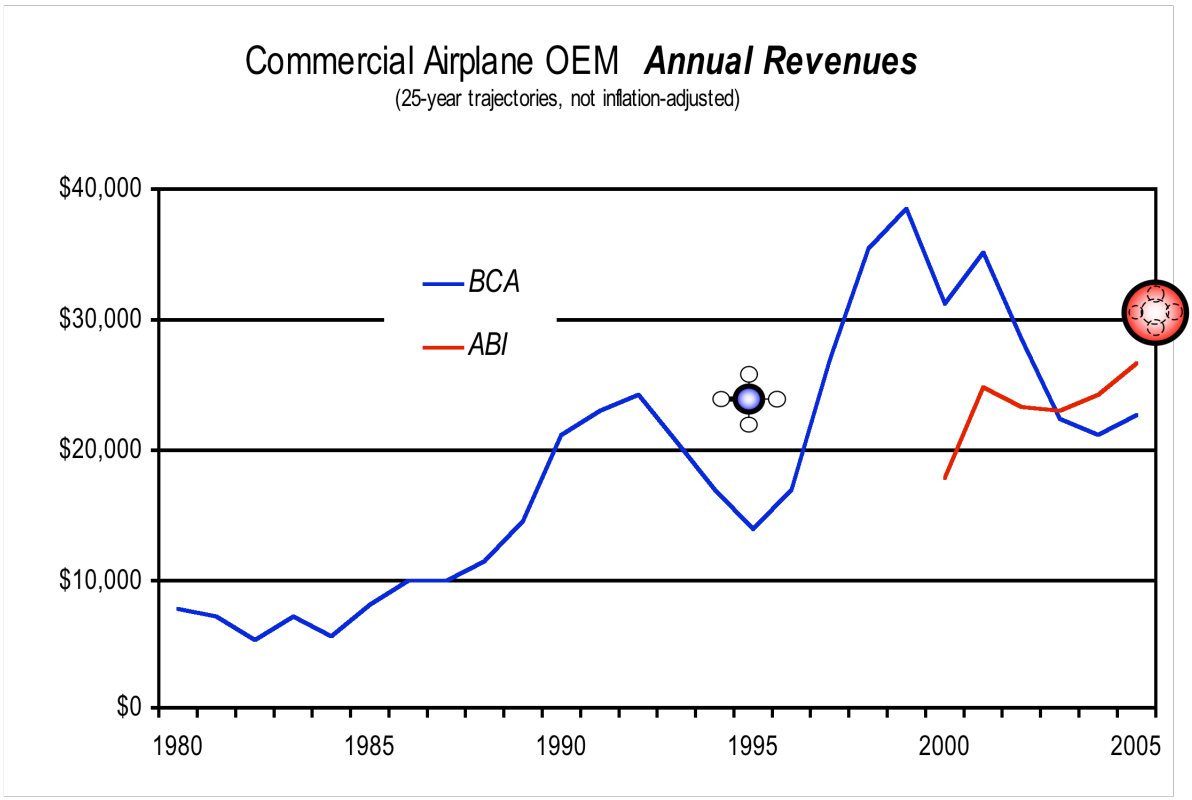


Figure 141: *Top*-line Revenues: *Airplane* Industry

3.1.2.2 *Bottom*-line Profits

3.1.2.2.1 *Auto* Industry

As shown in Figure 142 below.

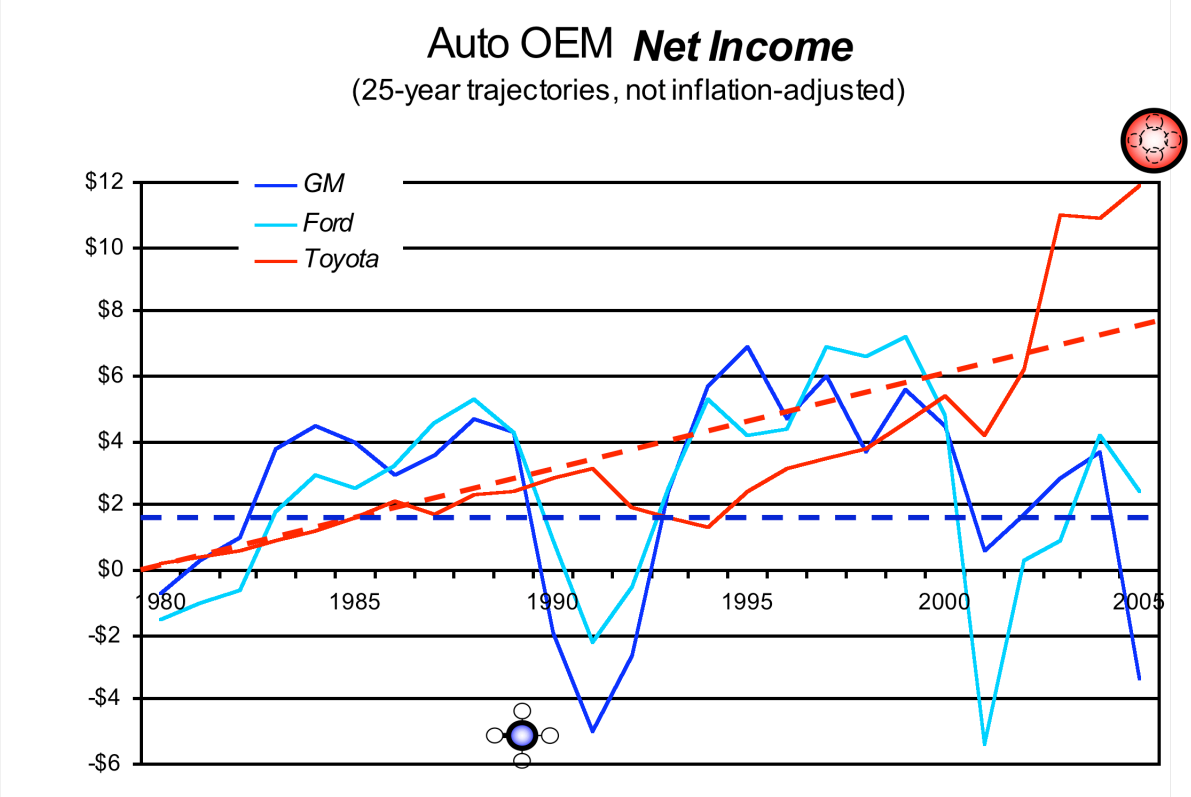


Figure 142: *Bottom*-line Profits: *Auto* Industry

3.1.2.2.2 *Airline* Industry

As shown in Figure 143 below.

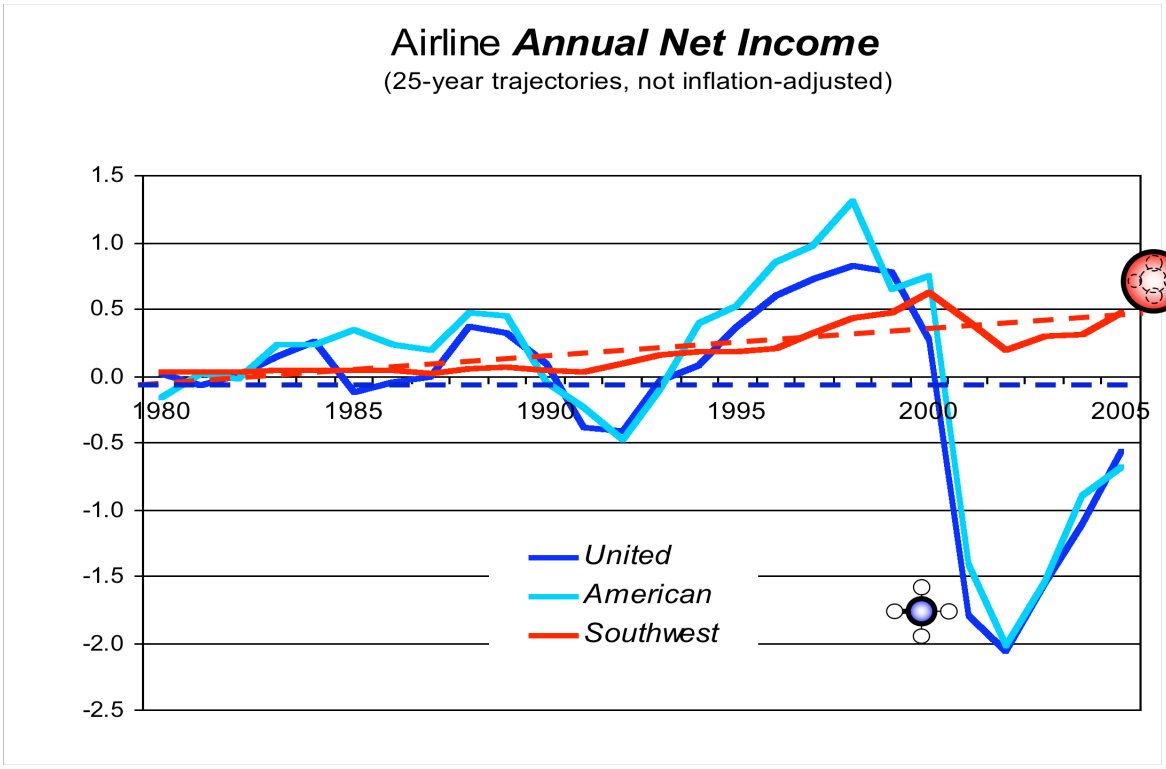


Figure 143: *Bottom*-line Profits: *Airline* Industry

3.1.2.2.3 *Airplane* Industry

As shown in Figure 144 below.

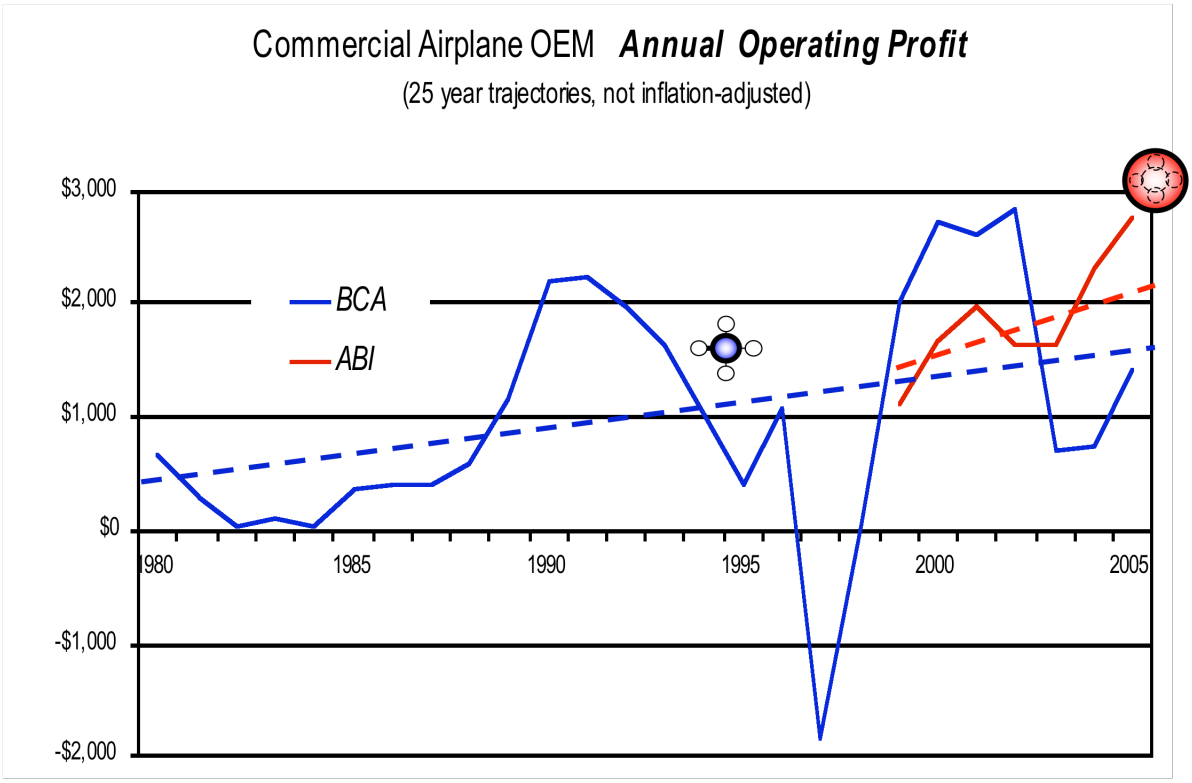


Figure 144: *Bottom*-line Profits: *Airplane* Industry

3.1.2.3 Profit-*ability*

In order to determine the relative profitability, one must normalize profits with respect to revenues, which results in an efficiency metric.

3.1.2.3.1 *Auto* Industry

As shown in Figure 145 below.

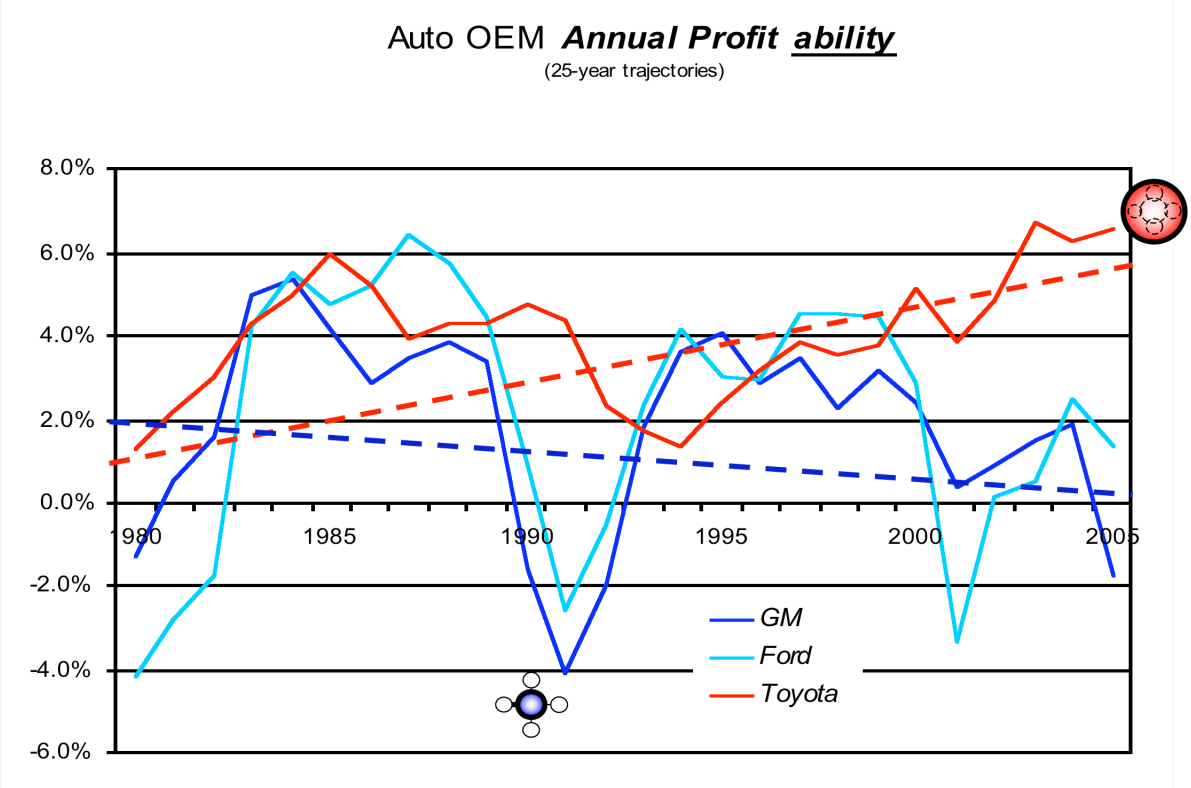


Figure 145: Profit-*ability: Auto* Industry

3.1.2.3.2 *Airline* Industry

As shown in Figure 146 below.

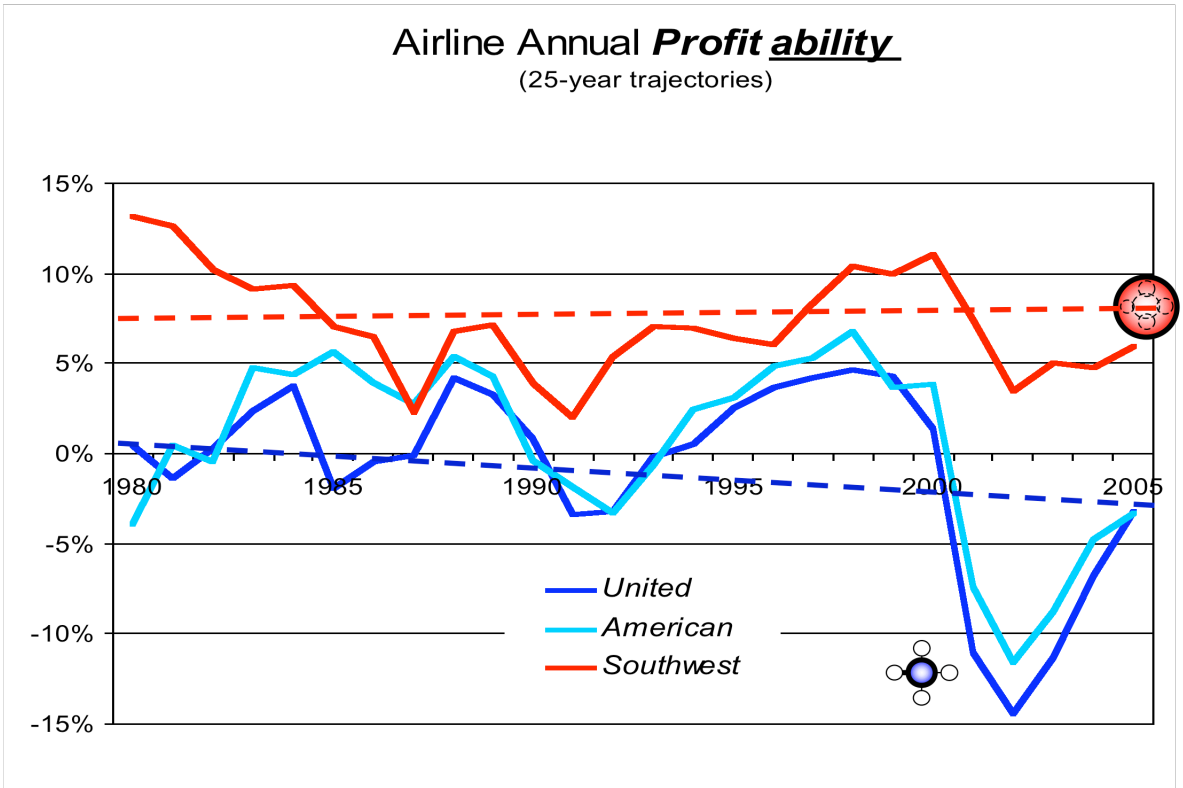


Figure 146: Profit-*ability: Airline* Industry

3.1.2.3.3 Airplane Industry

As shown in Figure 147 below.

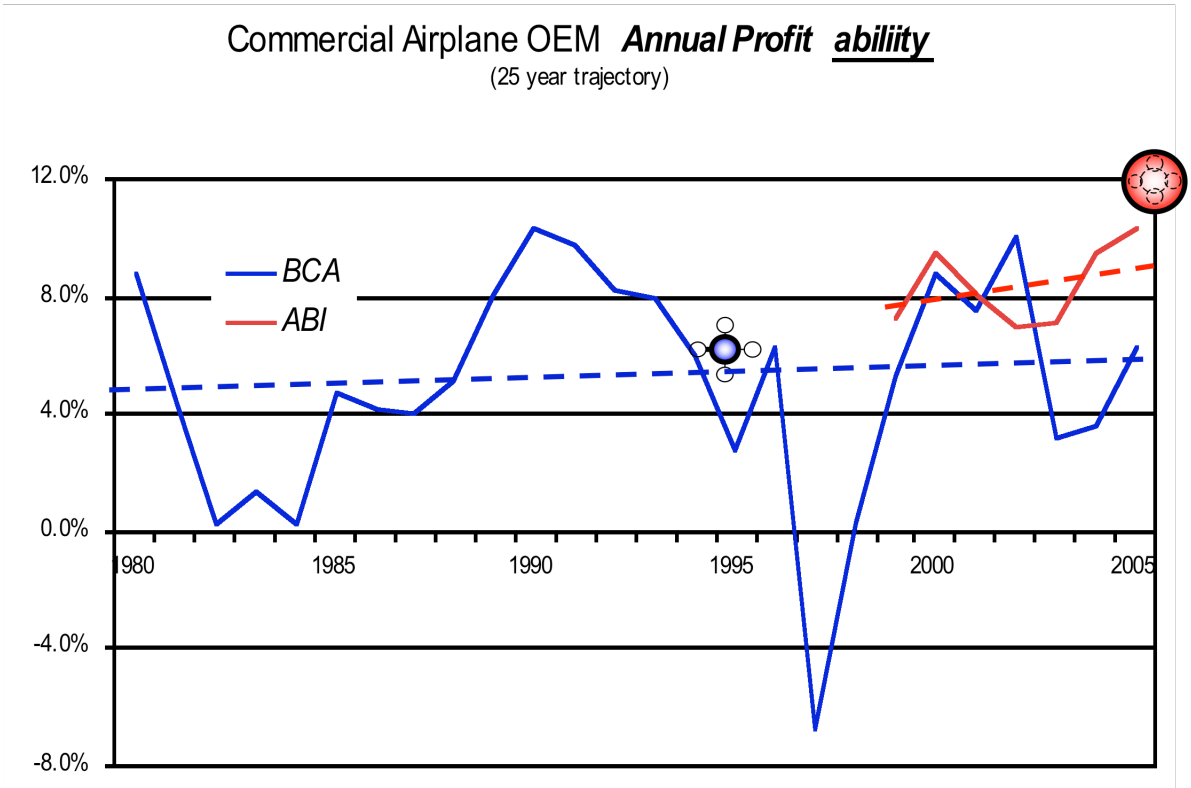
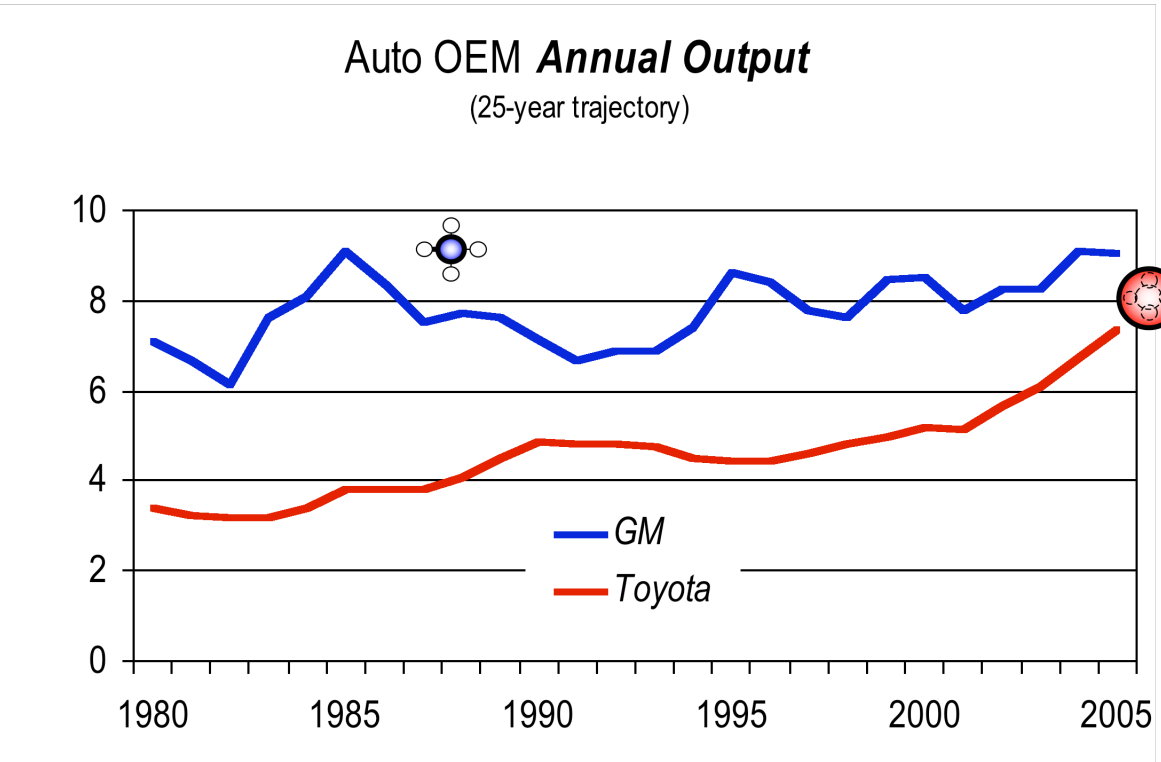


Figure 147: Profit-*ability: Airplane* Industry

3.1.2.4 Enabling *Enterprise Stability*

3.1.2.4.1 *Auto* Industry



As shown in Figure 148 below.

Figure 148: *Enterprise Stability: Auto* Industry

3.1.2.4.2 *Airline* Industry

As shown in Figure 149 below.

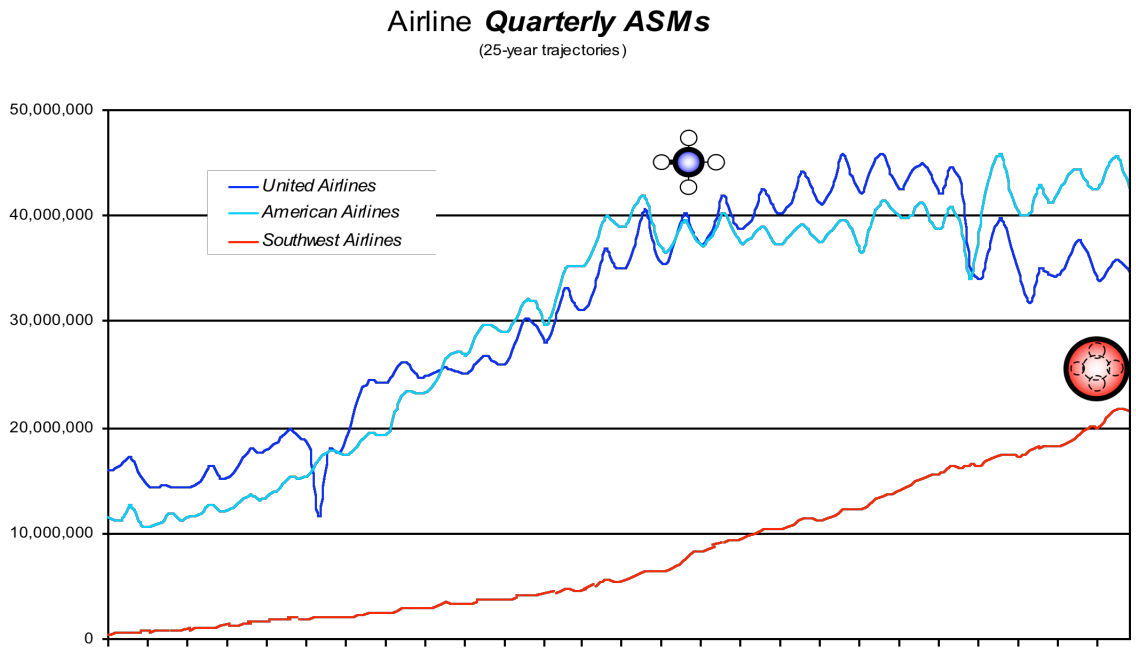


Figure 149: *Enterprise Stability: Airline* Industry

3.1.2.4.3 *Airplane* Industry

As shown in Figure 150 below.

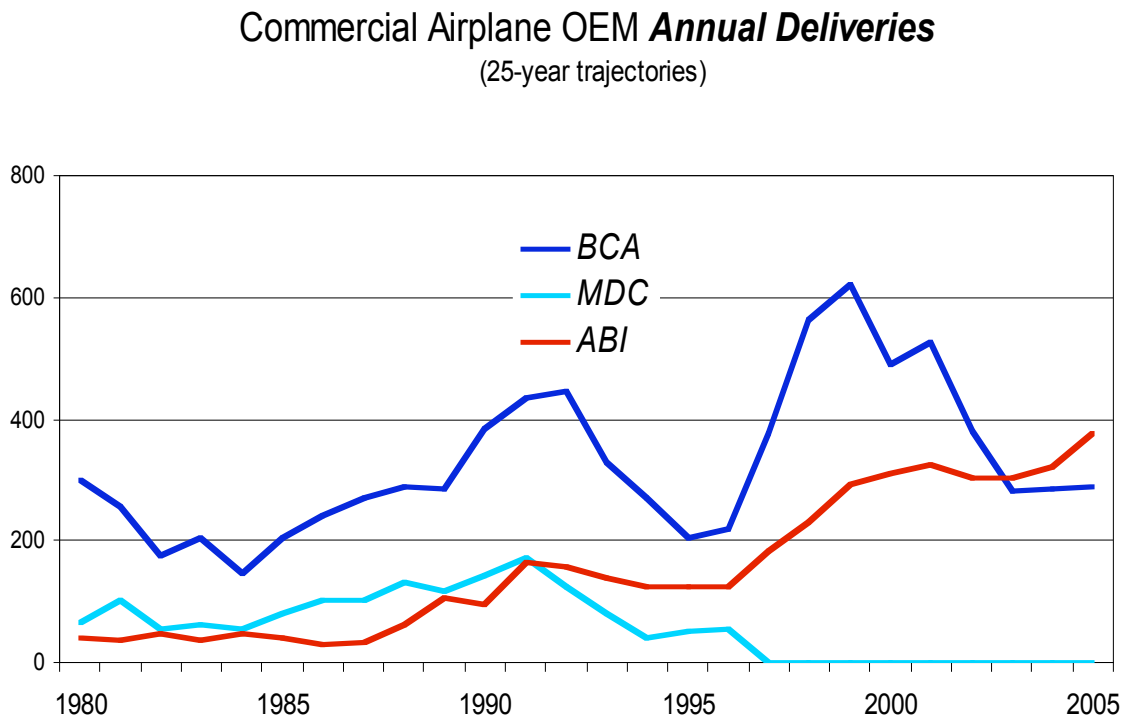


Figure 150: *Enterprise Stability: Airplane* Industry

Finally, we return to the long-term firm performance in the global large commercial airplane industry between the incumbent, *Boeing* and the challenger, *Airbus*. As *Airbus* only recently became a publicly listed incorporated firm, a long-term longitudinal comparison of its share price or market capitalization vis a vis *Boeing* is unfortunately not possible. As an initial proxy to determine an indication of the relative longitudinal performance of the two firms, we can observe market share time histories in Figure 151 below. Note we will later look at a richer matrix of financial and operational performance metrics including profitability, R&D investment, etc.

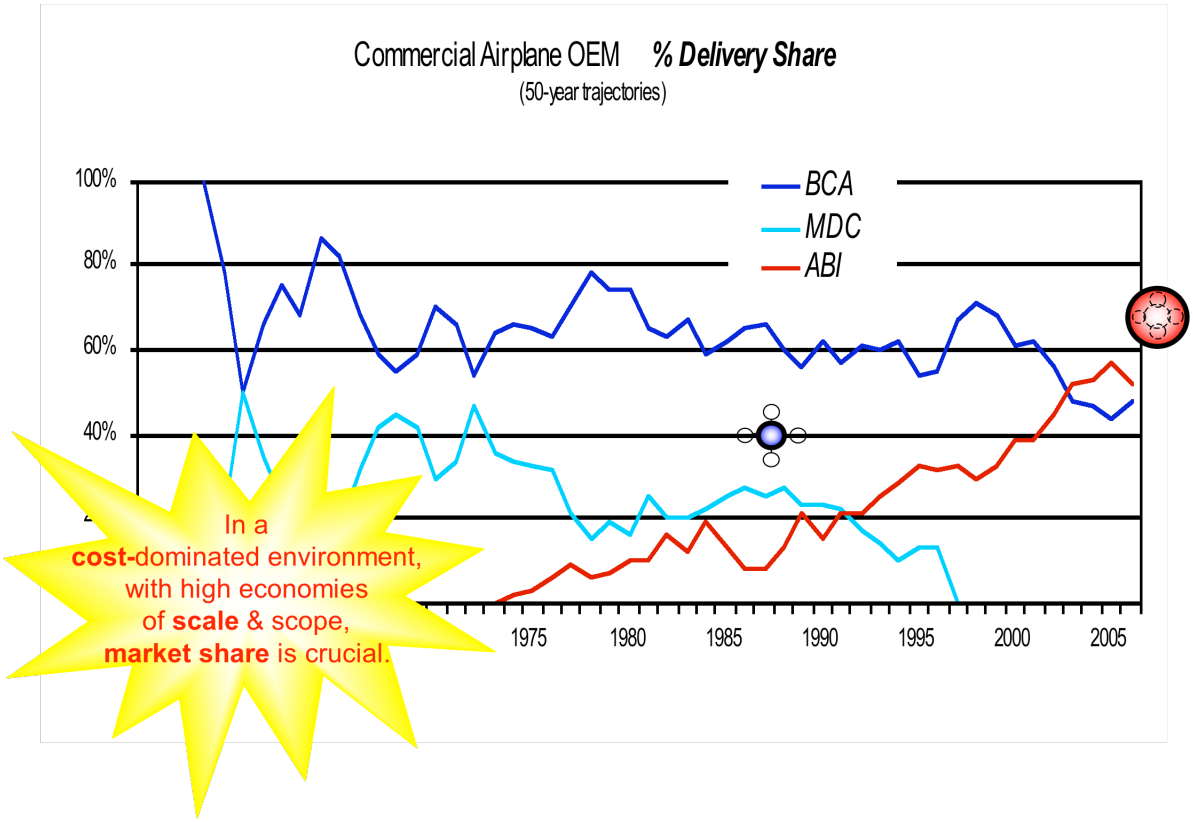


Figure 151: *Boeing* vs. *Airbus* Market (Delivery) Share Trajectories

*"For the past 30 years, we **didn't worry about Airbus** because we consistently held 60% market share and we thought they were just taking market share from McDonnell Douglas. Now that Douglas is gone and Airbus continues to grow, it turns out that there may be **something deeply different in Airbus**, and something inherently similar in Boeing and McDonnell Douglas."*[493]

[493] *Boeing* Senior Executive, Summer 2005.

3.1.3 *Market Value Decomposition:* Balanced *(top- and bottom-line)* Growth

Total Return to Shareholders (TRS) has been demonstrated to be correlated with concurrently high rates of both top-line revenues growth and bottom-line income growth.

Modular enterprise architectures assign a functional decomposition resulting in a clear separation and of ownership (by principals, typically shareholders) and management (their agents). This "efficiency" results in the classic principal-agent problem (Jensen and Meckling, 1976). Agency Theory posits that managers are typically interested in maximization of top-line revenues, as their pay and influence is tied to expanding the size of the firm, while investors are typically interested in maximization of bottom-line profits. Recent research has begun to support these claims (Cannella and Monroe, 1997; Gray and Cannella, 1997).

Integral enterprise architectures on the other hand assign a less clear functional separation of ownership and management, alleviating some of the problems and costs of agency. Resolution of these functional conflicts occur above at system or architectural level. Researchers have referred to this as Stewardship Theory (Donaldson and Davis, 1990).

3.2 Explanations for Firm Success

3.2.1 Popular *Explanations*

Toyota Motors is seen as having a "lean" production model (Womack, Jones and Roos, 1990). Porter has noted that Japanese firms do not have strategy, but have excellence in operations (Porter, 1996).

Southwest Airlines is seen as having a successful operational model. Porter extended this explanation to include an "activity network" (Porter, 1996).

Airbus Industrie is seen as "cheating" in the sense that they are not playing on a level field, largely due to the presence of government subsidies.

All these explanations tend to focus on tactical or operational issues, as opposed to some higher level strategic or architectural explanation.

3.2.2 *Plausible Rival Hypotheses*

> *"The persuasiveness of the arguments is greatly strengthened if serious attention is given to **alternative explanations** – and why these alternative are unlikely to hold. It is hard to overdo this part of the paper. The more robustness checks one can offer, the more convinced readers will become of the newly proposed mechaninsms."*[494]

The proposed framework takes a decidedly *systemic* view of explaining long-term firm performance. Typically these non-systemic explanations can be summarized under the following two mental models:

3.2.2.1 Explanations based on *Detail* Complexity

> *"We have the right strategy…we just need **better execution**."*

The preponderance of senior executive reasons for inadequate firm performance lies in the explanation of poor execution of strategy, rather than on poor strategy itself or even more abstractly, architectural misfit with environmental conditions. This class of plausible rival hypothesis is embedded in the focus on increasing *efficiency*, given a fixed strategy or architecture. Such hypotheses tend to focus on "laundry list" thinking, and consist of a series of disconnected causes, which typically persist over time.

By way of example, *General Motors* – after suffering the systematic 30-year decline of market share – boldly exclaimed on the inside cover of its recent annual report:

> *"Here's what's **new** about GM's strategy this year: **Nothing.**"*[495]

[494] Sigglekow, N. (2007), pg. 23.
[495] From *General Motors'* 2003 annual report, pg. 3.

These hypotheses are difficult to disprove using traditional reductionist approaches, due to their focus on *detail* complexity. An alternative means of disproving this class of plausible rival hypotheses lies in the observation of the longitudinal persistence of the problem, which may point to deeper underlying systemic explanations, of the stylized observation: If a firm consistently and persistently is not able to execute its strategy over the long term, then maybe it has a strategy that is fundamentally not implementable, or which is simply out of synch with the demands of the environment.

A means to attempt to counter such plausible hypotheses, is to conduct longitudinal research in order to question whether poor long-term performance is in fact due to continued poor execution (in which case, one might question if an un-executable strategy is in fact a good one), or is it due to a series of disconnected deleterious exogenous events, or is something more systematic and structural happening?

3.2.2.2 Explanations based on *Dynamic* Complexity

The largest class of plausible rival hypotheses are non-systemic in space and time (i.e with narrow time horizon and local or functional explanations).

> *"No one could have predicted this terrible event which was obviously **beyond our control**."*

The other class of plausible rival hypothesis is based on explanations invoking dynamic complexity (i.e. cause and effect are distant in space and time, and are outside of the firm's control). As discussed later, these are valid explanations, given a firm's enterprise architecture, but they are not robust when one relaxes this architectural constraint.

3.2.2.3 Example: International Trade Subsidies

> *"In **high-technology industries,** which typically are characterized by economies of scale and learning curve effects, **subsidized challengers** who are **expanding** will gain a reduction in net costs as a direct result of the subsidy, and a secondary efficiency gain from the increasing returns to scale as they expand output. As a result, the **profit-maximizing** option for the **incumbents** typically would appear to be to adopt an **'accommodating'** or **'submissive' response**."*[496]

In order to illustrate both types of explanations, we shall turn to the example from the primary case study of the *Boeing-Airbus* global duopoly. By far, the most popular explanation for *Airbus'* recent dominance of *Boeing* is the "subsidies" that it receives from the French, German, Spanish and British governments. This will be demonstrated in the course of this research dissertation not to be incorrect, but in fact an incomplete explanation in terms of *detail* complexity as well as boundedly rational in terms of *dynamic* complexity.

As is shown in Figure 152 below[497], aircraft manufacturers find it difficult to "close the business case" on developing a new commercial airplane, with $10-$15 billion dollars in non-recurring development costs front-loaded 5-7 years before any potential future revenue

[496] Brahm, R. (1995), pp. 79-80.
[497] Developed from Piepenbrock, T.F. (2004). Note: money is shown in green flowing counter-clockwise, while products / services are shown in yellow flowing clockwise.

stream. With even the most conservative investment hurdle rates, the NPV of the cash flow is low and often negative. Secondly, even if firms could secure financing on such low-return and risky projects, their customer's governments often mandate industrial participation in the form of offset agreements. Both of these scenarios give rise to the solution that *Boeing* and *Airbus'* suppliers' governments ultimately take on the development costs under "risk-sharing partnerships".

Figure 152: "Wicked" Problems in the Commercial Airplane Industry

Note how cause and effect are very distant in space and time (i.e. high *dynamic* complexity), and multiple stakeholders with differing objectives are playing (i.e. high *behavioral* complexity). The result is a very "wicked" problem.

Within the international and macroeconomic trade theory literature, comparative advantage is deemed to be the mechanism driving international trade. This is based on the assumption of constant returns to scale and perfect competition. However as Krugman (1987) points out, *economies of scale* - which is based on the assumption of increasing returns to scale and imperfect competition - is a cause of trade separate from *comparative advantage*.

> *"If **increasing** returns and **imperfect** competition are necessary parts of the explanation of international trade, however, we are living in a second-best world where **government intervention** can in principle **improve on market outcomes**."*[498]

[498] Krugman, P.R. (1987), pg. 134.

It may be that in certain industries under certain conditions, that government subsidies are not only necessary, but rational and intelligent; or more generally, in certain ecosystems, at certain times in it's evolutionary development, broader system boundaries will produce better system performance that the converse.

3.2.3 Intra-*species vs.* Inter-*species Explanations*

Explanations for competitive advantage – as posited in this methodology - can arise from two sources: differences *within* a competitor species, and differences *between* species of competitors.

Intra-species competitive advantage is a survival of the "fittest", where here "fit" means in the best shape (i.e. most efficient).

Inter-species competitive advantage is a survival of the "fittest", where here "fit" means the most responsive or adaptive to change (i.e. most effective environmental fit). It is this second explanation that this research will focus on. In other words:

- The competitive ecosystem will be composed of *hetero*geneous genotypes.
- The competitor exhibiting the greatest "efficiency-fitness" will not necessarily win the survival of the fittest competition. The winner in the long-run is posited to be the one which has best "environmental fitness".
- As a result, this research does not seek to advance traditional efficient-fitness theories of explanation, but to advance effective-fitness theory.

3.3 Notes from the Field: On Observing a Rare Species

After many years of intense adaptation and selection which saw the rise and fall of numerous and diverse species, a rich global ecosystem was reduced to only two competitors, locked in a fierce battle for survival as their environment grew ever colder.

Although they shared many similar characteristics - most scientists classified these competitors as belonging to the same species - I had a hunch that there were far greater hidden differences than visible similarities. In fact, the differences were so profound that I believed they could not in fact be rival cousins within the same species, but rather wildly different species fighting over the same territory. Outwardly they both looked like wild jackals, but inwardly one behaved more like a tame turtle, with very different internal DNA *structure* that drove wildly different outward *behavior*. Like the tale of the tortoise and the hare, the outcome of this struggle was far from obvious – in fact it was counterintuitive to scientists and children alike with the weaker of the two - the tortoise - appearing in fact to be slowly overtaking the stronger. In this battle of survival of the *fittest,* it was in fact the least "fit" competitor (in terms of strength or health) that was winning, because it appeared to be the competitor with the best "fit" with its harsh environment.

I was delighted therefore to be given the opportunity to live with each species in their respective lairs, observing them, testing them, getting to know them, their habits, their rituals, their "personalities", and their relationships with their environment, in an attempt to decode their respective DNA. It was a rare opportunity indeed for an aspiring scientist interested in studying how ecosystems evolve to spend extended periods of time over a number of years with every competitor of an ecosystem, especially during the crucial time when the "weaker" challenger competitor began to overtake the stronger incumbent. In fact, as the data unfolded, there appeared an interesting irony – the weaker challenger appeared to be defeating the stronger incumbent by employing the same behavior (derived from the same structure) that was seen in the ancestors of the incumbent itself. A strange cycle of DNA renewal appeared to be taking place on a population level over many generations.

Of course having been trained like most aspiring scientists, I was anxious to isolate a few variables in which to study in large numbers of diverse species in many ecosystems to test other scientist's theories, but this unique situation presented a very different opportunity. I had the "constraint" not of studying countless diverse species under controlled experiments in the laboratory, but of studying two apparently polar opposite species in the complex richness of their own entire ecosystem, watching (and in fact, helping) each try to dominate the other.

This opportunity led me not to test existing theories, but to try to build a new theory appropriate for a new phenomenon: the description of a new species and an explanation for the counterintuitive ways in which it competes. The goal therefore is not a narrow, generalized truth about some specific aspect of competition common in all ecosystems, but a broader systemic understanding of the evolution of the underlying forms and structures that drive the behavior and performance of diverse species.

3.3.1 *Common Characteristics, Traits and DNA*

Figure 153 below is a brief initial list of the common characteristics, or traits of the DNA of the three companies that form the basis of our initial theoretical sample.

- Systematically **outperform** powerful incumbents over the long-term
- Maximization of shareholder value is **not** the over-riding **priority**
- **Counterintuitive** behavior is seen as "**irrational**" to competitors
- Born into **mature** / maturing industries
- **Slower** (short-term) **growth** than competitors
- **Faster** (long-term) **growth** than competitors
- **Organic** (not acquisition-based) **growth**
- **Negative growth** is **rare** (few downsizings or divestitures)
- Higher levels of **stability** (e.g. workforce, R&D, product, production, supply chain)
- **Avoid** playing the "**market adjuster**" (i.e."swing producer")
- Strategy (initially) is "**cost leadership**" (not differentiation)
- **Don't outsource** the ability to think **strategically** (limited use of consultants)
- Compete as extended **enterprises** against incumbent **firms.**
- Optimize performance **more broadly** over **space** and **time.**
- ***Integral*** **"**enterprise ***architectures"…***

Figure 153: Common Characteristics of Dominant Competitors

One of the more important characteristics of each species is the quality of growth - or level of enterprise stability - which has many dimensions. As shown in
Figure **154** below, enterprise stability can be expressed in terms of high-level aggregate variables like production output, production input or product performance characteristics. Stylistically, modular enterprise architectures tend to exhibit time-histories which oscillate in the prime enterprise variables, while integral enterprise architectures tend to exhibit time-histories which possess more stability.

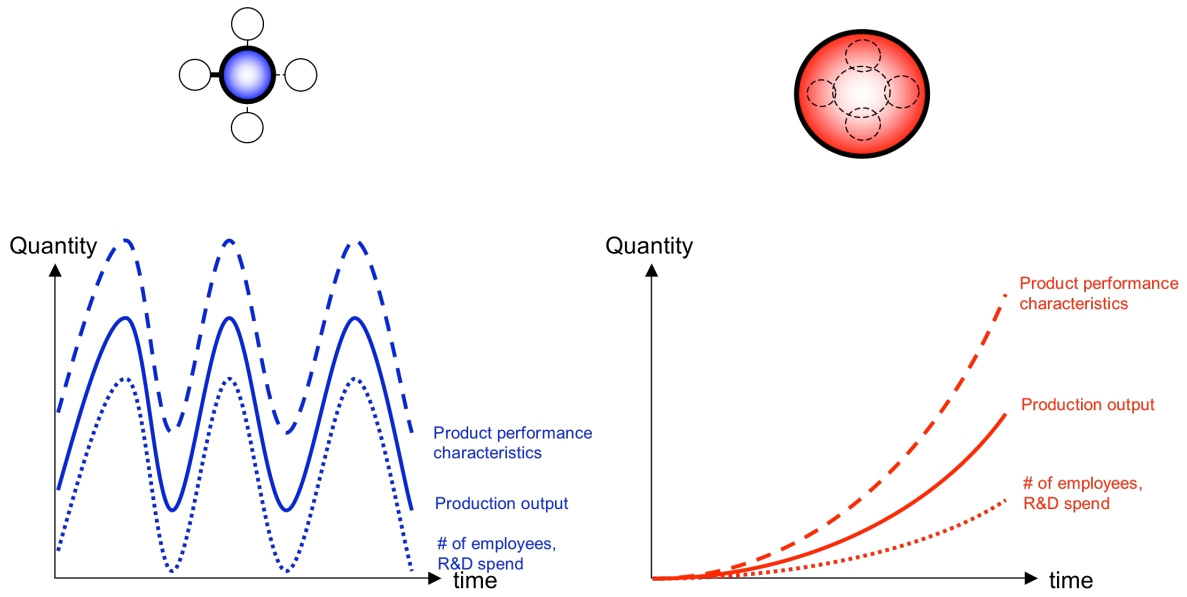


Figure 154: Stylized Enterprise Stability

3.3.2 *Defining and Measuring Each Species*

In the following three essays, a framework will be developed which enables qualitative and quantitative description of each "species", allows for their competitive dynamics and finally observes how the outcomes of these dynamics shape the evolution of the larger ecosystem in which they inhabit.

In essay #1, it will be argued that each species can be described *a priori* using qualitative descriptions of their high-level "input" forms and functions. These will be presented in a typology / taxonomy format.

In essay #2, it will be argued that each species can be defined *a posteriori* (i.e. inferred from observing their high-level "output" behaviors) using quantitative descriptions. These quantitative descriptions will allow for numerical simulation of competitive dynamics between the two species.

In essay #3, it will be argued that the dynamics arising from competition between species results in an evolution of the larger ecosystem.

3.4 Chapter Summary

This chapter introduces three subsequent essays which form an integrated framework which attempts to explain long-term firm performance. In this chapter, we defined the nature of the problem, namely the maximization of shareholder value.

The context for this construct within the framework is shown below in Figure 155. In the following chapter, we will next discuss how enterprise architectures provide the highest level explanations for the performance of the firm.

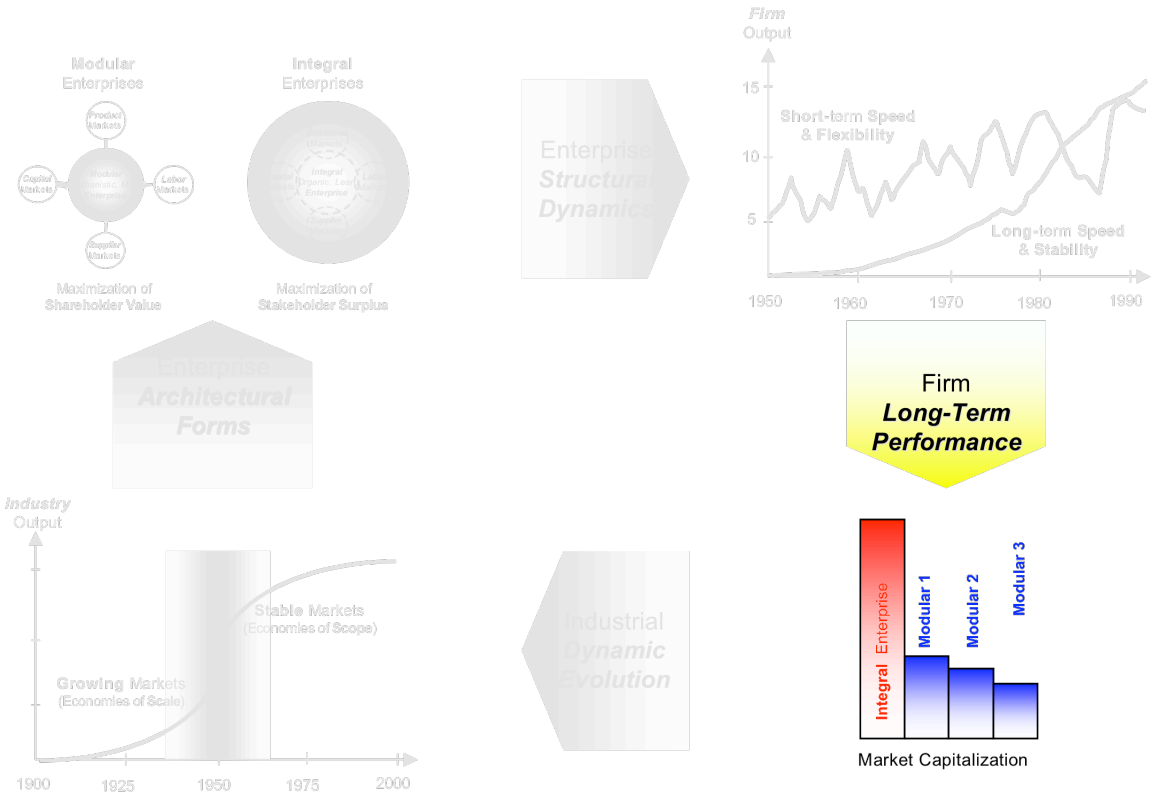


Figure 155: *Firm Performance* within Framework

Chapter 4 Enterprise *Architectural Forms*

4.1 Introduction

4.1.1 *Definition of Purpose, Precision and Accuracy*

> *"Some of the concepts used here are not defined with great **precision**, largely because no highly refined definition is required for my **purposes**; a more detailed or more precise application of the analysis may well justify further effort in this direction."*[499]

> *"There is **no advantage (and much error)** in making definitions of words **more precise** than the subject matter they **refer to**."*[500]

As an enterprise architecture is a high-level, abstract and conceptual notion of complex social phenomena, its precise definition can not and need not be articulated precisely.

> *"A **nonlinear vision** loses accuracy when it is converted into propositions. Theorists start with a vision for a theory an change it 'from entwined ideas at the edge of words to a **linear order** in which the ideas are unraveled and set forth in the form or a propositional argument' (TenHouten and Kaplan, 1973, pg. 147)."*[501]

In addition, as an enterprise architecture is complex, nonlinear, and emergent, the development of a theory built around such a notion is likely to lose its accuracy in the translation to more linear definitions.

> *"I am not aware of any social scientists who claim to have a theory that precisely predicts human behavior. Instead, we correctly speak in terms of **'tendencies,' 'inclinations,' and 'propensities.'** In empirical tests, we consider it a big success if our preferred theory explains just 10% of variance in human or organizational behavior. Most social scientists, I believe, marvel at **how little grasp** we have – after decades of trying – on the factors that influence human behavior."*[502]

4.1.2 *Construct of* Architectural Form

Based on this, the primary construct - which is borrowed from product design theory (Ulrich, 1995) and supply chain design theory (Fine, 1998) - is the notion of an *architecture*, which if extended outward towards a firm's ecosystem, is termed herein as an *enterprise architecture*. Note that this *inter*-firm architecture, is to be distinguished from the classical *intra*-firm architecture, that is common in the organizational design literature.[503]

> *"Building on the product architecture concept enables development of the construct of supply chain architecture, a **richer concept** than that of traditional make/buy or vertical integration, which focuses primarily on ownership of assets in the supply chain."*[504]

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[499] Penrose, E. (1959), pg. 3.
[500] Robinson, J. (1956), pg. 361, cited in Penrose, E. (1959), pg. 3, footnote 1.
[501] Weick (1995), pg. 386. 1.
[502] Hambrick, D.C. (2005), pg. 105.
[503] The idea for this distinction came from Prof. Michael Tushman.
[504] Fine, C.H. (1998), pg. 136, referring to work by Novak, S. (1998).

Although reference is made to a *product* architecture, an *enterprise* architecture – being a socio-economic construct - is not seen statically, but dynamically (or more accurately, as evolutionary). It is a social construct, "built" by humans for social purpose. Like humans and human organizations, it evolves whether by design or otherwise.

4.1.2.1 *Basic* definition of "Enterprise Architecture"

The enterprise (or ecosystem) is broadly defined as the firm and its relevant stakeholder groups. Drawing from the stakeholder theory of the firm (Mitchell, Agle & Wood, 1997), the architecture in question focuses primarily (but not exclusively) on the fundamental stakeholders of: customers, suppliers, employees and investors.

> *"Typologies at their best are **memorable, neat** and **evocative**."*[505]

> *"**Taxonomic** development is a critical element in the future health of organization science."*[506]

This construct characterizes a *typology* of enterprise architectural forms or "archetypes", which are fundamental basis for the underlying dynamic capabilities of the enterprise. While the typology of enterprise architectures is a *continuum*, the extreme archetypal cases (fully modular and fully integral)[507] are presented in their discrete binary form in Figure 156 below, and will be described in detail in the dissertation. It must be stressed that various *hybrid* architectural forms exist between these binary extremes, each having slightly different properties and structural dynamics. These subtleties will also be discussed in the theoretical framework.

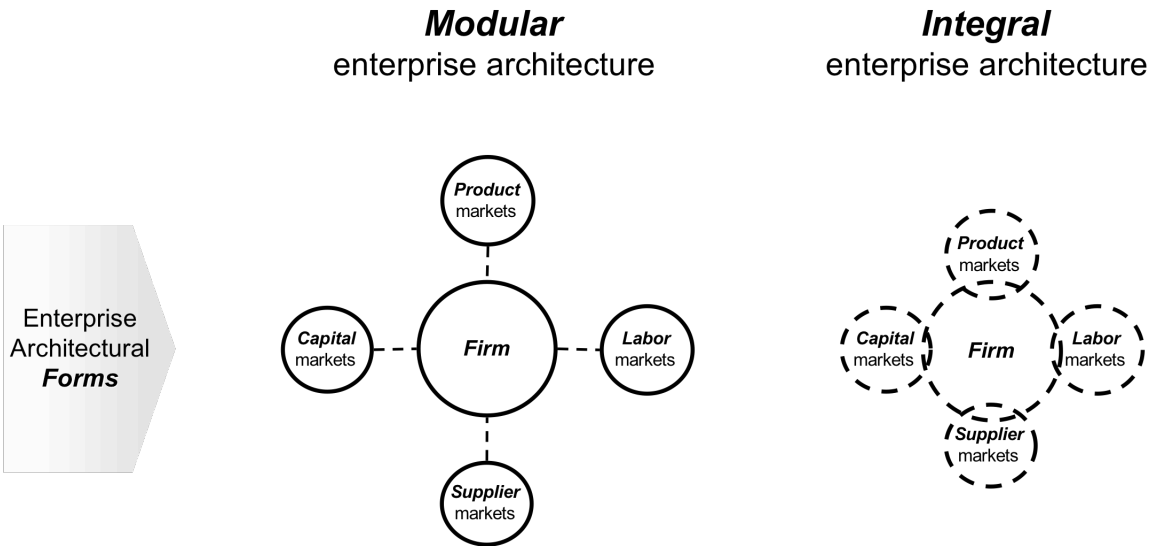

Figure 156: *Simple* definition of "Enterprise Architecture"

[505] Miller, D. (1996), pg. 506.
[506] McKelvey, B. (1975), pg. 509.
[507] Note, in software architecting, the notions of *open modular* and *proprietary integrated* are additional distinctions.

4.1.2.2 *Contingent* definition of "Enterprise Architecture"

> *"The world consists of **two kinds of people**: those who divide everything into **two groups** and those who don't."*[508]

The enterprise architectures shown previously are generic. This framework, however endeavors to provide an environmental context within which such architectures thrive and grow. In Essay #3, we will discuss in more detail the environmental conditions which support these architectures, but for now, the following color convention will be used ass shown in Figure 157 below.

- Blue signifies an architecture that grows in a *growing* market environment.
- Red signifies an architecture that grows in a *maturing* market environment.

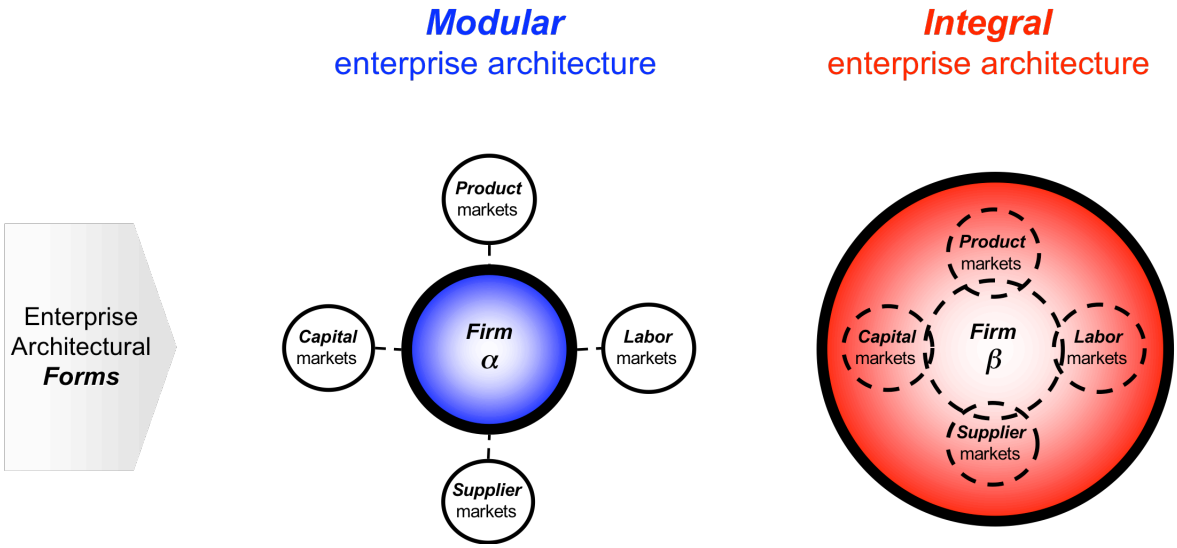

Figure 157: *Contingent* definition of "Enterprise Architecture"

[508] Anonymous.

4.1.3 *Construct as* Continuum

A qualitative view of the primary case study companies is shown in Figure 158 below, in order to illustrate that the while the constructs are represented as discrete theoretical binary archetypes, they are at the ends of a spectrum or continuum of enterprise architectures.

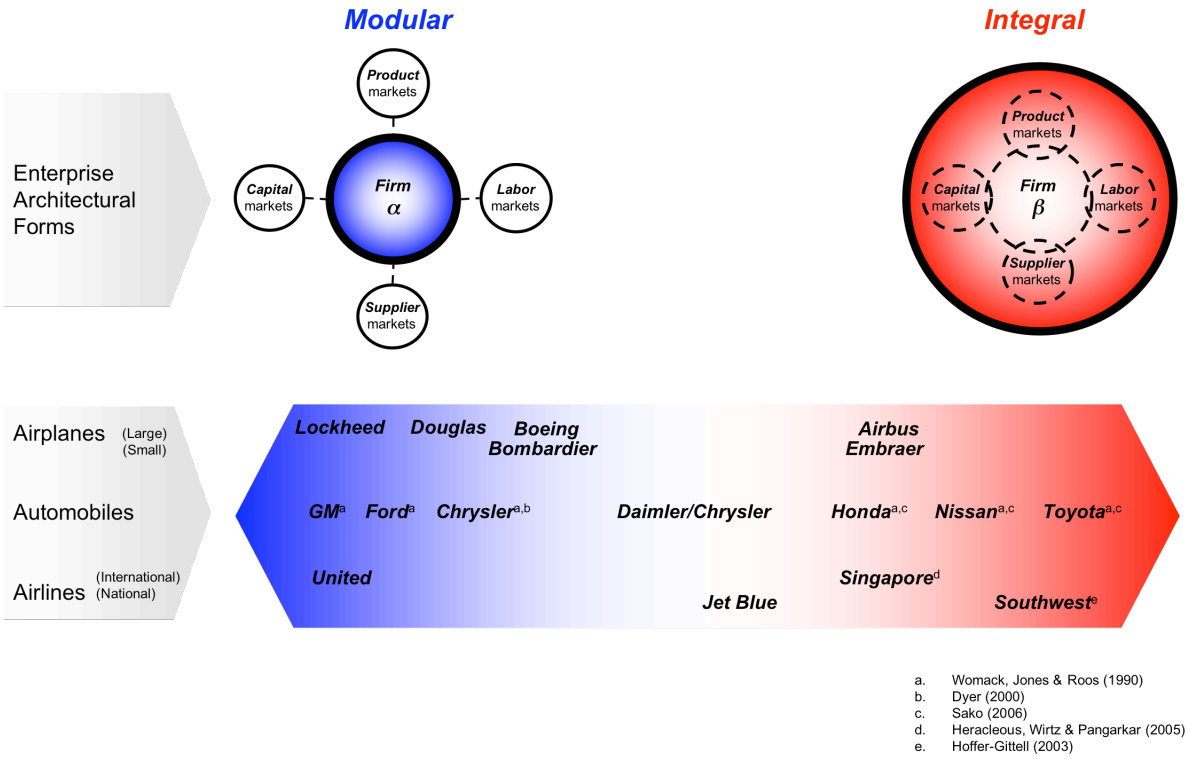

Figure 158: *Continuum* of Enterprise Architectures

As an explanatory construct, the enterprise architecture is likely to yield stronger and more accurate predictions in the cases of *GM* vs. *Toyota*, and *United* vs. *Southwest* Airlines as they represent clearer cases of archetypal extremes, given a state of environmental evolution. By contrast, it will be argued that *Boeing* and *Airbus* represent both more moderate archetypal forms, and therefore the enterprise architecture, while fundamental and primary in its explanatory power, must concede to traditional explanations of efficiency etc.

It is fitting therefore to use the notion of architecture to describe complex social systems, as it is a *systemically complete*, yet *imprecise* notion that captures "tendencies". As shown in Figure 159 below, an architecture neither predetermines choice, nor over-constrains action. It does however enable and give tendencies. Within an enterprise architecture, firms can have a wide variation of modular to integral tendencies in the components that make up their architectures. For example, modular enterprise architectures can and certainly do have "Theory Y" managers (McGregor, 1960), they can and certainly do have low cost strategies in certain market segments (Porter, 1980), however this does not take-away from the mean properties of "Theory X" pre-dominance and differentiated product strategy focus, which

will be discussed in subsequent sections, particularly as the environmental state defines the architecture.

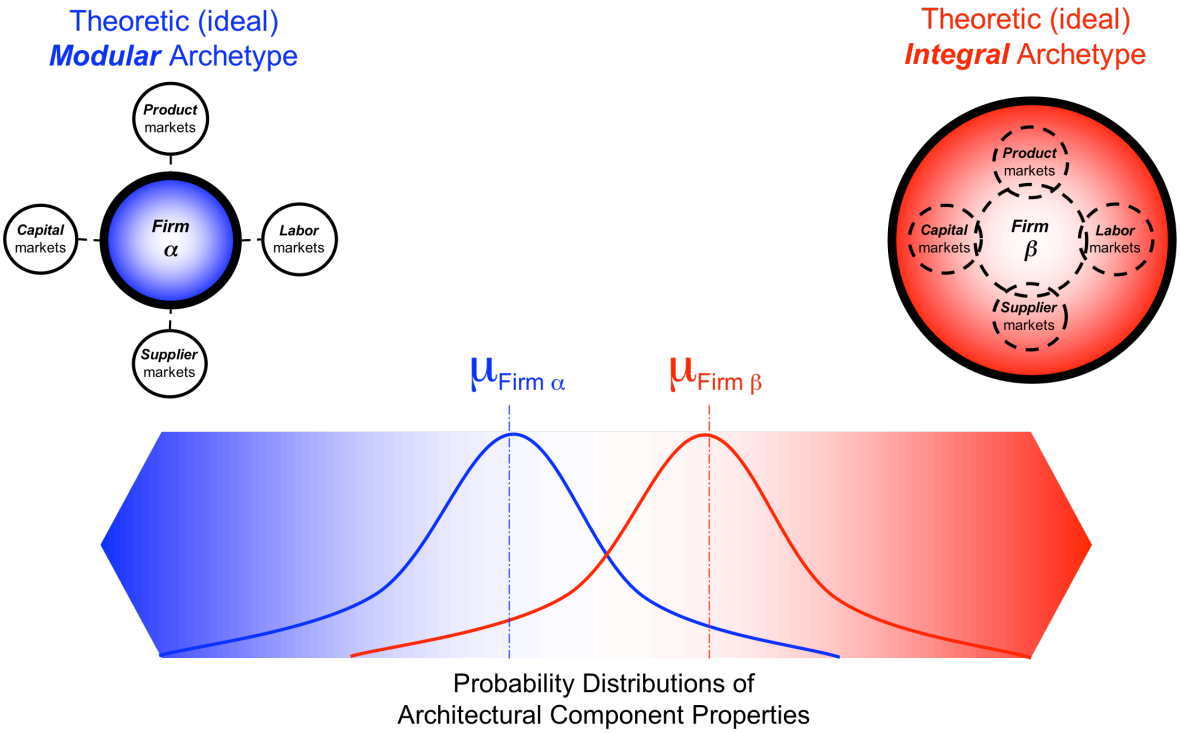

Figure 159: Architecture as Continuum of Probabilities

4.1.4 *Construct as Mediator…*

Recalling from chapter 1, Astley and Van de Ven's (1983) characterization of key debates in organizational theory was parsed along two axes: level of analysis and role of human agency. The construct of enterprise architecture therefore attempts to address and unify both debates.

4.1.4.1 …between *Firm* and *Environment*

In an attempt to answer the primary research question: "Is firm performance due to the characteristics of the firm or the environment?", the answer is hypothesized to lie in *how the firm interacts with the environment* - in other words, the nature of the *architecture of the firm's extended enterprise*.

4.1.4.2 …between *Determinism* and *Choice*

> *"Nothing is more **fundamental** in setting our research agenda and informing our research methods than our **view of the nature of human beings** whose behaviors we are studying... it makes a difference to research, but it also makes a difference for the proper design of...institutions."*[509]

An enterprise architecture is primarily a social (not a physical) construct. Like physical architecture, it both enables and constrains, but does not determine activity or human action.

> *"We **shape our buildings**; thereafter, our buildings **shape us**."*[510]

While most people think of physical architecture as static and unevolving, the truth is that it does on a rather slow and punctuated timeframe. An enterprise architecture, as a social construct is more obviously dynamic and evolving. It is emergent, as its invisible structure must be recreated every day in every new human interaction (Giddens, 1979).

> *"When does a building actually **become** built?."*[511]

[509] Simon, H. (1985), pg. 293.
[510] Attributed both to architect, LeCorbusier (1887-1965) and to Sir Winston Churchill in a speech in 1943.
[511] LeCorbusier (1887-1965).

4.1.5 *Construct as* Embedded Enabler *of Strategic Change*

The construct of enterprise architecture also serves as a pedagogical tool embedded within the ongoing process of enacting an existing architecture to create a means of self-reflexive analysis and enterprise (re)design.[512]

> *"To understand architecture and its impact one needs to understand the political and cultural dimensions of leadership and architecting, as Ted Piepenbrock described. [When considering] Ted Piepenbrock's efforts at Boeing, the audience is the Board of Directors, who are trying to make architectural decisions about the Boeing enterprise. Ted's role is not to be an outside architect; rather he is operating as a kind of facilitator in the board's own thinking about its architecture. He does, however, carry out his own research in the firm – this gives him credibility with the audience and helps him elucidate the key choices and consequences facing them in their architecting (i.e. modular versus integral enterprise). It is, I would argue, more sophisticated in its understanding of* ***enterprises as enacted systems*** *and enterprise architecture as a* ***practice that requires embedding****. This isn't to say that implementation will be successful – Ted himself thinks it will be near impossible for a modular enterprise to become integral. But he is* ***putting the possibility of implementation at the center*** *by locating the architects and audience in the same, very powerful people and using himself and his expertise as provocation and facilitator."*[513]

[512] I am indebted to fellow MIT PhD student, Jason Jay for helping me clarify this concept.
[513] Comments and critiques of this framework by graduate students in the Spring 2006 MIT ESD class, *Enterprise Architecting*.

4.1.6 *Heuristics associated with Architectural Form*

Heuristic 1a:
The architecture is the *form* of the system, and is the dominant factor in its *behavior*.[514] The architectural *form* of an enterprise (modular or integral) defines the enterprise's *effectiveness.* Enterprise *effectiveness,* together with enterprise *efficiency,* define an enterprise's performance capability. (Note: the more effective enterprise structure may not exhibit the highest performance in the short term.)

Heuristic 1b:
The architectural *form* of an enterprise is defined by the *boundaries* and *interfaces* between the key stakeholders or input providers (i.e. those who significantly affect the firm's costs and/or revenues). These are in turn defined by the *quantity* of stakeholders within a group and by the *quality* of relationships with stakeholders. The boundaries are characterized both *spatially* (near vs. far) and *temporally* (short-term vs. long-term).

Heuristic 1c:
The architectural *form* of an enterprise can be defined either by its *inputs* (i.e. the quantity and quality of relationships with key stakeholders), or by its *outputs* (i.e. the growth and stability characteristics). Given either inputs or outputs, one can infer the enterprise's architectural form.

Heuristic 1d:
The power and influence distribution of the stakeholder space is not homogeneous with respect to driving structural dynamics of growth and stability. (For example, the shareholders in a modular enterprise contribute relatively more influence to enterprise growth requirements).

The enterprise architecture concurrently and reflexively defines and is defined by managerial cognitive frames, which influence their behaviors and strategic choices and modes of operation. In addition, the enterprise architecture defines the participant firm's robustness to various environmental threats.

[514] D. Whitney et al. (2004), pg. 26.

4.2 Theoretical Foundations

The notion of *inter-firm* enterprise architectures - while not explicitly found in the management literature - can be constructed from a variety of eclectic theoretical traditions. The following briefly summarizes a few of the threads in various fields.

4.2.1 Economic *theories*

The discussion of economic theories is divided into micro- approaches, focusing on the firm and markets, as well as macro- approaches, focusing on national and international economies.

4.2.1.1 *Micro*-economics

4.2.1.1.1 Specialization and the *Division* of Labor

One of the first important contributions to the discussion of enterprise architectures, lies in one of the original theoretical justification for liberal free-market economics by Adam Smith (1776).

The notion of efficiencies based on specialization of tasks and the division of labor will loom large in our later exploration of modular enterprise architectures. This focus on "division" (or differentiation) lies in juxtaposition to the focus on "multiplication" (or integration) in integral enterprise architectures.

Finally, note that Smith's work will also form the basis of a later discussion on craft, mass and lean production.

4.2.1.1.2 New Institutional Economics

The definition of an enterprise architecture relies on some fundamental economic theory, which questions the reasons why firms exist at all – and which hypothesize that firms arise when markets fail.[515] This line of theory, embedded in *new institutional economics*, attempts to characterize a spectrum of economic production ranging from markets to hierarchies (Coase, 1937; Alchian and Demsetz, 1972; Williamson, 1985).

4.2.1.1.2.1 Theory of the Firm

> *"A **firm** is likely to emerge in those cases where a very **short-term** contract would be unsatisfactory."*[516]
>
> *"It seems improbable that a **firm** would emerge without the existence of **uncertainty**."*[517]

The mechanisms of markets are quite different from those creating hierarchies, and in fact from those of intermediate networks. Understanding this distinction will be fundamental in defining the spectrum between modular and integral enterprise forms. From the above quotations from Nobel laureate, Ronald Coase (1937), one might conjecture that while firms emerge due to the presence of long-term contractual demands and uncertainty, integrated enterprises may emerge due to the presence of even longer-term contractual demands as well as greater uncertainty.

4.2.1.1.2.2 Transaction Cost Economics: *Markets*, *Hierarchies* & *Hybrids*

In addition to the classical distinctions between markets and hierarchies, this work will advance the recent theories which have characterized a form between market and hierarchy: the *network* (Powell, 1990) or *hybrid* organization (Ahmadjian and Lincoln, 2001).

As shown in Figure 160 below, Gibbons (2004) posits that the transaction costs of non-integration between firms in the form of rent-seeking/haggling (e.g. with the supplier stakeholder) are similar to the costs of non-integration within firms in the form of politicking (e.g. with the labor stakeholder).

> *"I am fully persuaded that **rent-seeking between organizations** is an important **transaction cost of non-integration**. I will define rent-seeking as individually optimal (but socially destructive) **haggling** over appropriable quasi-rents. **Politicking within firms** seems to be the inescapable internal-organizational analog of haggling between firms."*[518]

[515] Putterman and Kroszner, (1996), pp. 1-31.
[516] Coase, R. (1937).
[517] Coase, R. (1937).
[518] Gibbons, R. (2004), pp. 25 and 30.

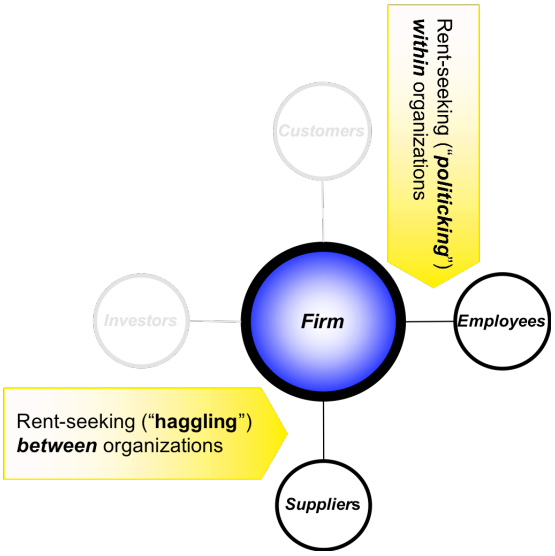

Figure 160: Transaction Costs of Non-Integration *between* and *within* Organizations

The traditional focus on contracting between the firm and its employees (Alchian & Demsetz, 1972), was broadened by Jensen & Meckling (1976) to include other stakeholders:

> *"Contractual relations are the essence of the firm, not only with employees but with suppliers, customers, creditors, and so on. The problem of agency costs and monitoring exists for all of these contracts, independent of whether there is* [team] *production.* [As a result], *it makes little or no sense to try to distinguish those things that are* ***'inside'*** *the firm (or any other organization) from those things that are* ***'outside'*** *of it. There is in a very real sense only a multitude of* ***complex relationships (i.e. contracts) between the legal fiction (the firm) and the owners of labor, material and capital inputs and the consumers of output****."*[519]

4.2.1.1.2.3 Agency Theory

Jensen & Meckling (1976) observed that when interests diverge between principals and their agents, losses may be incurred by the principals. These losses however can be minimized by imposing various controls on the agents.

The complementary viewpoint to agency theory has been suggested as "stewardship theory" (Donaldson and Davis, 1989 and 1991), in which the interests of principals and agents are aligned.

[519] Jensen and Meckling (1976), pp. 310-311.

4.2.1.1.3 Economics of *Profit-Maximizing* and *Labor-Managed* Firms

4.2.1.1.3.1 Terminology

Even within the academic discipline of economics, numerous names have been used to describe the two different economic firm types as shown in Table 8 below. For the sake of simplicity, this research uses the following terminology: *profit maximization* (PM) and *labor managed* (LM).

	Profit Maximizing	**Labor Managed**
Alternative Terminologies and Contexts	Capitalist, Entrepreneurial, Private	Cooperative, Employee-controlled, Illyrian, Public State-Owned Welfare-maximizing

Table 8: Terminologies for Economic Firm Types

4.2.1.1.3.2 Objective Functions

> *"The force driving this outcome is the **strategic asymmetry** between the PM and the LM firm in terms of their respective **objective functions**."*[520]

One of the most striking differences between PM and LM firms lies in their objective functions. In the following subsections, each will be briefly discussed in turn. In subsequent sections, the *objective* functions will be translated into *reaction* functions to investigate competitive interactive games.

4.2.1.1.3.2.1 Profit Maximizing (PM)

The objective function of the PM firm has been represented (Cremer and Crémer, 1992; Delbono and Rossini, 1992).

4.2.1.1.3.2.2 Labor Managed (LM)

The objective function of the LM firm has been represented (Lambertini and Rossini, 1998, pg. 15) as the maximization of the profit per worker, V:

$$V = (\text{revenues} - \text{costs}) / \text{labor}$$
$$V = (pq - rk) / L$$

Where p is the market price, q is the quantity sold by the firm, r is the price of capital, k is the quantity of capital used in the production process, and L is the quantity of labor used.

4.2.1.1.3.2.3 Mixed Objective Functions

[520] Lambertini and Rossini (1998), pg. 20.

*"The objective of a capitalist firm that engages in cooperative bargaining with its workforce can be represented as a **weighted function** of profit-maximization and the typical LM objective."*[521]

While the objective functions of PM and LM firms vary, various researchers have noted that there may be mixed objective functions (Law, 1977; Svenjar, 1982; Aoki, 1984; Miyazaki, 1984).

[521] Neary and Ulph (1996), pg. 2.

4.2.1.1.3.3 *Homogeneous* Duopoly competition

While much has been written about homogeneous duopoly competition between PM firms, the literature on duopoly competition between LM firms is more rare and recent. Each type of homogeneous duopoly will be briefly examined below with respect to either quantity or price competition under simultaneous or sequential conditions.

4.2.1.1.3.3.1 Cournot (*Quantity*) competition

As shown in Figure 161 below, Lambertini and Rossini (1998) develop the reaction functions for an LM duopoly as upward-sloping, in contrast to the reaction functions for a PM duopoly as downward sloping.

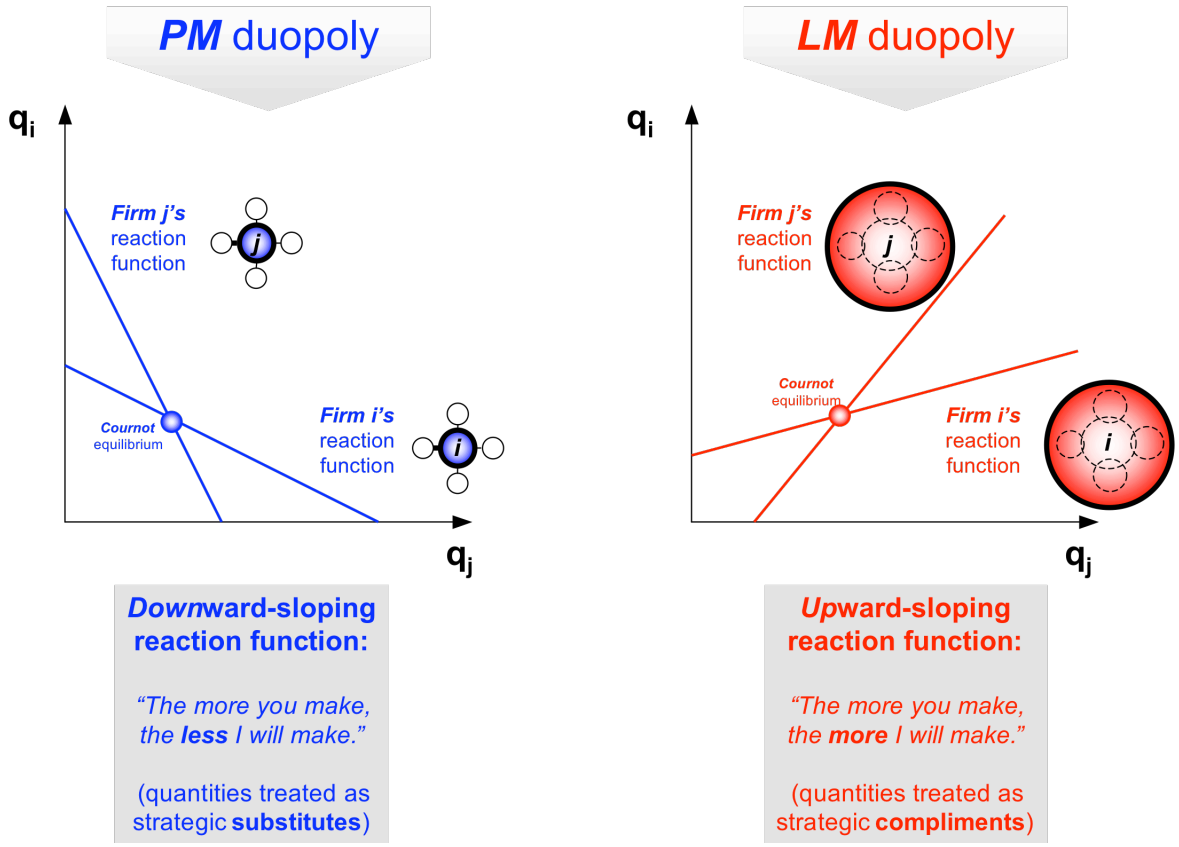

Figure 161: Reaction Functions for PM and LM Duopolies in Quantity Space

For the PM's downward-sloping reaction functions, quantities are treated like strategic substitutes, while for the LM's upward-sloping reaction functions, quantities are treated like strategic compliments, as first introduced by Bulow et al, 1985).

Lambertini and Rossini (1998) then summarize the responses of homogeneous duopolies with respect to capital commitment investments as shown in Figure 162 below.

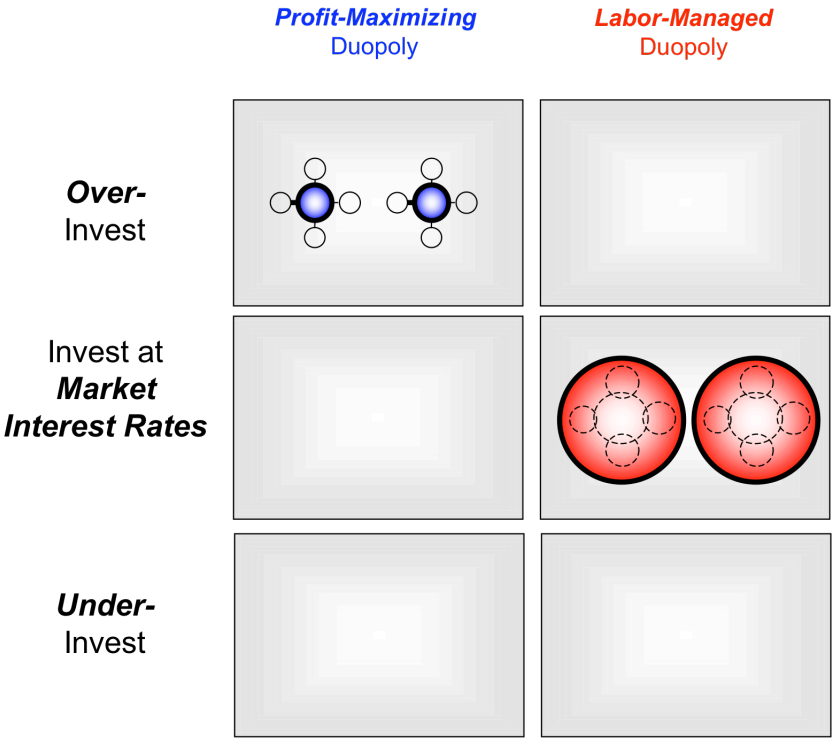

Figure 162: *Homo*geneous Duopoly under *Cournot (Quantity)* Competition

Zhang (1993) and Haruna (1993) discuss the use of excess capacity to deter entry in LM industries and economies.

4.2.1.1.3.3.1.1 Stackleberg (*sequential*) competition

The issue of choosing roles in a sequential duopoly is summarized by Lambertini (199?), and summarized in Figure 163 below.

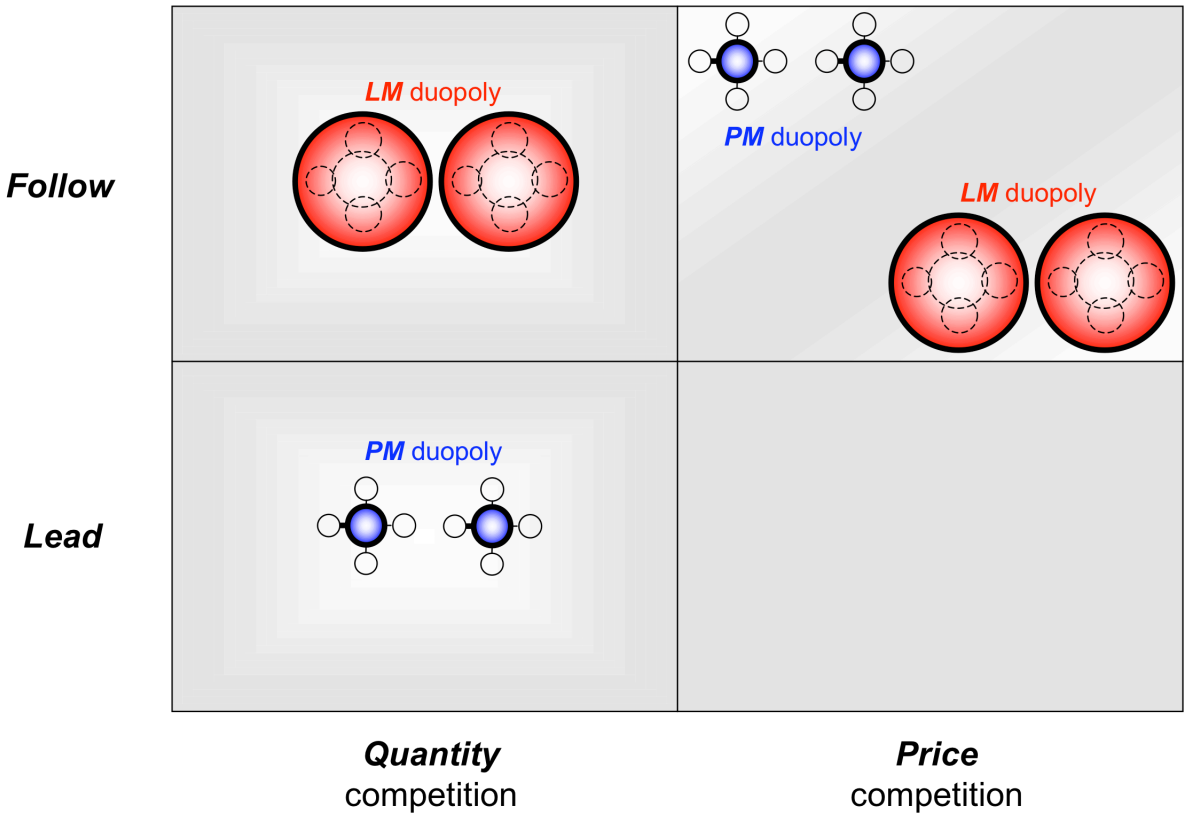

Figure 163: Sequential Games in a Homogenous Duopoly

4.2.1.1.3.3.2 Bertrand (*Price*) competition

4.2.1.1.3.4 *Heterogeneous* ("Mixed") Duopoly competition

> *"The analysis of the behaviour of **mixed markets**, where firms with **different objective functions** coexist, started at the **end of the last decade** [the 1980s] and still continues."*[522]

While the literature on the economics of homogeneous duopolies is extensive, the literature on the economics of heterogeneous or "mixed" duopolies is more recent and more sparse (Law & Stewart, 1983; Mai & Hwang, 1989; Horowitz, 1991; Cremer & Crémer, 1992; Futagami & Okamura, 1994; Neary & Ulph, 1996; Lambertini & Rossini, 1998; De Fraja & Delbono, 2002). See Appendix H for a summary.

This "mixed' duopoly characterizes the situation where each competitor has a different objective function, namely *profit maximization* and *labor managed*. It is the contention of the framework developed in this research dissertation that the *modular* enterprise architecture is characterized by the PM objective function, while the *integral* enterprise architecture is characterized by the LM objective function.

> *"Conventional wisdom suggests that **firms deviating** from profit-maximization will suffer **forced exit** in the long run. We **reverse this conclusion**. Empirical evidence is consistent with this prediction of relatively **robust market survivability** of LM firms"* [523]

The empirical work undertaken in this research dissertation tends to support much of this relatively recent theoretical work, which predicts the robustness of the LM form.

> *"The upshot is that the LM firm is relatively **more aggressive** than the PM firm in its **investment behaviour**. This combined with the LM firm's relatively **accomodatory behaviour** in **choosing output levels** at given levels of the capital stock, results in the LM firm being a **more robust market competitor** over an extensive subset of the parameter domain."*[524]

If this theoretical result holds true, supported empirically by evidence in this research dissertation, then one is confronted with the question, "why if LM firms are so robust, are there apparently so few of them?" Leading hypotheses (Neary & Ulph, 1996) center around the difficulty in formation of LM firms as opposed to their survivability once established.

> *"The **LM firm is not able to survive competition with a PM firm, when starting from scratch**. The LM firm is so 'prudential' that **it doesn't enter** the market."*[525]

Finally, as will be discussed more in chapter 6, the birth rates of various enterprise architectures will be argued to be contingent upon the nature of the architectures of the existing competitors. Specifically, it will be posited that integral enterprise architectures (or LM firms) will find it to be very difficult to "grow" in the early environment, rich with modular competitors (or PM firms).

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[522] Lambertini, L. and Rossini, G. (1998), pg. 14.
[523] Neary and Ulph (1996), pp. 1.
[524] Neary and Ulph (1996), pp. 20.
[525] Lambertini, L. and Rossini, G. (1995), pg. 11.

4.2.1.1.3.4.1 Cournot (*Quantity*) competition

In order to investigate the equilibrium of a mixed duopoly under Cournot competition, one must first begin with the reaction functions which is downward-sloping for the PM firm and upward-sloping for the LM firm as shown in Figure 164 below.

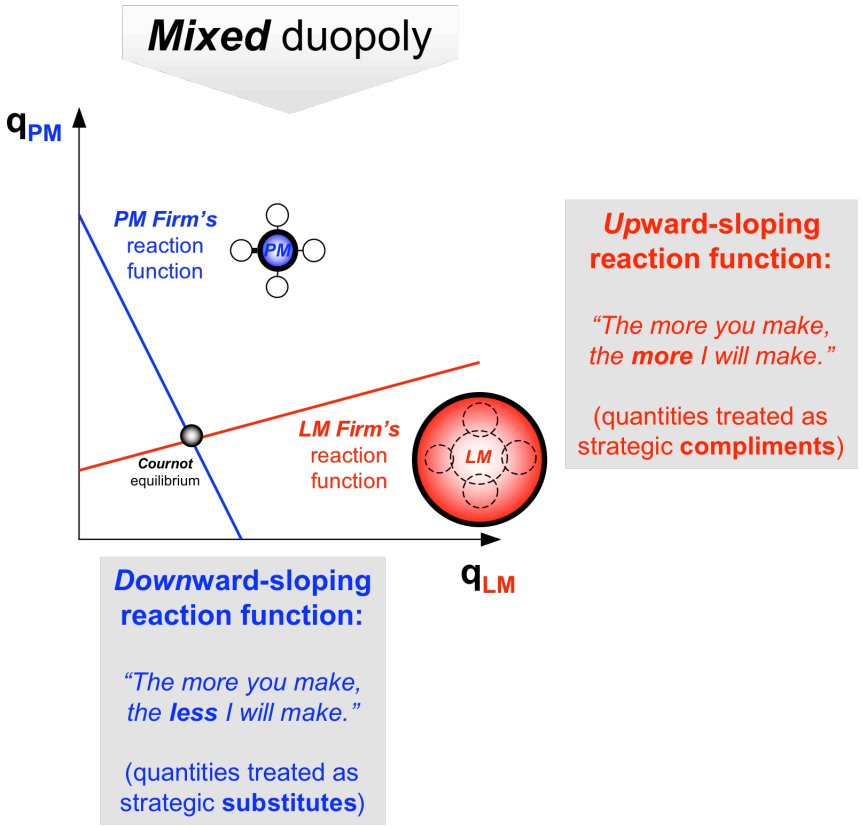

Figure 164: Reaction Functions for a Mixed Duopoly in Quantity Space

Lambertini and Rossini (1996) investigated the responses of homogeneous duopolies with respect to capital commitment investments as shown in Figure 165 below. The key to understanding the seemingly counter-intuitive results lies in understanding the respective firm's reaction functions.

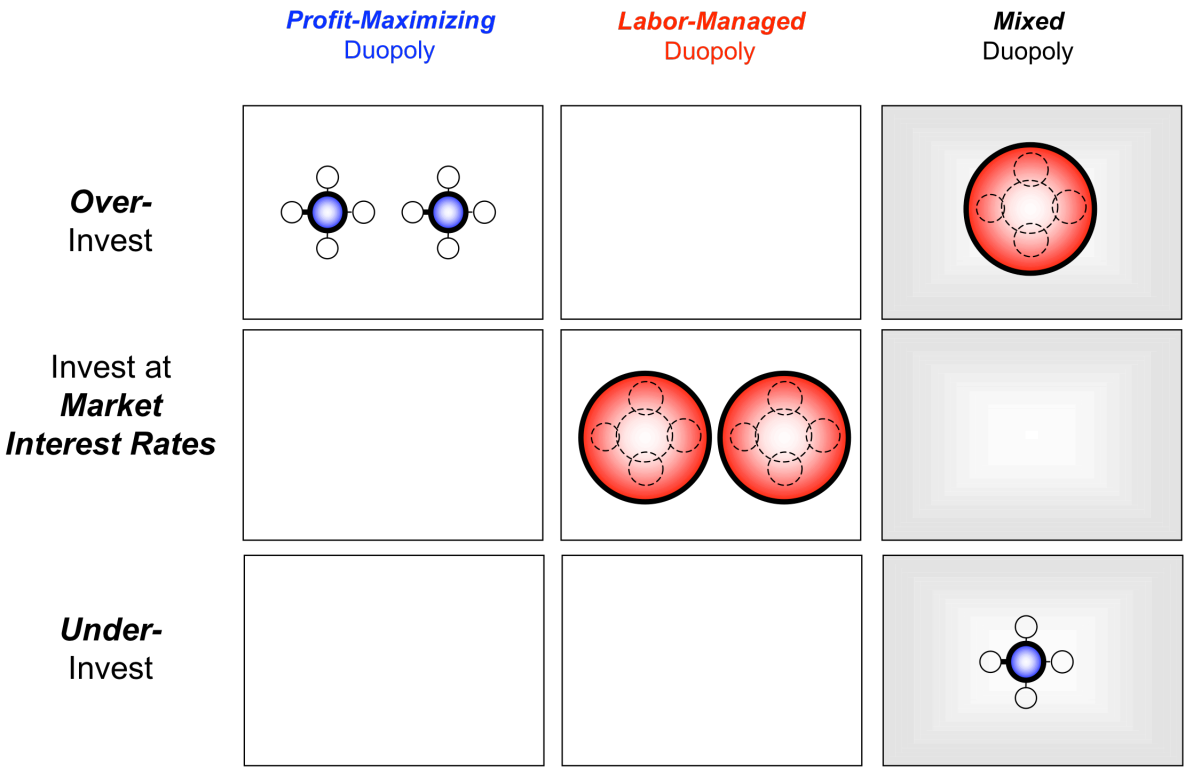

Figure 165: *Hetero*geneous Duopoly under *Cournot (Quantity)* Competition

As will be discussed in more detail in chapter 5, not only does the LM firm keep expanding output ("the more you make, the more I will make") more than a PM firm ("the more you make, the less I will make"), but it relentlessly expands capacity more *slowly* than the PM firm.

4.2.1.1.3.4.1.1 Stackleberg (*sequential*) competition

4.2.1.1.3.4.2 Bertrand (*Price*) competition

4.2.1.1.4 Strategic Complementarities

*"...doing **more** of one thing **increases** the returns of doing **more** of another..."*[526]

Milgrom & Roberts (1990 and 1995) argued within an economics framework the benefits of integrated and interdependent activities. In fact later, Porter (1996) referred to such complementarities as "activity networks". Later Whittington et al. (1999) empirically demonstrated that such complementarities (while rare) are linked to increased performance. As will be discussed later, the presence of such complementarities signal the presence of an integral enterprise architectures.

While Hedlund (1994) and Whittington et al. (1999) posit that such complementarities are part of a "new" and more successful form of organization, this research posits that they are note necessarily new in an *absolute* sense, but they are new in a *relative* sense, that is new relative to the state of the evolution of the industry in which firms are embedded.

[526] Milgrom and Roberts (1995), pg. 181.

4.2.1.2 *Macro*-Economics and *Political* Economy

> *"Some **Western economists** and **organization theorists** go to great length to formulate theories of the firm in terms of **opportunism, moral hazard, incentive compatibility,** and **monitoring**. Work in the transaction cost tradition following Coase (1937) and Williamson (1975), agency theory (for example Jensen and Meckling, 1976), and property rights (for example Alchian and Demsetz, 1972) all share the **preoccupation with opportunism obstructing the achievement of efficiency** in given, specified tasks or transactions. Aoki (1990) stresses the shortcomings of such models for understanding the **Japanese** firm."*[527]

The literature in macro- and international economics has tended to focus on the Anglo-Saxon vs. the German/Japanese models (Piore and Sabel, 1984). In fact, Aoki and Jackson (2008) use a micro-economic game theoretic approach to define various equilibria in the linkages between organizational architectures and corporate governance, which are reflected in the the Anglo-American, German and Japanese models. The following subsections give examples of how each of these models are characterized.

4.2.1.2.1 Varieties of Capitalism

The Varieties of Capitalism (VoC) perspective (Crouch and Streeck, 1997; Hall and Soskice, 2001) is a national level explanation of integral enterprise architectures driven by institutional complementarities (Goyer, 2006). At the core of these varieties of capitalism, expressed herein as enterprise architectures, lies the constructs of trust and equity in interorganizational relationships (Scheer, Kumar and Steenkamp, 2003).

> *"The VoC perspective emphasizes the critical importance of **patterns of institutional complementarities** across the **various sub-spheres (finance and corporate governance, industrial relations, innovation system, and inter-firm relations)** of the economy that lead to diverging forms of behavior on the part of economic actors."*[528]

While rooted in political economy, it focuses on the firm as the center of analysis (Hall and Soskice, 2001; March, 1962).

> *"It brings **the firm** back into a **central position** in our understanding of the political economy."*[529]

The VoC literature has been characterized in a number of theoretical and empirical ways. The theoretical characterizations have occured as *liberal market economies* vs. *coordinated market economies*, as *consumer economics* vs. *producer economics* or as economic *statics* vs. *dynamics*. The empirical charactizations have taken the form of Anglo-Saxon model vs. the German-Japanese model. Each will be discussed briefly in turn.

4.2.1.2.1.1 *Liberal Market* Economies vs. *Coordinated Market* Economies

The Liberal Market Economy (LME) and Coordinated Market Economy (CME) represent the ideal types at the extremes of the spectrum of a continuum of varieties of capitalism, as presented by Hall and Soskice (2001). Figure 166 below qualitatively summarizes select

[527] Hedlund, G. (1994), pg. 80.
[528] Goyer, M. (2006), pg. 401.
[529] Hall, P.A. and Soskice, D. (2001), pg. v.

nations on the VoC spectrum. Note that this provides the macro-institutional context for firms operating within these political economies. It does not, however, necessarily predetermine firm or enterprise architectures, as a LME could support an enterprise architcture that has strong CME tendencies as is the case of *Southwesst Airlines* in the US LME.

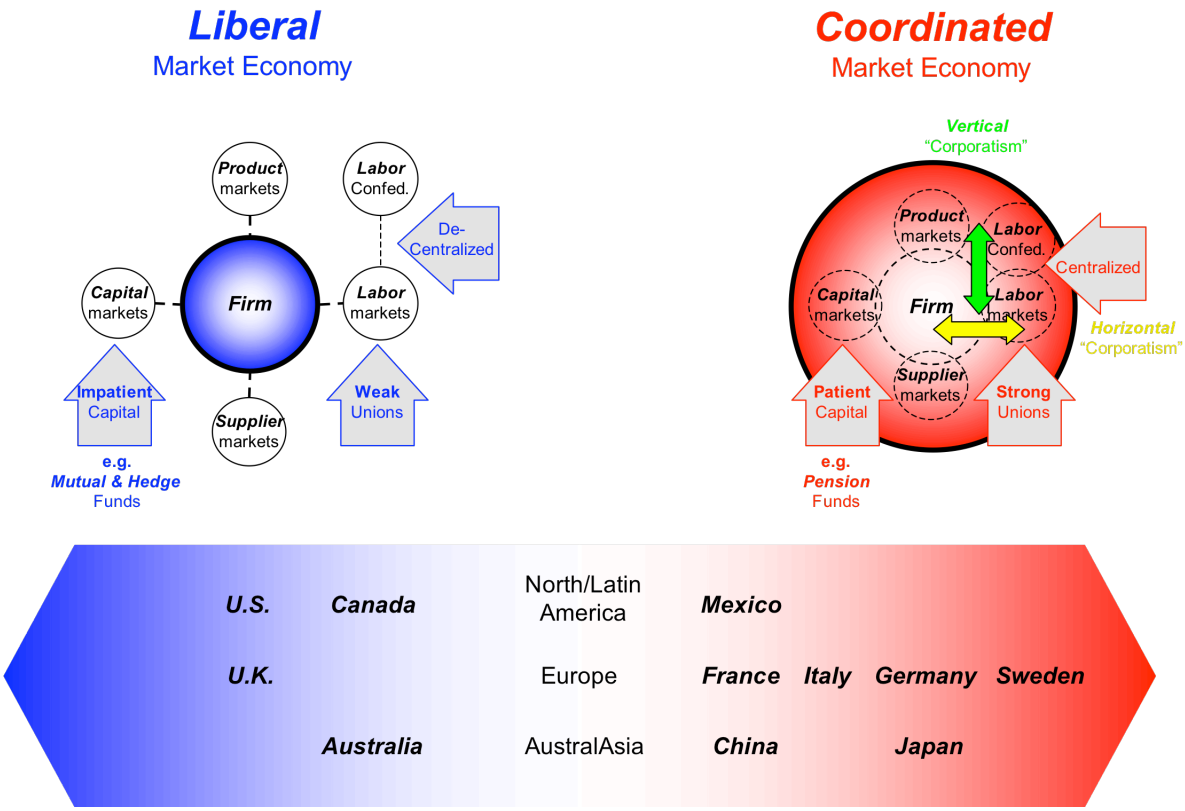

Figure 166: Spectrum of Varieties of Capitalism

Finally, Hall and Soskice (2001) posited that each variety of capitalism was better suited to different forms of innovation: LME's produce *radical* innovation, while CME's produce *incremental* innovation.

> *"In short, the institutional frameworks of **liberal** market economies provide companies with better capacities for **radical** innovation, while those of **coordinated** market economies provide superior capacities for **incremental** innovation."*[530]

4.2.1.2.1.2 *Consumer* vs. *Producer* Economics

This dialogue within the field of macro- and international economics has tended to classify the Anglo-Saxon model as *profit* maximizing based on *consumer* economics, while the German/Japanese model is *market share* maximizing based on *producer* economics (Thurow, 1992).

It is interesting to note that while *profit* maximizing firms tended to grow-up in *mass* production economies where the power was in the "*producer* push" world, and yet this is based on macroeconomic *consumer* economics.

[530] Hall and Soskice. (2001), pg. 41.

Conversely, *market share* maximizing firms tended to grow-up in *lean* production economies where the power is in the "customer pull" world, and yet this is based on macroeconomic *producer* economics.

Heuristic 1e:
The architectural *form* of an enterprise is governed by the *institutional environment*. While it will be possible to find both integral and modular enterprise architectures within a given institutional environment (e.g. U.S. capitalism), there are clear national tendencies.

General:

> *"Anglo-Saxon firms are **profit maximizers**; Japanese business firms play a game that might better be known as 'strategic conquest'. Americans believe in '**consumer economics**'; Japanese believe in '**producer economics**.'"*[531]

> *"While firms in producer economics and consumer economics both want profits, the role played by profits is very different. In the profit-maximizing firm, **profits are the goal – the objective function**. In the empire-building firm, **profits are the means to the end** of a larger empire – **a constraint. The goal is market share**."*[532]

> *"The **time scale** of what the Japanese mean by profit maximizing is **so long** that it isn't what Anglo-Saxons mean by profit maximizing."*[533]

> *"Firms based on the principle of producer economics are clearly on the offensive in international markets, while those based upon profit maximizing are on the defensive. But perhaps this is just the **ebb and flow of economic battle**. In the 1950s and 1960s the profit maximizing firms of the United States put their competitors on the defensive."*[534]

Key Stakeholders:

> *"The United States has organized a system that is the **exact opposite** of that of Germany and Japan. Those countries have organized a system (business groups) to **minimize the influence and power of impatient shareholders,** while the United States has organized a system (fund dominance) to **maximize the influence of impatient shareholders**."*[535]

> *"If the executives of profit-maximizing American firms are asked to state the order in which they serve various constituencies, **shareholders come first**, with customers and employees a distant second and third. Most managers will argue that the sole purpose of the company is to maximize shareholder wealth. Customers and employees are only important to the extent that they contribute to this goal. If Japanese firms are asked the same question, the order of duty is reversed – **employees first**, with customers second and shareholders third."*[536]

4.2.1.2.1.3 *Profit* maximization (*Consumer* economics)

General:

> *"**The Anglo-Saxon model is not wrong**. Individualism and the desire for consumption and leisure are all parts of human nature. But they are not all of human nature. Individualistic*

[531] Thurow, L. (1992), pg. 32.
[532] Thurow, L. (1992), pp. 124-125.
[533] Thurow, L. (1992), pg. 131.
[534] Thurow, L. (1992), pp. 149-150.
[535] Thurow, L. (1992), pg. 136.
[536] Thurow, L. (1992), pg. 137.

> *consumer economics is not wrong!* ***It merely explains only part of what needs to be explained!*** *Man is not just a consumption-leisure-maximizing machine. He or she is also a producer."*[537]

Market Share:

> *"If one examines the American consumer electronics industry, it is a history of profit-maximizing* ***strategic retreat into oblivion****. But at every point in time, they made their demanded rate of return. Being rational, they would* ***go out of business before they would accept a below-market rate of return.****"*[538]

> *"Fighting for greater market share is* ***irrational*** *to the rational profit maximizer. He would rather surrender than fight. Fighting lowers one's consumption. Since his theories tell him that he can always go work for the winner, going out of business is the rational thing to do. Who one works for is not important. The consumption maximizer is a mercenary who would rather switch than fight."*[539]

Labor:

> *"The United States is in a statistical class by itself when it comes to* ***labor-force turnover****. From an income-maximization perspective, this is a sign of* ***efficiency****. Workers are dismissed when they aren't needed."*[540]

Investment:

> *"In the United States, private research and development spending falls in recessions and rises in booms. In Europe and Japan, it does not. To an American firm, cutting R&D is a technique for* ***maintaining profits during a period of declining sales****. In Europe and Japan, R&D is not cut, since it is seen as the source of* ***long-run competitive strength****."*[541]

> *"In American accounting conventions, since* ***R&D is expensed****, cutting R&D spending leads to higher bottom-line profits immediately. In Japan, where* ***R&D is capitalized****, it does not. The Japanese accounting system is set up to* ***discourage short-term behavior****. The American counterpart is set up to* ***encourage it****."*[542]

> *"Private time horizons are believed to be too short.* ***Private hurdle rates used in business-investment calculations are always far above the economy's long-term rate of return on assets****. In the United States, the private hurdle rate is 15 to 20 percent, while the historical rate of return on business assets is 7 percent. Banks such as the Japanese Development Bank or the Long-Term Credit Bank are* ***designed to finance the long-term investments*** *that normal banks and firms avoid."*[543]

4.2.1.2.1.4 *Market-Share* maximization (*Producer* economics)

General:

> Japanese practices *"should make Japanese business firms* ***inefficient,*** *yet when facing American or European competition,* ***they always seem to win****. Their market share always goes up, never*

[537] Thurow, L. (1992), pp. 118 & 120.
[538] Thurow, L. (1992), pg. 133.
[539] Thurow, L. (1992), pg. 133.
[540] Thurow, L. (1992), pg. 139.
[541] Thurow, L. (1992), pp. 141-142.
[542] Thurow, L. (1992), pg. 142.
[543] Thurow, L. (1992), pp. 145-146.

> *down. What are handicaps for others are strengths for them. Are the Japanese just better as individuals – playing the same game but just doing it better by working harder, saving more, and being smarter than everyone else – or does their success spring from **having organized a different system**, playing the game differently? Is Japan just better, or is it exceptional?"*[544]

> *"Germany, the dominant European economic power, sees itself as having a '**social-market**' economy and not just a 'market' economy. **Codetermination** is required to broaden the ranks of corporate stakeholders beyond that of the traditional capitalistic owners to include workers."*[545]

Goals & Objectives:

> *"Their goal is **market-share maximization** (strategic conquest) and **value-added maximization (a measure that includes profits and wages)**, not simple profit maximization."*[546]

Investment:

> *"Empires **overinvest** relative to profit-maximizing firms, since they plan to **last forever**. Their aim is future expansion, not maximizing current consumption."*[547]

> *"To **lengthen time horizons** and **accept a lower rate of return**, impatient consumption-oriented stockholders must be kept under control. The Japanese or German business groups have been organized to do just that. With interlocking ownership, impatient consumption-oriented shareholders can be held at bay."*[548]

Labor:

> *"The empire-building firm sees **labor as a strategic asset to be nurtured**. One wants the highest quality and best-fed soldiers."*[549]

4.2.1.2.1.5 Economic (comparative) *Statics* vs. Economic *Dynamics*

One of the key issues of competitive advantage is short-term efficiency vs. long-term dynamic capabilities, as captured by the economic concepts of "comparative statics" (i.e. getting onto the maximum place on the production possibilities curve) and "economic dynamics" or moving the production possibilities curve out.

> *"The theoretical advantages of profit maximization were in fact mathematically derived under the assumptions of what economists call '**comparative statics**'. In comparative statics, a stable no-growth environment, firms prove their effectiveness by becoming efficient. The cost minimizer wins. Japanese lifetime employment and seniority wages should, for example, be a handicap. In **economic dynamics**, the central problem is rapid growth. In reaching this growth goal, many of the cost-cutting advantages of comparative statics may be liabilities… **a short-run static advantage that turns out to be a long-run dynamic handicap**."*[550]

4.2.1.2.1.6 National Examples: *Anglo-Saxon* vs. *German-Japanese* models

[544] Thurow, L. (1992), pp. 114.
[545] Thurow, L. (1992), pg. 36.
[546] Thurow, L. (1992), pg. 118.
[547] Thurow, L. (1992), pg. 129.
[548] Thurow, L. (1992), pg. 134.
[549] Thurow, L. (1992), pg. 138.
[550] Thurow, L. (1992), pg. 150.

*"The German/Japanese model is one of **close co-operation** between banks and enterprises, a paternalistic state and a **communitarian** view of management-worker relations. This model translates into a **long-term view** of strategy, a **readiness to invest** in equipment and training and a respect for the hands-on skills required for technology and production."*[551]

*"The Anglo-Saxon model, associated with **turbulent financial markets** and **impatient lenders**, hostile takeovers and a **hire-and-fire** approach to labour… an emphasis on **short-term financial results**, an aggressive external orientation to strategy, and a high valuation put on **speed and flexibility**."*[552]

[551] Albert (1991).
[552] Albert (1991).

4.2.2 Sociology & Organizational *theories*

Much of sociological and organizational theories are predicated on the organization as an open system which exchanges with the environment and therefore may or may not adapt to the environment. Three broad schools of thought fall into this "fit" category with differing emphases on the level of change and adaptation, as shown in Figure 167 below.

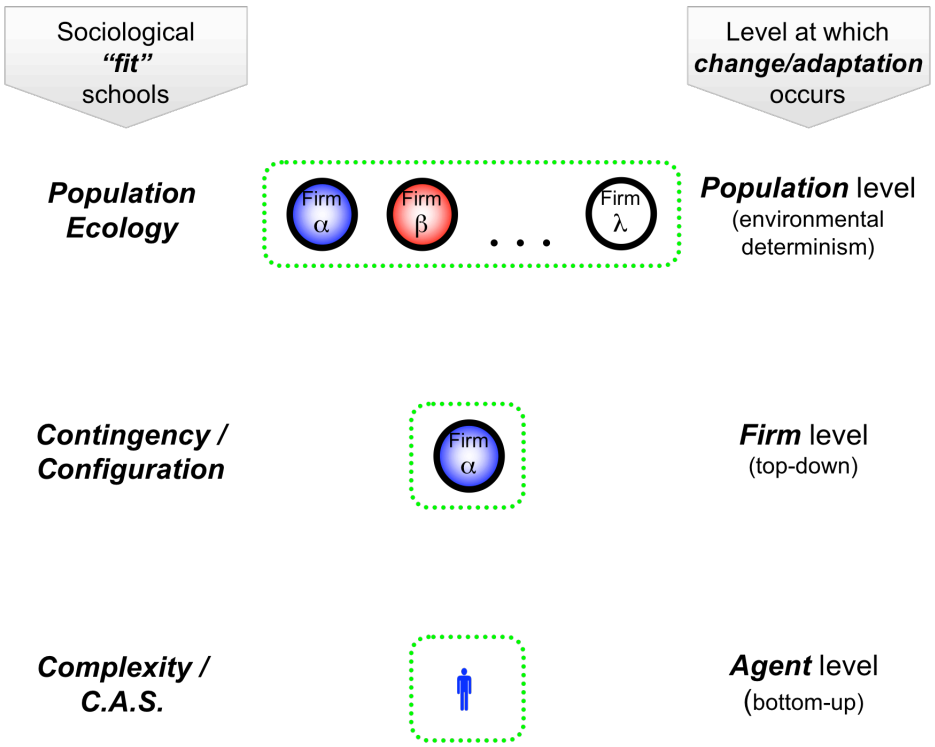

Figure 167: Organizational Theories of "Fit"

4.2.2.1 Theories of Bureaucracy

4.2.2.1.1 *Division* of Labor vs. *Centralization* of Authority (Weber)

In his exploration of the ideal type of bureaucracy, Weber (1952) noted two primary and opposing forces acting in all organizations: the division of labor and the centralization of authority (or coordination).

4.2.2.1.2 *Conflict* vs. *Order*

Sociologists have different assumptions about the nature of society, with one of the key debates surrounding the dichotomy of order-conflict, also known as "regulation-radical change." Cohen (1968) presents two models of society with competing sets of assumptions:

> *"Commitment, cohesion, solidarity, consensus, reciprocity, co-operation,* ***integration****,* ***stability*** *and persistence. Coercion, division, hostility, dissensus, conflict,* ***malintegration*** *and* ***change****."*[553]

Burrell and Morgan (1979) simplify and summarize the work of and another prominent sociologist, Dahrendorf's (1959).

> *"The* ***order*** *view of society emphasizes:* ***stability, integration****,* ***functional co-ordination*** *and* ***consensus****. The* ***conflict*** *view of society emphasizes:* ***change, disintegration, conflict*** *and* ***coercion****."*[554]

These concepts will form the theoretical underpinnings of the grounded theory that is being developed herein.

4.2.2.1.3 *Theory X* and *Theory Y* (McGregor)

McGregor (1960) was one of the first to acknowledge two very distinct styles of management which are summarized in Table 9 below.

Enterprise Architecture	***Modular***	***Integral***
Managerial Style	Theory ***X***	Theory ***Y***
Characteristics	Authoritarian, directive, coercion, control	Flexible, open, democratic, motivating, delegation, trust and intrinsic job satisfaction

Table 9: Contrasting Managerial Styles: *Theory X* & *Theory Y*

[553] Cohen (1968), pp. 166-167.
[554] Burrell and Morgan (1979), pp. 12-13.

4.2.2.2 *Social Systems* Theories

The following theories encompass a series of major threads in sociology and organizational theory from General System Theory (with the focus on physics and biological metaphors), Structural Functionalism (with the focus on the biological metaphor) and Contingency Theory.

4.2.2.2.1 Structural Functionalism

As was discussed in Part I, the framework presented herein can be expressed in terms of structural functionalism. This sociological paradigm based its theories on biological analogies and sought to explore morphology, physiology and development in social systems. As a result, Essay #1 will confine itself to the exploration of morphology or form and structure without reference to function.

4.2.2.2.1.1 Cooperative Systems

Barnard (1938).

4.2.2.2.1.2 Cooptation

As a structural functionalist, Selznick (1948) posited a sociological mechanism for ensuring stability, called "cooptation".

> *"**Cooptation** is the process of **absorbing new elements into the leadership** or policy-determining structure of an organization as a means of averting threats to its **stability** or existence. This is a **defensive mechanism**..."*[555]

[555] Selznick, P. (1948), pg. 34.

4.2.2.2.2 *General Systems* Theory

> *"**General system theory** seeks to classify systems by the way their **components are organized (interrelated)** and to derive the **'laws,' or typical patterns of behavior**, for different classes of systems singled out by the **taxonomy**."*[556]

> *"Certain methods of studying **behavior** apply to all organized systems, namely **structure, function and evolution**. Any organized system can be seen from these three perspectives which encompass the broadest scope of a **general system theory**."*[557]

von Bertalanffy (1962). Boulding (1956). Rappoport (1968).

4.2.2.2.2.1 *Open* vs. *Closed* Systems

Closed systems are characterized by isolation from their environment, while open systems are characterized by an exchange with their environment. Within organizational systems, this exchange might include information, material, energy, etc. While closed systems characterize phenomena like physics, it was also used to characterize organizations up until the general systems theorists (von Bertalanffy, 1950). Figure 168 below summarizes this distinction.[558]

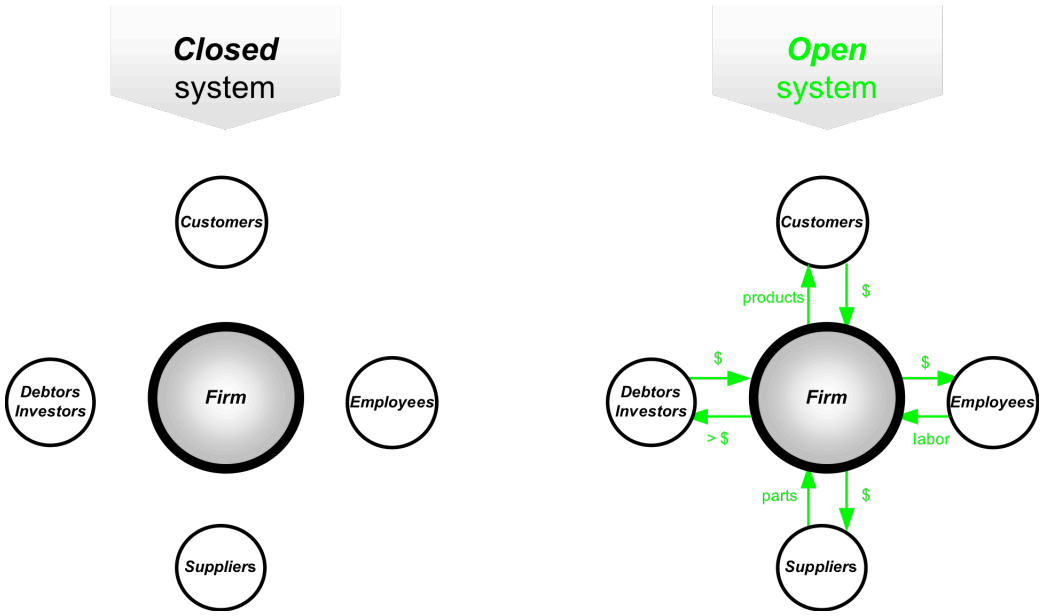

Figure 168: *Closed* vs. *Open* Organizational Systems

4.2.2.2.2.2 Open-Closed *Systems* vs. Open-Closed *Causality*

> *"von Bertalanffy may have **confused the concept of a closed loop of circular causality with his own notion of a 'closed system.'** The later is a system that exchanges no material or energy with*

[556] Rapoport, A. (1968), pg. xvii.
[557] Rapoport, A. (1968), pg. xx.
[558] Ackoff, R. (1990), draws a similar diagram of an open systems (stakeholder) view of the corporation.

> *its environment, an entirely distinct and independent idea from the notion of a closed sequence of causes and effects."*[559]

Richardson (1990) presents a compelling history of feedback thought in the social sciences. As a fundamental part of his thesis, he chronicles the historical uses (and misuses) of the notion of firms as "open" systems.

> *"A 'closed system' in general systems theory is a system that experiences no interchange of material, energy, or information with its environment. In contrast, Forrester's concept represents a system that is not* ***'materially closed,'*** *but rather* ***'causally closed'*** *– the closed boundary separates the dynamically significant inner workings of he system from the dynamically insignificant external environment. The two views of closed systems – materially closed and causally closed – are related but are significantly different. No serious system dynamics model is closed in the general system theory sense. Every one exchanges material with its environment. Because of such exchanges,* ***Forrester's 'closed boundary' systems are, in von Bertalanffy's terms, 'open systems.'"***[560]

This point is very important to the theory developed in this dissertation, as although most strategy research embraces firms as open systems which exchange material etc. with their environments, the preponderance of this research implicitly assumes that firms' while openly exchanging things with their environments have little active role in determining collectively with their environments *what* is to be exchanged, *how much, how often* and *why* it is exchanged. This is shown in Figure 169 below.

[559] Richardson, G.P. (1990), pg. 122.
[560] Richardson, G.P. (1990), pp. 297 and 298.

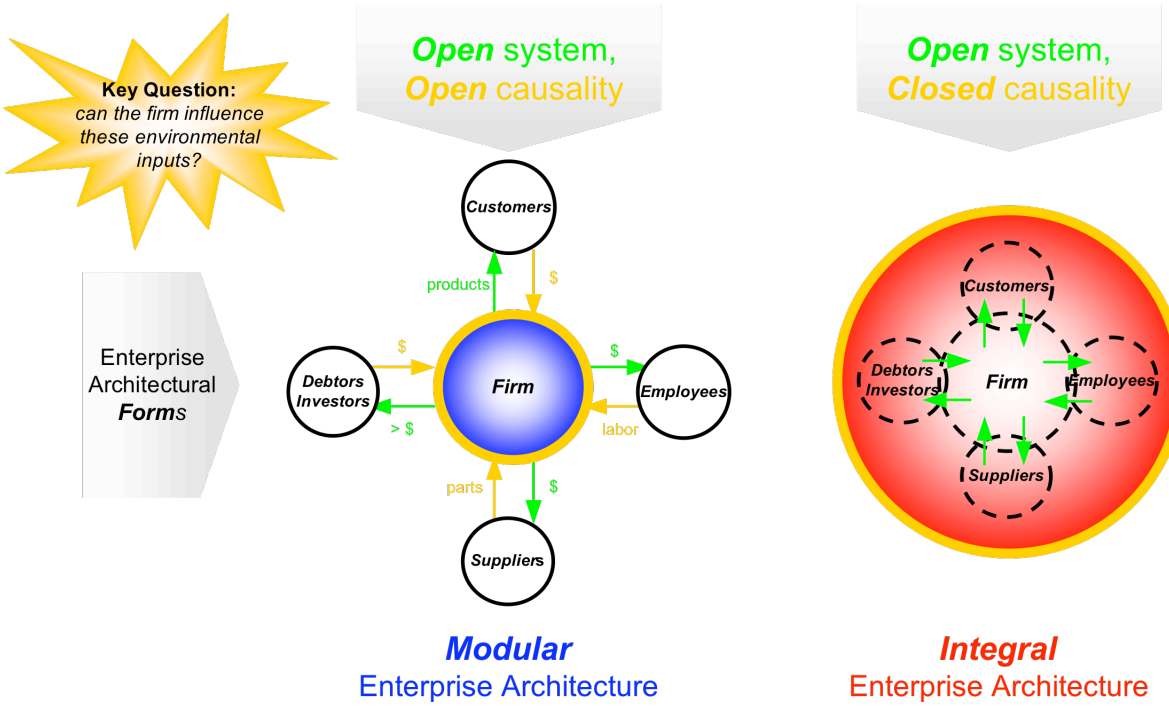

Figure 169: Open and Closed *Causality* within an Open *Systems* Framework

For the purposes of this essay #1, I will define two different cognitive approaches to this assumption, which are embedded in the two extremes of enterprise architectures. We will again pick up this discussion in essay #2, in order to create the dynamic structural mechanisms which ultimately drive different behaviors of the two different enterprise architectures.

4.2.2.2.3 *Structural Contingency* Theory

Structural contingency theory (Burns and Stalker, 1961; Woodward, 1965; Lawrence and Lorsch, 1967; Thompson, 1967; Blau, 1970) has left an important mark on organizational theory in that it specifies that the most effective organizational structural designs are contingent upon environmental (Burns and Stalker, 1961), technological (Woodward, 1965) and size (Blau, 1970) factors. Table 10 below summarizes the primary research contributions of the contingency theorists.[561]

Year	Author	Research Setting	Claims
1954	Gouldner	1 (gypsum company)	Differences in work structuring reflected degree of danger and uncertainty in production.
1958	Woodward	92 (industrial firms)	Differences in structural features reflect complexity of technology employed.
1958 1963	Rice	1 (Indian textile firm)	There are three environmental imperatives that must be satisfied: *technological, social* and *economic*.
1961	Burns & Stalker	20 (industrial firms)	More simple & stable environments yield *mechanistic* structures vs. *organic* structures.
1967	Lawrence & Lorsch	6 (firms)	More complex environments demand more *differentiation* & *integration*.
1967	Thompson	0 (theoretical)	Different levels within organizations are more open to the environment than others.
1971	Blau et al.		Effects of size and environmental complexity on structure.
1973	Galbraith		Related task complexity and structural complexity.
1978	Pfeffer & Salancik		Power / dependence relations among organizations.

Table 10: Contingency Theory Research Summary

As shown in Figure 170 below, contingency theory can be thought of as explaining variation in two ways: between organizations and within organizations.[562]

[561] Source: W. Richard Scott in Introduction to Thompson (1967), pg. xix-xxi.
[562] Source: W. Richard Scott in Introduction to Thompson (1967), pg. xix-xx.

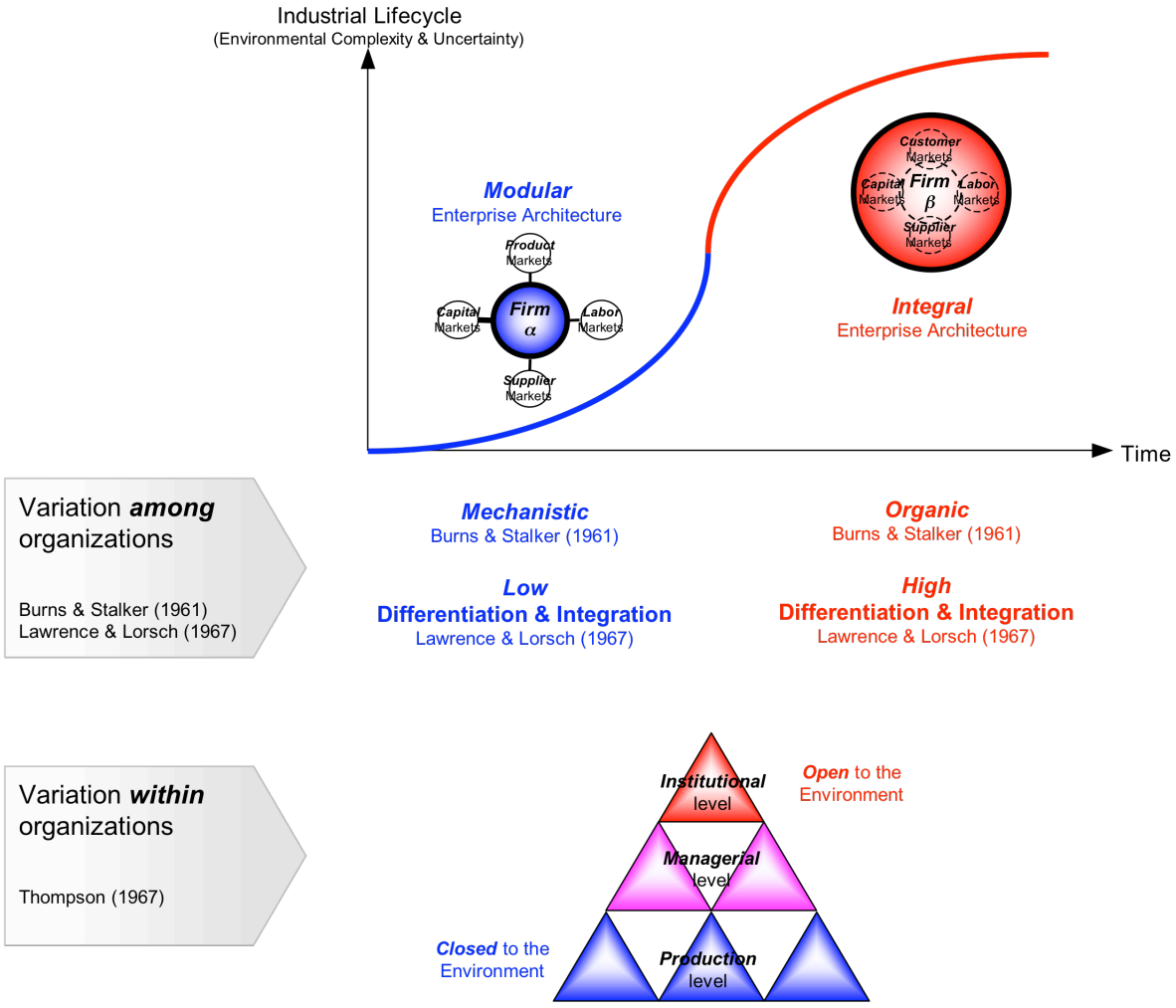

Figure 170: Summary of Two Contingency Models

4.2.2.2.3.1 *Mechanistic* vs. *Organic* (Burns & Stalker)

Burns and Stalker (1961) identified environmental *variability* (characterized as "stable" and "unstable") as a critical contextual factor in organizational design. They hypothesized two corresponding organizational designs: formal "mechanistic" and informal "organic" which would produce more effective performance in the respective environments of stability and instability.

Classical organizational theorists tended to view organizations - no matter how complex they are - as *deterministic*. To the contrary, modern organizational theorists tend to view organizations as *probabilistic*. Burns and Stalker (1961) captured this dichotomy using the terms "mechanistic" and "organic".

Table 11 below summarizes the mechanistic and organic archetypes.

*"We are now at the point at which we may set down the outline of the two management systems which represent for us the **two polar extremes of the forms (or 'ideal types')** which such systems can take when they are **adapted to a specific rate of technological and commercial change**."*[563]

Table 11: *Mechanistic* and *Organic* Organizational Archetypes (Burns & Stalker)[564]

Characteristic	*Mechanistic*	*Organic*
a. Knowledge & experience	The specialized differentiation of functional tasks	The contributive nature of special knowledge & experience
b. Nature of the individual tasks	Abstract, with purposes distinct from those of the organization as a whole	Realistic, with tasks set by the total situation of the organization
c. Means of task definition & reconciliation	Immediate superiors	Interaction with others
d. Definition of rights, obligations & methods	Attached to each functional role	A limited field (shedding of 'responsibility')
e. Translation of rights, obligations & methods	Responsibilities of the functional position	Spread of commitment to the organization
f. Structure of control, authority & communication	Hierarchy	Network
g. Location of technical & commercial knowledge	Exclusively at the top of the hierarchy	Anywhere in the network
h. Direction of communication & interaction	Vertical	Lateral
i. Content of communication	Instructions & decisions (command)	Information & advice (consultation)
j. Condition of membership	Loyalty to the organization & obedience to superiors	Commitment to organization's tasks & ethos of progress & expansion
k. Sources of importance & prestige	Internal (local) knowledge, experience & skill	Affiliations & expertise external to the firm

4.2.2.2.3.2 *Small & Large Batch* and *Process* Technologies (Woodward)

Woodward (1965) observed that there were more effective organizational designs depending upon the type of production technologies employed.

4.2.2.2.3.2.1 *Craft, Mass* and *Lean* Production

A quarter century later, researchers at MIT's *International Motor Vehicle Program* (IMVP) studying the global automobile industry identified similar production technologies with implications for organizational design (Womack, Jones and Roos, 1990; MacDuffie, 1991).

*"This dissertation examines the thesis that **flexible production systems** are supplanting **mass production systems** because of their superior manufacturing perfomance. The dissertation argues that **flexible production systems** follow a **different 'organizational logic' than mass production**. This logic has two dimensions: structural and cultural. The 'structural logic' of a production system is identified in terms of the deployment of resources, the link of core production activity to the market, the structure of **authority relations**, and the link between conception and execution.*

[563] Burns, T. and Stalker, G. M. (1961), pp. 119 and xi..
[564] Burns, T. and Stalker, G. M. (1961), pp. 120-122.

> *The 'cultural logic' is identified as a way of thinking about **production activities** that emphasizes their **integration** with **innovation activities.**"*[565]

In our research, we take a more macro-enterprise view of such "organizational logic." In addition, we define external environmental contingencies (as well as internal organizational contingencies) which enable the success of mass and flexible production systems.

4.2.2.2.3.3 Uncertainty Reduction (Thompson)

Thompson (1967) argued that much of organizational action can be explained by the need to reduce uncertainty, which originates in the environment (Kamps and Polos, 1999). He articulated much of his theory through 95 propositions.

[565] MacDuffie, J.P. (1991), abstract.

4.2.2.2.3.4 *Differentiation* and *Integration* (Lawrence & Lorsch)

From a systems theory point of view, Stacey (1995) notes that the forces of integration lead to stable equilibrium via negative feedback, while the forces of division lead to instability via positive feedback.

This "division of labor – centralization of authority" dichotomy would later be reiterated by Lawrence and Lorsch, in their 1967 classic, *Organization and Environment: Managing Differentiation and Integration*.[566] They demonstrated that organizational subunits adapted separately to their own specific environments. Therefore, organizations which face dynamic (or unstable) and diverse (or heterogeneous) environments, must possess a greater degree of structural differentiation and integration in order to be effective.

4.2.2.2.3.4.1 Critiques

4.2.2.2.3.4.1.1 Invalid & Inconsistent Claim

Lawrence and Lorsch's claim that higher levels of environmental dynamism and diversity are best met with higher levels of organizational differentiation is supported by the empirical data in this research. However, their subsequent claim that these higher levels of organizational differentiation are matched by corresponding higher levels of organizational integration, is neither supported by empirical data in this research, nor in fact by the empirical data in their original seminal research.

From an assessment of their original empirical data (albeit a small-N theoretical sample used for building grounded theory), the first claim indeed seems plausible, as high-performing firms in increasingly dynamic and diverse environments indeed do have higher levels of organizational differentiation. See Table 12 below.[567]

Table 12: Inter-Industry *Differentiation* and *Integration* Comparison

Industry	Organization Performance	Avg. Differentiation	Avg. Integration
Plastics	High Performer	10.7	5.6
Foods	High Performer	8.0	5.3
Containers	High Performer	5.7	5.7

Note, however, that the second claim indeed seems implausible, as high-performing firms in increasingly dynamic and diverse environments indeed have *lower* levels of organizational differentiation. This finding is broadly in line with the empirical data gathered in this research.

[566] This connection between Weber and Lawrence and Lorsch was originally made by Scott and Mitchell (1972), pp. 7.
[567] Taken from Lawrence and Lorsch (1967a), pg. 103.

Finally, from their own theorizing, they seem to indicate the incompatibility of these opposing forces:

> *"The findings of this study indicate that, other things being equal, **differentiation** **and** **integration** **are essentially antagonistic**, and that one can be obtained only at the expense of the other."*[568]

> *"Our findings have also indicated that the states of differentiation and integration are **inversely related**. The more **differentiated** an organization, the **more difficult** it is to achieve **integration**."*[569]

> *"**Integration** is a better single predictor of **performance** than **differentiation** alone."*[570]

Presumably, if the two are as incompatible and as hard to achieve as they suggest, then one might expect that performance would suffer if firms didn't focus on one or the other, as the environment dictates.

4.2.2.2.3.4.1.2 Longitudinal Discontinuity

Finally, while Lawrence and Lorsch's first claim of contingency appears to be supported by this research, it is limited in that it represents a cross-sectional slice. They are able to make *inter*-industry comparisons between high performing firms:

> *"In any case, the **contrast** between the plastics and the container organizations is **very sharp**. In a sense, the represent **opposite ends on a continuum**, one dealing with a **very dynamic and diverse environment, where innovation** is the dominant issue, while the other is dealing with a **very stable and homogeneous environment, where regularity and consistency of operations** were important."*[571]

Conversely, the data represented by this research is longitudinal, and therefore allows for intra-industry heterogeneity to be compared over time. This allows us to make *intra*-industry comparisons between high performing firms.

[568] Lawrence and Lorsch (1967b), pg. 47.
[569] Lawrence and Lorsch (1967a), pg. 157.
[570] Lawrence and Lorsch (1967b), pg. 46.
[571] Lawrence and Lorsch (1967a), pg. 155.

4.2.2.2.4 *Political* Theories of the Firm

As an extension of social system and contingency theories, political coalition theory sees the interaction of the environment as a political process, with power relationships being contingent on resource dependence. March (1962) was one of the first to articulate the case for the business firm being a "political coalition".

> *"Basically we assume that a business firm is a **political coalition** and that the executive in the firm is a **political broker**. The **composition** of the firm is not given; it is **negotiated**. The **goals** of the firm are not given; they are **bargained**. We assume that there is a set of potential participants in the firm. At least initially, we think of such classes of potential participants as **investors (stockholders), suppliers, customers, governmental agents, and various types of employees**."*[572]

March (1962) characterizes the differences between economic theories of the firm and political theories of the firm.

> *"The focus of attention shifts from the owners (and their objectives) to the actual, operating organizers of the coalition – whoever they may be. In general, we view **stockholders** much as a theory of political systems might view **citizens**. Their demands form loose constraints on the more active members of the coalition. Their initiative in policy formation and in determining the nature of the coalitions is small."*[573]

> *"The theory* [of the business firm as a political coalition] *does not solve the problem of conflict by simple payments to participants and agreement on a superordinate goal. Rather it emphasizes the importance of policy demands and payments and of **sequential** rather than **simultaneous** mediation of demands."*[574]

4.2.2.2.4.1 *Resource Dependence* Theory (Pfeffer & Salancik)

The resource dependence theory looks at the ways in which organizations reduce environmental uncertainty (Thompson, 1967; Pfeffer and Salancik, 1978; Pfeffer, 1982). These include either internal "buffering" or external "bridging".

Recent theorists have noted the limitations of Pfeffer and Salancik's formulation, by disaggregating the notion of interdependence into two dimensions: power imbalance and mutual dependence (Casciaro and Piskorski, 2005).

4.2.2.2.4.2 *Stakeholder* Theory of the Firm

Much of the establishment of a theoretical construct of an enterprise architecture is based on the relatively new theoretical notion that the firm is not necessarily designed specifically to advance the unitary profit interests of the owners or shareholders. There are other types of firms driven by different "objective functions", namely those who are trying to balance the plural objectives of multiple stakeholders. Within the strategic management field,

[572] March, J.G. (1962), pg. 672.
[573] March, J.G. (1962), pg. 674.
[574] March, J.G. (1962), pg. 674.

Whittington (2000) identifies this range of objective functions or "profit motives" as a primary classification of firms.

The stakeholder view of the firm is a relatively new theoretical perspective within the fields of economics and organizational theory (Follett, 1918; Freeman, 1984; Evan and Freeman, 1988; Ackoff, 1990; Donaldson and Preston, 1995; Mitchell, Agle & Wood, 1997; Ramirez, 1999). While the major works have proliferated in the past 25 years, the thread can be traced back to the ideas of Mary Parker Follett in the field of political science in 1920's (Schilling, 2000).

As will be discussed later in Essay #2, the stakeholder view of the firm implies a formal recognition of a series of exchanges with entities or stakeholders outside the firm. This relationship with the firm's environment is seen as an "open" system, however it may not be seen as causally open, depending on how the causal mechanisms are constructed.

As will be discussed in the following section, this recognition of firms with differing objective functions has been made recently within the field of economics under the heading of "mixed" duopolies.

4.2.2.3 Ecological View

The ecological view of organizations and organizational change takes an evolutionary perspective. Borrowed from the intellectual domain of biological ecosystem science, which is divided into "*synecology*", which is the study of multiple, interdependent populations within communities and ecosystems, and a subset called "*autecology*", which is the study of individual organisms within single populations (Whittaker, 1975, pp. 4-5) as shown in Figure 171 below.

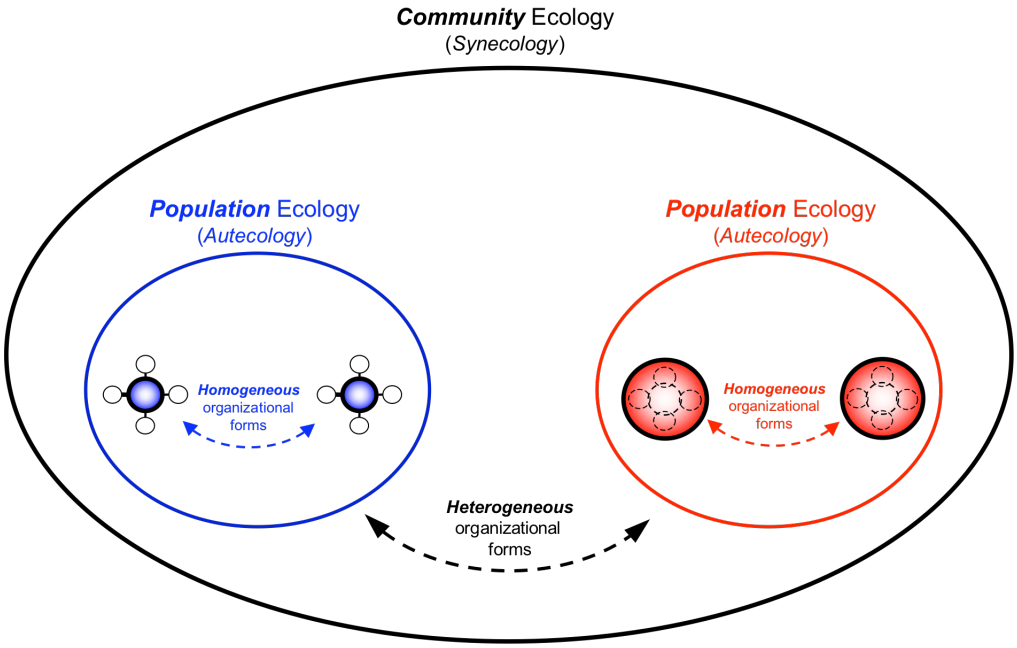

Figure 171: Two Ecologies: *Community* and *Population*

While much work in organizational sociology has focused on autecology (known as "population" or "organization" ecology), relatively little work has focused on synecology (known as "community" ecology). The framework developed herein is an attempt with this higher, more general analysis of ecosystems.

> *"The perspectives adopt* ***different levels of analysis*** *and produce* ***contrasting views of the characteristic mode and tempo*** *of organizational evolution.* ***Population ecology*** *limits investigation to evolutionary change unfolding within established populations, emphasizing factors that* ***homogenize organizational forms*** *and maintain population stability. Population ecology thus fails to explain* ***how populations originate in the first place*** *or how evolutionary change occurs through the proliferation or heterogenous organizational types.* ***Community ecology*** *overcomes these limitations: it focuses on the* ***rise and fall of populations as the basic units of evolutionary change,*** *simultaneously explaining forces that produce* ***homogeneity and stability within populations and heterogeneity between them****."*[575]

This research postulates that if intra-species structural inertia were zero, then variation would take place within species, and population heterogeneity would not exist.

[575] Astley, 1985, pg. 224.

4.2.2.3.1 *Population* Ecology (Autecology)

The first definitions of population ecology is the organizational unit and its environment, that is, the organizational *form* and the organizational *niche.*

4.2.2.3.1.1 Organizational *Form*

Population ecologists define populations as the collection of organizations exhibiting the same structural form (Carroll, 1984). *Form* is defined as a "blueprint for organizational action" (Hannan and Freeman, 1977, pg. 935) that a number of organizations share. In this sense, an organizational form can be expressed as a typology or taxonomy as will be suggested later in this chapter under the categorization of *architectural form*.

> *"**Form** serves as the organizational ecologist's analogue to the biological ecologist's **species**. Form summarizes the **core properties** that make a set of organizations ecologically similar. Oranizational populations are specific **time-and-space** instances of organizational forms."*[576]

Note that while *ecologists* define *populations* as organizations exhibiting the same structural form, *economists* define *industries* as including all organizations serving the same demand or function, which could include quite diverst types of providers of substitutable products (Scott, 2003, pg. 127, footnote 2). This framework therefore defines multiple populations of organizational forms serving an industry (or niche).

Hannan and Freeman (1989, pg. 51) identify four properties of organizations which can be used to classify them into forms:

- Stated goals (i.e. *objective functions)*
- Forms of authority (i.e. *modular* vs. *integral)*
- Core technology (i.e. *growth* vs. *stability)*
- Marketing strategy (i.e. *differentiated* vs. *cost-leadership)*

4.2.2.3.1.2 Organizational *Niche*

4.2.2.3.1.3 Structural *Inertia*

[576] Hannan and Carrol, 1995, pg. 29.

4.2.2.3.2 *Community* Ecology (Synecology)

> *"The organization **field** can be viewed as encompassing the other levels: the **individual** organization, the organizational **set**, and **two or more populations** of interdependent organizations."*[577]

Synonymous with inter-organizational *community* is the organizational *field* (Scott, 2003, pp. 129-132).

Much of the focus of organizational ecology research has focused on populations of organizations – otherwise known as "population" ecology – while relatively few references exist in the management literature on multiple populations or "community" ecology (e.g. Astley, 1985; Beard and Dess, 1988). It is however at the community level, that populations of organizations adapt to form new species of populations.

> *"That the **community** is the essential **adaptive mechanism** may be taken as the distinctive hypothesis of ecology."*[578]

4.2.2.3.2.1 Verhulst Population Growth in Finite Environment

In order to define how populations grow, we can determine the key variables which enable and constrain their growth.

4.2.2.3.2.2 Species Archetypes: *r-strategists* and *K-strategists*

4.2.2.3.2.3 Lotka-Volterra (Predator-Prey) Inter-species Competition

[577] Scott, 2003, pg. 131.
[578] Hawley, 1950, pg. 31.

4.2.2.4 *Institutional* and *Neo-Institutional* Theory

4.2.2.4.1 *Institutional* Theory

Selznick (1949)

4.2.2.4.2 *Neo-Institutional* Theory

As one of the "bit four" theories to grow out of the 1960's contingency theory, neo-institutional theory was launched by the works of Meyer and Rowan, in1977 and DiMaggio and Powell in 1983.

> *"**What makes organizations so similar**? Once a set of organizations emerges as a field, a paradox arises: rational actors make their organizations increasingly similar as they try to change them."*[579]

While much of the new debate in economics and strategic management in the past two decades has focused on what are the sources of firm *heterogeneity* (Barney, 1991), the debate in sociology has been just the opposite: what are the sources of firm *homogeneity* or institutional isomorphism (Meyer and Rowan, 1977; DiMaggio and Powell, 1983).

[579] DiMaggio and Powell, 1983, pg. 147.

4.2.2.5 *Social Network* Theory

This section deals with an important subset of social network theory, namely *inter-firm* network theory.

4.2.2.5.1 Embeddedness

> *"Research on **embeddedness** is an exciting area in **sociology and economics** because it advances our understanding of **how social structure affects economic life**."*[580]

Some of the original research on "embeddedness" within inter-firm networks was done by Schumpeter (1950) and Granovetter (1985), and was subsequently developed by researchers like Uzzi who focus specifically on "structural embeddedness" or on how the "network architecture of exchange relationships influence economic activity" (Uzzi, 1997, pg. 36).[581]

4.2.2.5.1.1 *Under*-embedded network

Uzzi (1997) characterizes a continuum of exchange relationships with the neoclassical form as follows:

> *"In the ideal-type atomist market, exchange partners are linked by **arms-length** ties. **Self-interest** motivates action, and actors regularly switch to new buyers and seller to take advantage of new entrants or avoid dependencies. Personal relationships are **cool and atomistic**."*[582]

4.2.2.5.1.2 *Over*-embedded network

Conversely, the embedded form has the following characteristics:

> *"Embedded actors **satisfice** rather than maximize on price and shift their focus from the narrow economically rational goal of **winning immediate gain** and **exploiting dependency** to cultivating **long-term, co-operative ties**. The basic conjecture of this literature is that embeddedness creates economic opportunities that are difficult to replicate via markets, contracts or vertical integration."*[583]

> *"In an embedded logic of exchange, **trust** acts as the primary governance structure. Joint problem-solving arrangements promote **voice rather than exit**. On a microbehavioral level, actors follow **heuristic and qualitative decision rules**, rather than intensely calculative ones. These factors furnish an alternative mechanism for **matching customer demand to production**."*[584]

Uzzi (1997) then goes on to demonstrate empirically the competitive advantages of embeddedness, but notes some economic limitations, particularly with regard to adaptability:

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[580] Uzzi, 1997, pg. 35.
[581] Uzzi does not consider the other three forms of embeddedness put forth by Zukin and DiMaggio (1990): cognitive, political and cultural.
[582] Uzzi, 1997, pg. 36.
[583] Uzzi, 1997, pg. 37.
[584] Uzzi, 1997, pg. 61.

> *"Embeddedness is a logic of exchange that promotes **economies of time, integrative agreements**, Pareto improvements in allocative efficiency, and **complex adaptation**. These positive effects rise up to a threshold, however, after which embeddedness can **derail economic performance by making firms vulnerable to exogenous shocks** or insulating them from information that exists beyond their network."*[585]

> *"The same processes by which embeddedness creates a **fit with the current environment** can paradoxically reduce an organization's ability to **adapt**."*[586]

4.2.2.5.1.3 *Hybrid* network

Figure 172 below illustrates the concept of embeddedness with respect to the enterprise architectural theory presented in this research.[587]

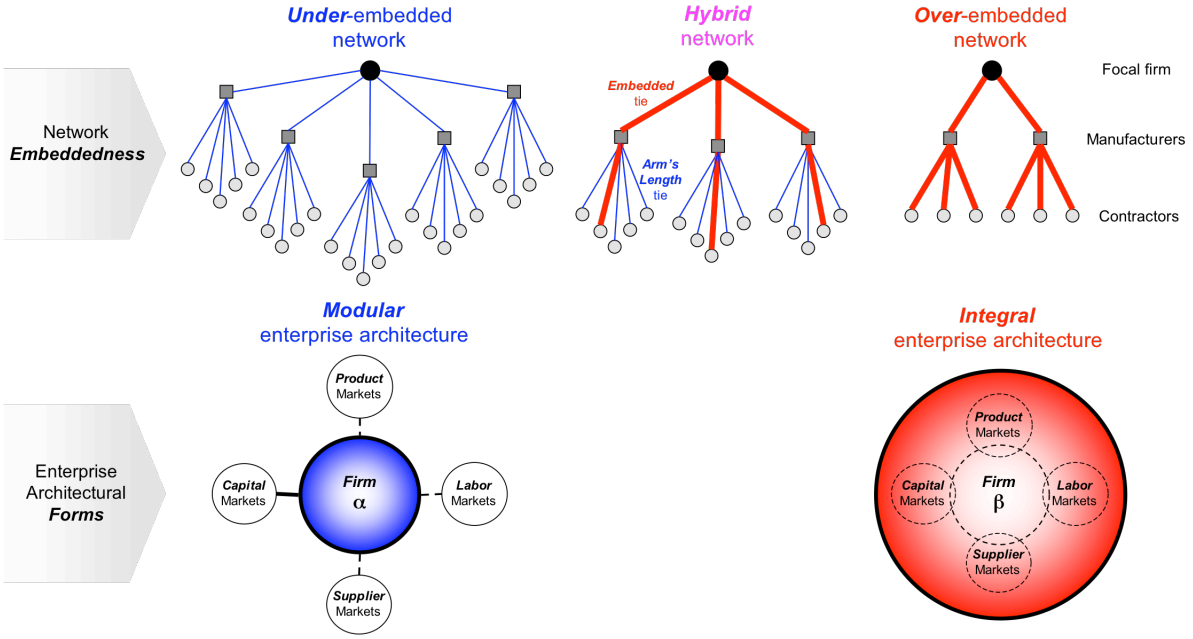

Figure 172: *Embeddedness* and Enterprise Architectures

As will be argued in Essay #2, this vulnerability to exogenous shocks appears to apply to *architectural/environmental* shocks, as opposed to *structural/operational* shocks.

[585] Uzzi, 1997, pg. 35.
[586] Uzzi, 1997, pg. 57.
[587] Note that Uzzi's work appears to focus on the supply or value chain axis only. Note unfortunately that Uzzi refers to the hybrid network as "integrated". This unfortunately is confusing with respect to the terminology used in this dissertation.

4.2.2.5.2 Socialization

(Granovetter, 1985).

4.2.2.5.2.1 *Under*-socialization

4.2.2.5.2.2 *Over*-socialization

4.2.2.5.3 *Keiretsu* as *Inter*-firm Networks

Various threads have emerged, including the empirical observation of social forms like Japanese “keiretsu” (Lincoln, Gerlach and Ahmadjian, 1996).

4.2.2.6 *Behavioral Decision* Theory

4.2.2.6.1 Bounded Rationality

Simon (1958), Cyert and March (1963).

4.2.2.6.2 *Exploration* vs. *Exploitation*

March (1991).

4.2.2.6.3 Misc.

Kahneman et al., (1982), Simon (1982), and Sterman (1989).

4.2.2.7 Miscellaneous Theories

4.2.2.7.1 *Loose* vs. *Tight* Coupling

When Simon speaks of loosely-coupled systems as being more "stable", he is referring to their "survivability" or "damage-tolerance", as they are able to localize disruptions.

Later, I shall argue that loosely-coupled systems correspond to the notion of modular architectures, which generate greater degrees of *in*stability - with stability meaning in this case variablility.

Weick (1976).

4.2.2.7.2 *Functional* vs. *Process* Design

> "[In the **functional** subdivision], *the stress is on **efficiency** within each of the separate functional specialties. It is an organizational form having advantages in a very **slowly changing** product situation. The functional organization runs into difficulty as the product life cycle becomes short. In the **project** organization, top management takes a view that is **longer** than the individual project."*[588]

[588] Forrester, J. (1961), pp. 329-330.

4.2.2.7.3 *Complexity / Complex Adaptive Systems* Theory

More recently, sociological contingency theory has taken a new form, that of complex adaptive systems.[589] This has begun to find its way into the strategic management literature (Levy, 1994; Stacey, 1995; Lengkick-Hall and Wolff, 1999; Caldhart and Ricart, 2004). Researchers have explored evolutionary biological[590] phenomena (Kauffman, 1993) and mapped them onto business phenomena (Levinthal, 1997; Rivkin, 2000; Sigglekow, 2002).

4.2.2.7.3.1 NK Model of Interdependencies (Kauffman, 1993)

Kauffman's (1993) NK model defines interdependencies between activities, where each of N total activities interacts with K other activities. The NK model has been transported to the strategic management domain by Levinthal (1997) and Rivkin (2000). In management research, the NK model can be thought of as a complex production function, which is comprised of these activities as well as the traditional capital and labor (Lenox, Rockart and Lewin, 2006). In this way, the NK model captures interdependencies between activities in a more general way than Milgrom and Roberts' (1990, 1995) complementarity concept which invokes the power and simplicity of supermodularity.

The presence of *low* interdependencies between parts, chunks, or stakeholders (i.e. N=1) signals a *modular* enterprise architecture, whereas the presence of *high* interdependencies between parts, chunks, or stakeholders (i.e. N≈K) signals an *integral* enterprise architecture, as shown in Figure 173 below.

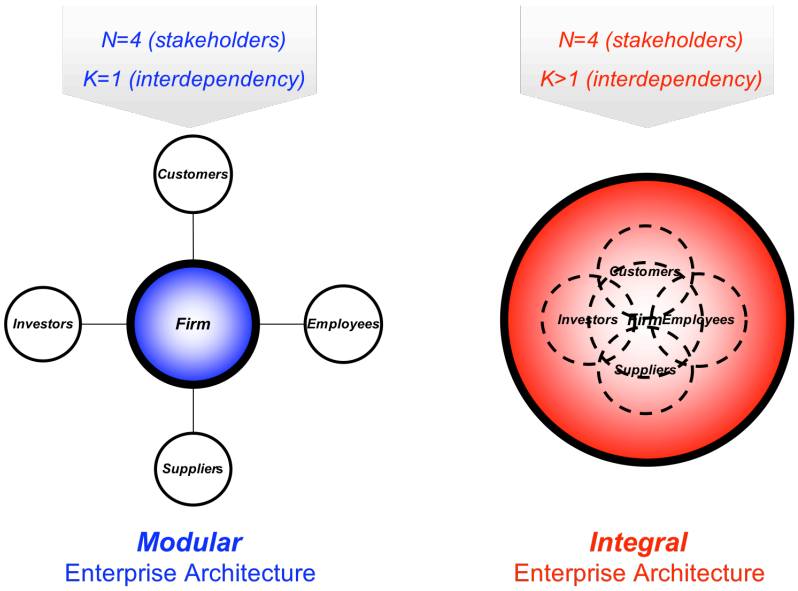

Figure 173: NK Model and Enterprise Architectures

[589] I am indebted to Dr. Felix Reed-Tsochas of the University of Oxford for assisting me in developing this.
[590] Note that the notion of a *fitness* function in evolutionary biology is simply the negative of a *potential* function in the nonlinear physics of attractors and basins.

Modular enterprise architectures therefore possess a rather simple objective function or "landscape", which is a single concave globally optimal peak. Integral enterprise architectures on the other hand possess a more complex objective function or landscape, which consists of multiple local optima, having the appearance of a rugged surface (as will be summarized in the next section).

4.2.2.7.3.2 *Fitness* Landscapes

A fitness landscape is simply the representation of genotype similarity on the horizontal axis and fitness or reproductive / business success on the vertical axis.

In applying this concept to the framework presented herein, it is posited that fitness or business success in an emerging market is characterized by competition between enterprises having similar genotypes / phenotypes in a *stable* landscape. Conversely, fitness or business success in a maturing market is characterized by competition between enterprises having different genotypes / phenotypes in a *rugged* landscape as shown in Figure 174 below.

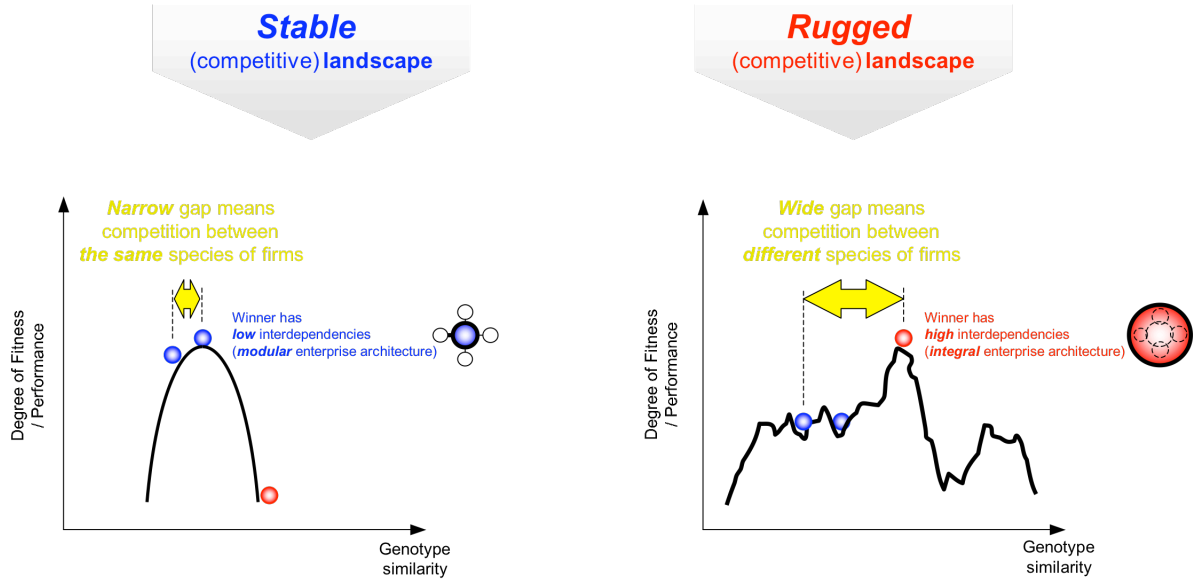

Figure 174: Competition within *Stable* and *Rugged* Landscapes

4.2.2.7.3.2.1 Part-Whole Relationships

In biology, the part-whole relationship is the relationship between an organism's *genetic* structure (or internal interdependencies) and its phenotype (or *overall* structure), which is in turn related to the organism's fitness with its environment (or external interdependencies).

4.2.2.7.3.2.2 *Rugged* Landscapes

Kauffman (1993) modeled the selection dynamics in the biological domain with heterogeneous interdependent traits. He found that as the number of interdependent

elements increases, the fitness landscape presents an increasing number of local optima (Dosi et al. 2003, pg. 105-106).

> *"In the presence of **strong interdependencies** (as is often the case in many complex products), the **system can not be optimized by separately optimizing each element** from which it is made. Indeed, in the case of strong interdependencies, it might well be the case that some, or even all, solutions obtained by tuning each component 'in the right direction' yield a **worse performance** than the current one."*[591]

4.2.2.7.3.3 Competition vs. Cooperation

Political scientist, Robert Axelrod, in *The Evolution of Cooperation* (1984) used game theoretic research with the iterated Prisoner's Dilemma results in a TIT-FOR-TAT as optimal. This was followed up more recently with agent based modeling in *The Complexity of Cooperation* (1997).

> *"Fool me **once**, shame on **you**. Fool me **twice**, shame on **me**!"*[592]

> *"Toyota has two faces. It is a **stern** father and a **compassionate** mother."*[593]

[591] Dosi et al. (2003), pg. 106.
[592] Ancient Chinese proverb.
[593] Shogo Tsuru, former chairman of Nippon Oil Seal, as quoted in Hino, S. (2006), pg. 59.

4.2.3 Strategic Management *theories*

4.2.3.1 SCP vs. RBV

There is clearly a considerable wealth of constituent research in the field of strategic management from two schools rooted in microeconomic theory: the Industrial Organization subfield dating back to Bain (1956) advanced the industry structure emphasis and on the resource-based view of the firm dating back to Penrose (1959), with their respective descendant proponents appearing a quarter century later in Porter (1980) and Wernerfelt (1984). Since this time, much research in this field has focused on the refinements of theories in each subfield, including: asset stock accumulation and dynamic capabilities (Dierickx and Cool, 1989; Teece, Pisano and Shuen, 1990).

It will be demonstrated theoretically later in this chapter that different enterprise architectures will be built and operated by people and institutions having different mental models or who operate a different "core logic" (Lengnick-Hall and Wolff, 1999) regarding the nature and purpose of strategy.

In fact, it will be hypothesized that *modular* enterprise architectures operate a core logic, which is more closely aligned with the SCP paradigm and the hypercompetitive and high-velocity perspectives that embody "guerilla logic" (Lengnick-Hall and Wolff, 1999).

In contrast, it will be hypothesized that integral enterprise architectures operate a core logic, which is more closely aligned with the RBV paradigm and the ecosystem/chaos perspectives that embody "complexity logic" (Lengnick-Hall and Wolff, 1999).

4.2.3.2 Flexibility vs. Comittment

Ghemawat, (1992), Pacheco-de-Almeida, G., Henderson, J.E., and Cool, K.E. (2008).

4.2.3.3 *Profit*-Maximizers vs. *Profit*-Seekers

Each of these two schools can be seen to represent the assumptions behind *modular* enterprise architectures (SCP) and *integral* enterprise architectures (RBV). The SCP school assumes firms as profit-*maximizers*, while the RBV school (including Schumpter-Penrose-Nelson/Winter) assumes firms as profit-*seekers*.[594]

4.2.3.4 *M*-Form vs. *N*-Form

Hedlund (1994).

4.2.3.5 Strategic Groups

The notion of "strategic groups" was asserted by Porter (1980, 1981), in an effort to discretize heterogeneity of firms within an industry. As will be discussed later, enterprise

[594] Cantwell, (2002), pp. 13.

architecture configurations of modular vs. integral will be seen to belong to different strategic groups.

4.2.4 Architectural *theories*

The notion of *enterprise architecture* cuts across the many manifestations of "architecture" in management literature: e.g. complexity in- (Simon, 1962) building- (Alexander, 1964), product- (Ulrich, 1995), systems- (Meier and Rechtin, 2000; Nightingale and Rhodes, 2004), supply chain- (Novak and Eppinger, 1998), organizational- (Sanchez and Mahoney, 1996; Rechtin, 1999), human resource- (Lepak and Snell, 1999), innovation and- (Henderson and Clark, 1990), as well as the various interactions between architectures (Fine, 1998; Sako, 2003).

Although, civil, product and system architecting are focused primarily on technological systems, the concepts can be extended along the spectrum towards socio-technical systems and ultimately towards social systems. As shown in Figure 175 below, this is a matter of increasing both behavioral and dynamic complexity (Rittel and Webber, 1973; Senge, 1990).

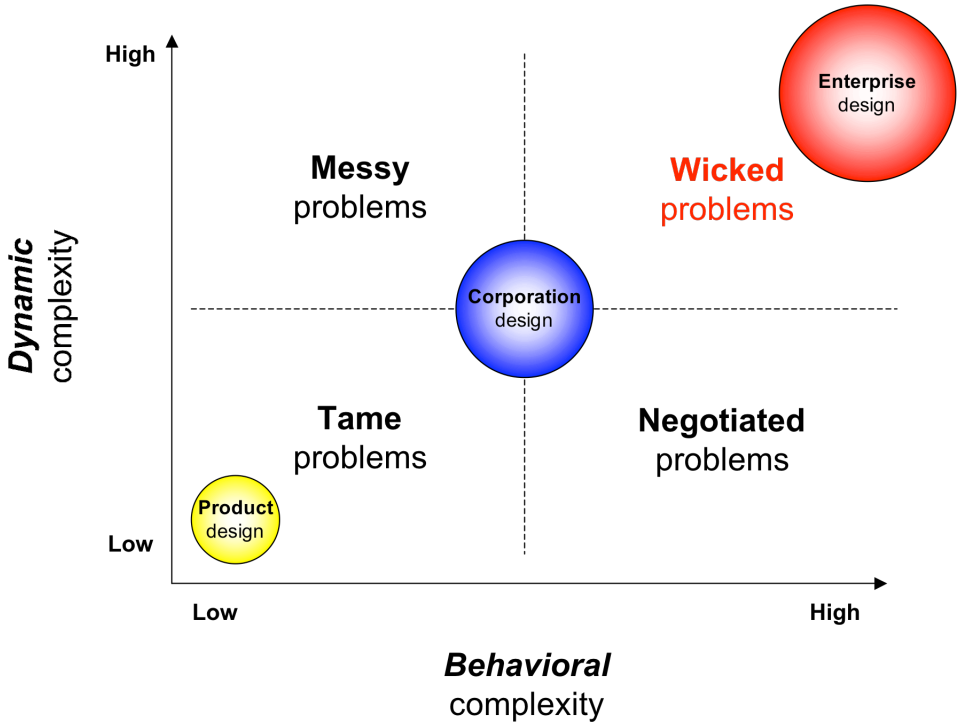

Figure 175: From *Technical*, to *Socio-Technical*, to *Social* Systems

4.2.4.1 *Civil* Architecture

4.2.4.1.1 Form (and Structure)

> *"Form: The **shape** and **structure** of an object. The **essence** of something."*[595]

> *"Structure: Something made up of a number of **parts** that are held or put together in a **particular way**."*[596]

4.2.4.1.2 Function

> *"Function: the **action** for which a person or thing is particularly **fitted** or employed."*[597]

In classical architectural theory, the relationship between architectural form and function is important and explicit. A similar relationship can be seen to drive the business enterprise's architectural form, namely the business objective function.

> *"**Form** follows **function**."*[598]

Heuristic 1f:
The architectural *form* of an enterprise will be governed by the objective *function* of the enterprise (or at least by the "keystone" firm). Modular enterprises are driven by the maximization of *economic value*, while integral enterprises are driven by the creation and distribution of *stakeholder surplus*.

> *"The starting point for the book is therefore Chandlerian: How does **strategy determine structure**, and what are the complex ways in which structure and strategy interconnect? Here **strategy** may be defined as the planning and carrying out of the **growth** of organizations, and **structure** is understood to mean the **organizational form** devised to administer activities and resources (Chandler, 1962, pg. 13)."*[599]

This is a modification of Chandler's classic *Strategy and Structure* (1962), which explored *intra*-firm design (focusing on the evolution of the multi-divisional "M-form") as opposed to *inter*-firm design. Chandler asserted that the firm's *internal structure* should follow its strategy. In comparison, this framework is asserting that a firm's *external architecture* should follow its *objective function*. It is important to note that the concepts of both form and function are higher level and more abstract notions than Chandler's.

> *"**Form** and **function** are **one**."*[600]

Finally, in the spirit of systems thinking and feedback causality, Frank Lloyd Wright (1939) argued for the integration of form and function as existing in a concurrent duality.

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[595] From "*Dictionary.com*".
[596] From "*Dictionary.com*".
[597] From "*Dictionary.com*".
[598] Louis Sullivan (1896).
[599] Sako, M. (2006), pp. 1-2.
[600] Frank Lloyd Wright (1939).

4.2.4.1.3 Fit

The notion of "fit" is well established in civil architectural terms (Wright; Alexander, 1964; etc.) This topic will be taken up again in more detail in chapter 6, where the environment is explored in more detail.

4.2.4.2 *Product* Architecture

While the focus of *civil* architecture was largely on environmental fit, as well as form following function, the focus of *product* architecture lies in decomposing functions and mapping them onto structures to achieve the desired performance.

The following briefly summarizes and attempts to disentangle the various definitions and uses of "architecture" in the product development and management literatures.

4.2.4.2.1 Building Blocks, Components, Chunks, Modules

Product architecture is broadly defined as the mapping of function to form. Most researchers in product development use different terms to express form (or components of form) ranging from "building blocks" or "chunks", (Ulrich, 1995; Ulrich and Eppinger,1995) and "modules" (Baldwin and Clark, 2000).

> *"Product architecture is the assignment of the functional elements of a product to the physical **building blocks** of the product."*[601]

> *"Product architecture is the scheme by which the function of the product is allocated to **physical components**."*[602]

> *"The architecture of the product is the scheme by which the functional elements of the product are arranged into **physical chunks** and by which the chunks interact."*[603]

> *"An architecture specifies what **modules** will be part of the system, and what their **functions** will be."*[604]

While *product* architecture is defined in both functional and *physical* terms, *enterprise* architecture is defined in both functional and *organizational* terms as will be discussed in later sections.

4.2.4.2.2 Interfaces

> *"In management literature, more than in the engineering literature, there is a tendency to home in on **interface** specification as an important feature of modularity."*[605]

[601] Ulrich, K. and Eppinger, S. (1995), pp. 182-183.
[602] Ulrich, K. (1995), pg. 419.
[603] Ulrich, K. and Eppinger, S. (1995), pg. 183.
[604] Baldwin, C. and Clark, K. (2000).
[605] Sako, M. (2003), pg. 231.

4.2.4.2.3 Typology of Product Architectures

4.2.4.2.3.1 *Modular*

According to Ulrich and Eppinger (1995, pg. 183), *modular* product architectures:

- have functions assigned to one chunk;
- therefore, a chunk executes only one function;
- interactions between chunks are clearly-defined;

4.2.4.2.3.2 *Integral*

According to Ulrich and Eppinger (1995, pg. 184), *integral* product architectures:

- have functions assigned to more than one chunk;
- therefore, a chunk executes more than one function;
- interactions between chunks are ill-defined;

> *"An **integral** architecture allows for **redundancy** to be eliminated through **function-sharing**."*[606]

An example of the range of product architectures employed is shown in Figure 176 below. In this example, a passenger airplane can be seen to have two primary functions, providing lift for flight, and providing a cabin for the passengers.

A conventional modular one-to-one mapping of function to form would entail an architectural solution in which separate physical "chunks" or modules would be separately designed, built and operated to accommodate each function. In this example, the wings (with their special airfoil shape) would serve to create lift, while the tubular fuselage would house the payload or passengers.

Conversely, an integral many-to-one mapping of function to form would entail an architectural solution in which one "chunk" or module would be integrally designed, built and operated to accommodate both functions. In this example, the fuselage would become the lifting device, or put another way, the wings would house the payload or passengers.

[606] Ulrich, K. and Eppinger, S. (1995), pg. 188.

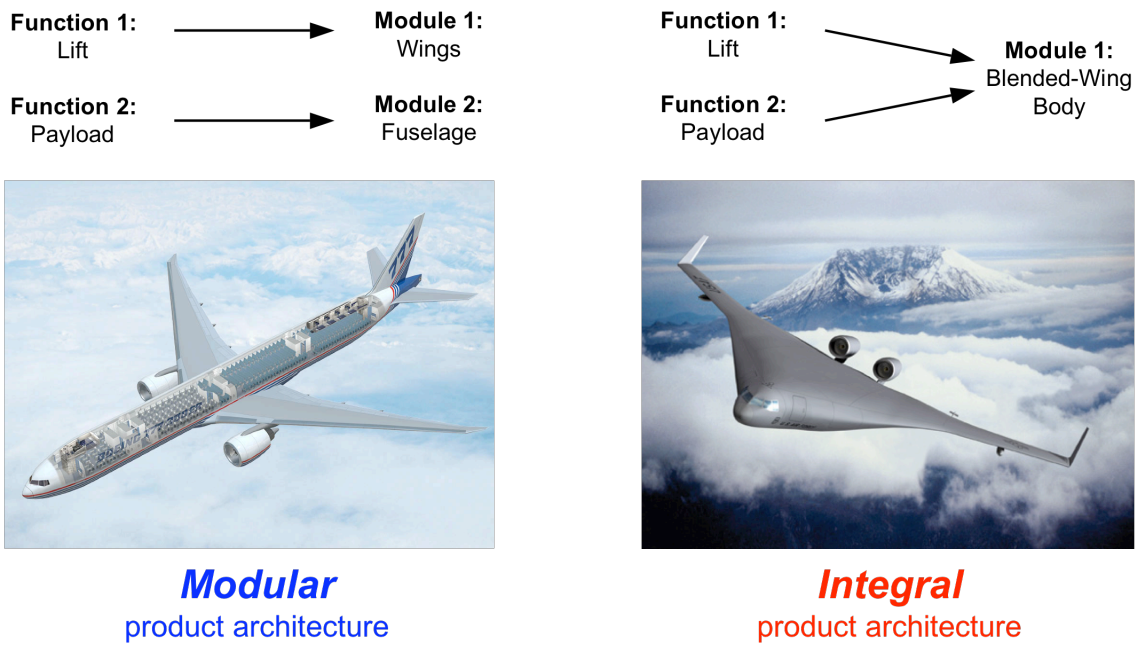


Figure 176: Product Architecture Example

> *"Conventional aircraft comprising separate wings and fuselages accomplish the functions of providing lift, carrying fuel, and housing passengers using separate portions of the aircraft. Typically wings and fuselages are designed by different engineers and made in different factories. The **Airbus** Consortium was structured to take advantage of this architecture. Wings are made in the UK, fuselage barrel sections in Germany, tail sections in Spain, and final assembly and integration takes place in France. But there are some disadvantages in terms of coordination as well as transportation of large subassemblies. For example, the International Space Station may have suffered from certain mismatches between physical and organizational architectures."*[607]

As will be discussed in subsequent sections, product architectures may have an influence on the design of organizational architectures.

[607] Whitney, D. et al. (2004), pg. 10. Also noted in "Airbus' Jigsaw Plane", *BusinessWeek*, March 14, 2006.

4.2.4.2.4 Design Rules

> *"Design rules allocate **functions to modules**, identify **operating principles**, and set **interfaces** among modules that determine **how organizations evolve**."*[608]

Helper and Khambete (2006, pg. 10) note that Baldwin and Clark (2000) emphasize the *location* of interfaces as opposed to the ways of *governing* the interfaces:

> *"Baldwin and Clark define a modular architecture as one which has few interdependencies between modules (and more interdependencies within modules). Their book focuses on the impact of the **location** of these interfaces (what happens if modules are split, recombined, etc.) They argue that a modular architecture promotes innovation by allowing more division of labor. They pay little attention to ways of **governing** interfaces (interdependencies) between components; mentioning only two: **Design rules (highly structured)** and **Discussion (loosely structured).**"*[609]

4.2.4.2.4.1 Three Types of Modularity

Modularity in design, manufacturing and use. (Baldwin and Clark, 2000). (Brusoni and Prencipe, 2006).

4.2.4.2.4.1.1 Modularity in *Design*

4.2.4.2.4.1.2 Modularity in *Manufacturing*

4.2.4.2.4.1.3 Modularity in *Use*

[608] Brusoni and Prencipe (2006).
[609] Helper and Khambete (2006), pg. 10, footnote 6.

4.2.4.2.5 Product *Performance*

> *"I define product **performance** as how well the product implements its **functional** elements. Product performance **excludes economic performance,** except to the extent that it arises from the product's technical performance, because economic performance is also highly dependent on the firm's production, service, sales and marketing activities."*[610]

Having defined the spectrum of product architectures, the obvious question is: "Which architecture performs better?" The answer is obviously, "It depends."

> *"Arguments for the **integral** design are often largely technical or **performance-based**, whereas arguments for **modular** tend to be based on business concerns such as **cost and time to market**."*[611]

4.2.4.2.5.1 *Modular* performance

In general, modular product architectures are designed for *local* high performance (Ulrich, 1995, pg. 432). In addition, modular architectures tend to exhibit lower acquisition cost, which must be balanced against higher relative life-cycle costs.

4.2.4.2.5.2 *Integral* performance

> *"A product embodying an **integral** architecture will often be designed with the **highest possible performance** in mind."*[612]

In general, integral product architectures are designed for *global* high performance (Ulrich, 1995, pg. 433) defined for narrow and specific environmental conditions. In addition, integral architectures tend to exhibit lower life-cycle costs, in spite of their higher acquisition costs.

[610] Ulrich, K. (1995), pg. 432.
[611] Fine, C.H. (1998), pg. 136, acknowledging D. Whitney's contribution.
[612] Ulrich, K. and Eppinger , S. (1995), pg. 184.

4.2.4.3 *System* Architecture

While the focus of *product* architecture was largely on decomposing functions and structures to achieve the desired performance, the focus of *system* architecture lies in greater detail and dynamic complexity, as well as design for emergence.

The following two sub-sections articulate two very different and potentially complementary processes for architecting systems.[613]

4.2.4.3.1 Top-down Deterministic Mechanistic Reductionism

> *"**Reductionism** relies on the assumption that a **divide-and-conquer** strategy will really work, that understanding the behavior of each element and defining each interface correctly and completely will assure a properly working system. This assumption brings with it a host of other attitudes and methods, generally called **top-down**, that assume that things can be **preplanned and scripted**, and that following the script is the way to get a successful result."*[614]

As we have discussed in other social science literatures, this top-down approach is reminiscent of Theory X (McGregor, 1960), hierarchical command and control organizational structures. The reductionist divide-and-conquer strategy is reminiscent of the efficiencies of division of labor (Lawrence and Lorsch, 1967). The deterministic preplanned and scripted approach is reminiscent of the mechanistic traditions (Burns and Stalker, 1961).

4.2.4.3.2 Bottom-up Emergent Organic Holism

> *"In contrast to top-down is **bottom-up**, in which requirements and system design are expected to **emerge** over time and by means of **trial and error**. Under these assumptions, no complete script can be written, not all of the events and decisions can be anticipated or scheduled, and the final result is not known."*[615]

As we have also discussed in other social science literatures, this bottom-up approach is reminiscent of Theory Y (McGregor, 1960), flat and empowered organizational structures. The holist strategy is reminiscent of the effectiveness of integration (Lawrence and Lorsch, 1967). The emergent and unscripted approach is reminiscent of the organic traditions (Burns and Stalker, 1961).

[613] Weick, K. (1993) refers to the two types of organizational design as: *formal* and *emergent*.
[614] Whitney et al. (2004), pg. 4.
[615] Whitney et al. (2004), pg. 4.

4.2.4.4 *Organizational* Architectures

*"Modular and integral architectures are **like oil and water. They don't mix**."*[616]

In addition to the study of physical architectures, whether civil, product or system, the discussion then tends towards the architectures of those organizations which design, produce and operate the physical architectures.

A recent study of the literatures in 36 journals on modularity in product, process, organization and innovation over the past 35 years revealed relatively little work in the area of organizational modularity (Fixson, 2006). Table 13 below summarizes the literatures at the intersection of modularity and organizations.

Table 13: Research on Modularity in Organizations

Authors	Year	Modularity Type				Industry
		Product	Process	Organ-ization	Innova-tion	
Baldwin & Clark	2000			✓	✓	Computer
Browning	2001	✓	✓	✓		Auto. sub-system
Djelic & Ainamo	1999			✓		Luxury Fashion
Ethiraj & Levinthal	2004	✓		✓		(non-specific)
Fine, Golany & Naseraldin	2005	✓	✓	✓		Automobile
Garud & Kumaraswamy	1995	✓		✓		Computer & Auto.
Helfat & Eisenhardt	2004			✓		Electronics & IT
Henderson & Clark	1990			✓	✓	Photolithographty
Kusunoki, Nonaka & Nagata	1998			✓		Materials & Systems
Salvador, Rungtusanatham & Forza	2004	✓	✓	✓		(multi –industry)
Sanchez & Mahoney	1996	✓		✓		Aircraft, Auto, Elec.
Schilling	2000	✓		✓		Stereo, Computer
Schilling & Steensma	2001		✓	✓		(multi –industry)
Siggelkow & Levinthal	2003	✓		✓		(non-specific)
Sinha & Van de Ven	2005			✓		(multi –industry)
Sosa, Eppinger & Rowles	2003	✓		✓		Aircraft Engine
Sosa, Eppinger & Rowles	2004	✓		✓		Aircraft Engine

[616] Fine, C.H. (2005), pg. 4.

Comparing Physical- and Organizational Architectures

4.2.4.4.1.1 Common Points

From both physical architectural theory as well as sociology / organizational theory, we know the following:

4.2.4.4.1.1.1 Architecture *Enables* Function

Structure (or its more abstract form, architecture) is necessary to *enable* function. For example, in order to conduct the function of producing manufactured goods, one needs a structure/architectural form like a factory. In order to conduct the social function of business, one needs an organizational structure like a bureaucracy (Weber, 1952).

4.2.4.4.1.1.2 Architecture *Constrains* other Functions

In doing so, structure (architecture) *constrains* other functions. For example, the physical structure/architectural form of a factory, while enabling some production functions, constrains other functions like pursuit of leisure activities, like swimming. The social structure of bureaucracy, while enabling some business functions, constrains other functions like conducting an insurgent revolution.[617]

4.2.4.4.1.1.3 Architecture does not *Predetermine* Choice

But within an architecture, a range of *choice* (i.e. functional flexibility) is preserved. For example, within the physical architecture of a factory, one can manufacture goods or one can even meditate (even if not in a church, synagogue, mosque or temple). Within the organizational structure/architecture of a bureaucracy, one can conduct business or one can even raise a family (even if not in a more informal, trust-based environment).

[617] It is interesting to note that when radical environmental change occurs, people in social organizations tend to preserve structures, instead of higher-order goals and objectives.

4.2.4.4.1.2 Differences

4.2.4.4.1.2.1 Visibility

Physical architectures are visible, while organizational architectures are invisible. This can present problems in theory development and testing in social science via "unobservables".

4.2.4.4.1.2.2 Evolution

Physical architectures can be approximated as static, or at least they "evolve" very slowly. Organizational architectures are dynamic, that is they have the potential to evolve very rapidly, particularly if their structural inertia is low (Hannan & Freeman, 1984).

4.2.4.4.1.2.3 Emergence

Physical architectures can be approximated as top-down deterministic, while organizational architectures are bottom-up emergent, that is they are continually enacted by their constituent agents.

4.2.4.4.2 Two Levels of Organizational Architecture

We will next explore both *inter*- and *intra*-firm architectures in the following sub-sections.

4.2.4.4.2.1 *Inter*-firm (Enterprise) Architectures

4.2.4.4.2.1.1 Concept Extended from Product Architecture

While we previously examined how the notion of architecture was used to map function to physical form, we now use the concept to relate how function relates to organizational form as shown in Figure 177 below.

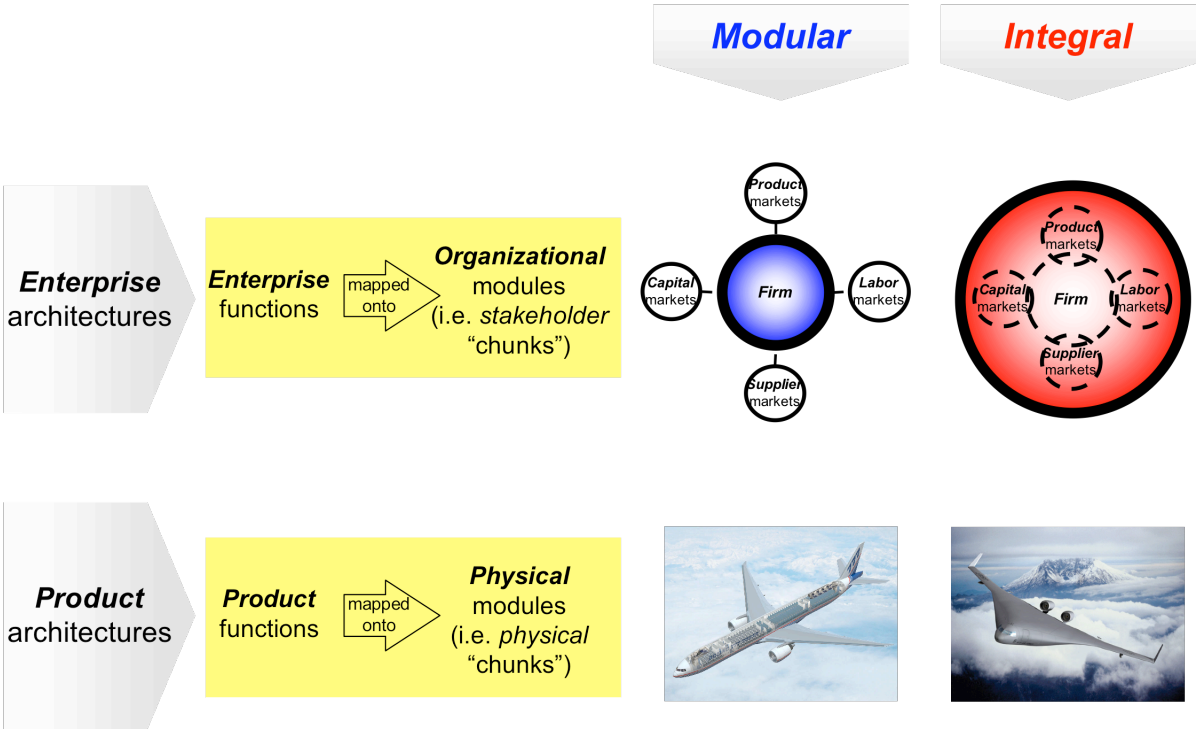


Figure 177: Mapping Function to *Organizational* (not *Physical*) Form

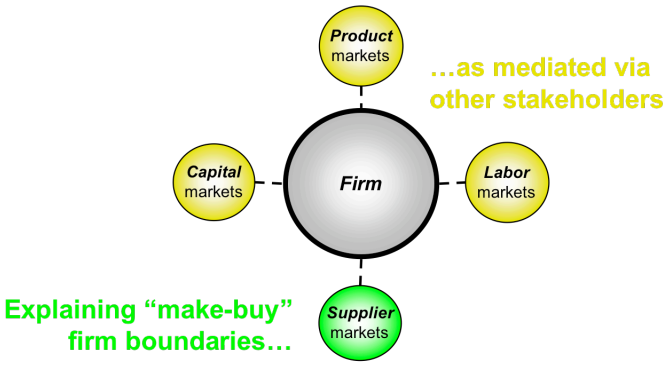
4.2.4.4.2.1.2 Sub-case Example: *Supply Chains*

Baldwin and Clark (2000) show that firm boundary decisions in the computer industry are mediated by stakeholder groups representing both labor and capital markets. They argue that modularization or disintegration of the computer industry is driven by users demand for compatibility (modularity-in-*use*), which lead to modularity-in-*design*. The "environmental" or stakeholder factors that enabled such a transformation were the mobility of technical labor in the first instance, and the availability of venture capital to fund modular design firms.

Sako (2003) compares the catalysts driving product and organizational architectures in the computer and automobile industries, by searching for explanations in the stakeholder groups of labor and capital markets. She argues that the catalyst driving modularity in the automobile industry is modularity-in-*production* generated by the assembly of technologically and ergonomically complex components. The "environmental" or stakeholder factors that enabled such a transformation were the wage differentials of labor in the first instance, and the drive by investors to push for outsourcing and consolidation in a maturing industry with overcapacity and cost-competition.

Finally, Piepenbrock (2004) extends Baldwin and Clark (2000) and Sako's (2003) analyses to the commercial airplane industry, by noting that the catalyst driving modularity is modularity-in-*use* generated by the imperative of offset agreements in order to access international markets. This adds another stakeholder to the discussion, namely the customer via access to product markets. The "environmental" or stakeholder factors that enabled such a transformation were the wage differentials of labor to a small degree, but the access to risk-sharing partnerships with suppliers as a means of capital investment.

Figure 178 below, adapted from Sako (2003), applies the framework to illustrate the different catalysts driving product and organizational architectures in three industries: computers, automobiles, and airplanes.



Industry	Computers	Automobiles	Airplanes
Reference	Baldwin and Clark (2000)	Sako (2003)	Piepenbrock (2004)
Catalyst for Modularity	Mi**U** → Mi**D** (user demand for compatibility)	Mi**P** → Mi**D** (production complexity and ergonomics)	Mi**U**, Mi**P** → Mi**D** (market access via production offsets)
Organizational Adaptation	Modular design teams & start-ups first, outsourcing later	Outsourcing, tiering and consolidation of suppliers	Outsourcing, tiering and consolidation of suppliers
Labor markets	Mobility of technical labor	Wage differentials between OEM and suppliers	International socio-political demand for work-placement
Capital markets	Venture capital for start-ups	Investment banking advice for M&A	Risk-sharing partner suppliers fund development costs
Product markets			Offsets give market access to international sales

Figure 178: Stakeholder Catalysts driving Product and Organizational Architectures

Within the commercial airplane industry, the above-described stakeholder analysis, which ultimately drives product- as well as organizational architectures (and subsequent outsourcing) is shown in Figure 179 below.

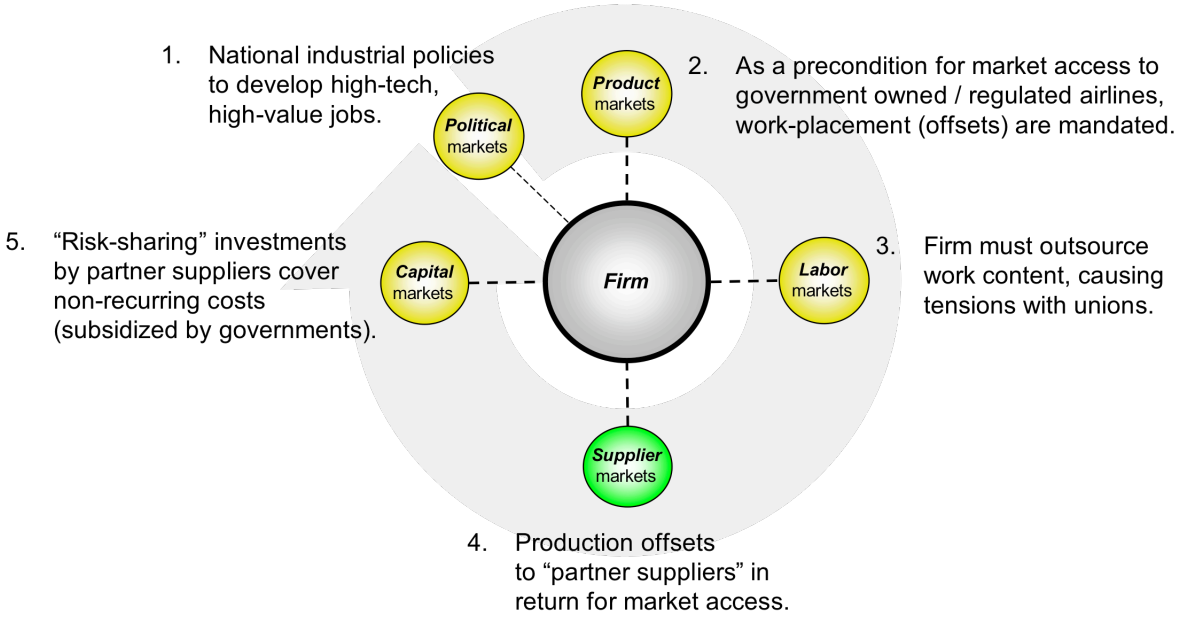


Figure 179: Product & Organizational Architectures in Commercial Airplane Industry

4.2.4.4.2.2 *Intra*-firm Architectures

A mapping can be posited to exist between *inter*-firm (enterprise) architectural functions, and *intra*-firm functions or projects as shown in Figure 180 below.[618] It will be demonstrated that a modular *inter*-firm enterprise architecture tends to be served by a modular *intra*-firm architecture, while an integral *inter*-firm enterprise architecture tends to be served by an integral *intra*-firm architecture.

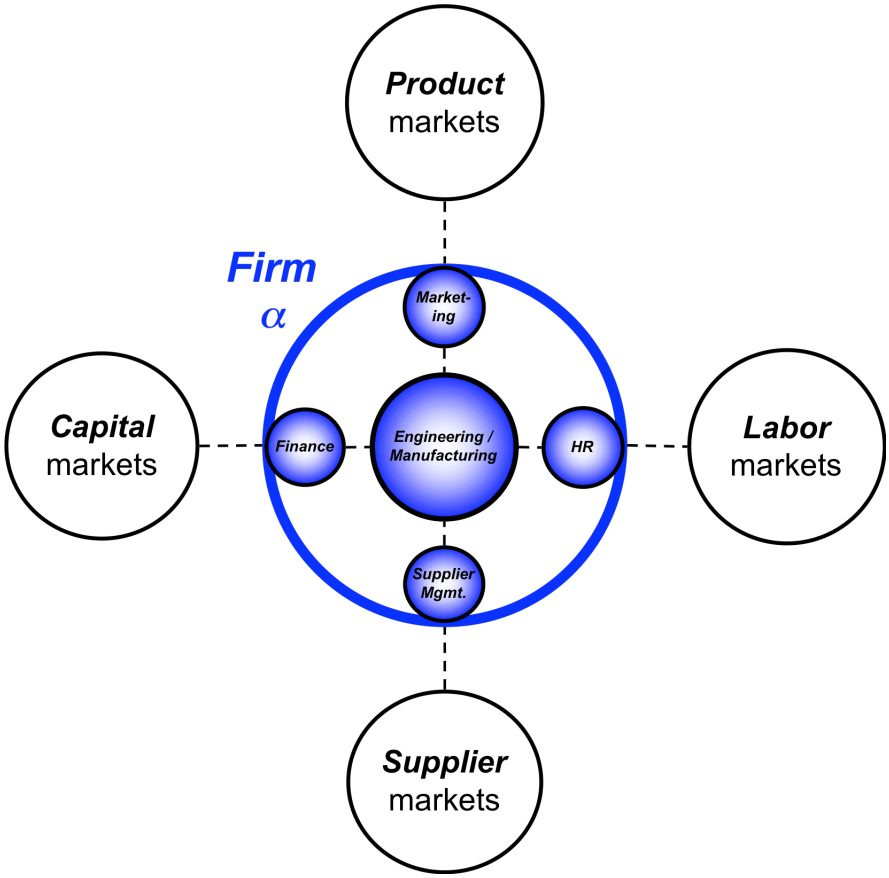


Figure 180: *Inter*-firm to *Intra*-firm Functional Mapping

Functional vs. Project (Forrester, 1961). Nadler & Tushman (1997).

[618] Note that the customer-firm-supplier axis represents the three minimum internal business processes of marketing, engineering and supplier management as discussed in Hagel and Singer (2000).