4-19-2012 12:00 AM

Developing Dynamic Capabilities in Environments of Persistent Disturbances

Brent A. McKnight
The University of Western Ontario

Supervisor
Dr. Pratima Bansal
The University of Western Ontario

Graduate Program in Business
A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy

DEVELOPING DYNAMIC CAPABILITIES IN ENVIRONMENTS OF PERSISTENT DISTURBANCES

(Spine title: Dynamic Capabilities and Persistent Disturbances)

(Thesis Format: Monograph)

by

Brent McKnight

Graduate Program in Business Administration

A thesis submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

The School of Graduate and Postdoctoral Studies
The University of Western Ontario
London, Ontario, Canada

THE UNIVERSITY OF WESTERN ONTARIO
School of Graduate and Postdoctoral Studies

CERTIFICATE OF EXAMINATION

Supervisor	Examiners
Dr. Tima Bansal	Dr. Glenn Rowe
Supervisory Committee	
Dr. Mark Zbaracki	Dr. Jean-Philippe Vergne
Dr. Robert Klassen	Dr. Robert Lannigan
Dr. Fernando Olivera	Dr. Maurizio Zollo

The thesis by

Brent Alexander McKnight

entitled:

Developing Dynamic Capabilities in Environments of Persistent Disturbances

is accepted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Date

Chair of the Thesis Examination Board

Abstract

Dynamic capabilities explain how firms adapt to environmental dynamism by modifying their underlying resources and capabilities. However, despite a robust understanding of how dynamic capabilities are influenced by different *dimensions* of environmental dynamism (eg. velocity), scholars have not explained how dynamic capabilities develop in the presence of different *configurations* of environmental dynamism. Common configurations of environmental dynamism include *environmental shifts,* which pertain to discontinuous environmental change, and *ongoing environmental change,* which depicts hypercompetitive environments. In this thesis, I explore how dynamic capabilities develop in the context of a configuration of environmental dynamism that I call *persistent disturbances,* defined as *repeated temporary events confronting firms*. My research investigates how firms build and further develop dynamic capabilities in the presence of persistent disturbances.

In my research, I engaged in an inductive historical case study to build new and to elaborate on existing dynamic capability theory. I chose the North American automotive industry for my context, focusing on the time period between 1965 and 2010, during which the industry was confronted with *persistent disturbances* in the form of labour difficulties, economic cycles, competitive pressures, energy challenges, and government regulations. I focused my analysis on three firms: General Motors, Chrysler, and Ford. I created a longitudinal dataset consisting of both qualitative and quantitative data obtained from archival sources including annual reports and the Ward's Automotive Yearbooks. I analyzed these data in three iterative stages. First, I focused on identifying the persistent disturbances that had impacts on automotive firms. Second, I explored how the firms in my study responded to those persistent disturbances.

Third, I built new theory and elaborated existing theory pertaining to how dynamic capabilities develop over time in the presence of persistent disturbances.

My analysis yielded important findings. First, I found that, in response to *persistent disturbances,* dynamic capabilities developed through a process of capability layering. The result was a dynamic capability architecture that comprised layers of capabilities that functioned to facilitate change. Dynamic capability development proceeds from early periods of coping towards increasing technical fitness as firms build new dynamic capability layers by adding and modifying the capabilities that functioned as building blocks supporting the dynamic capability. My research also distinguished *persistent disturbances* from other configurations of environmental dynamism and offer insights regarding how different configurations of environmental dynamism influence dynamic capability development.

Overall, this thesis makes important contributions to dynamic capability theory and to understanding the role of environmental dynamism in strategic management scholarship. My thesis also has important implications for practice.

Keywords: Dynamic Capabilities; Resilience; Environmental Dynamism; Automotive Industry

Acknowledgments

There are many people that have helped me in ways big and small along this challenging journey. I wanted to take a moment to note a few of them.

Dr. Tima Bansal provided strong and engaged mentorship to me that influenced every aspect of my becoming a professor. Tima taught me skills and knowledge about conducting scholarly research and delivering high quality teaching, and constructively challenged me at crucial junctures. Looking back it is easy to see how I owe her a debt of gratitude across the different aspects of my development as a scholar. Tima also opened up every possible door for me and actively supported me in countless ways. I am grateful for Tima's strong and steadfast support.

I would like to thank my examination committee – Dr. Maurizio Zollo, Dr. JP Vergne, Dr. Glenn Rowe, and Dr. Robert Lannigan. Each member of the committee engaged strongly with my thesis work, and offered insightful comments and suggestions that have already helped me drive my work forward. Thank you very much for your dedication.

My supervisory committee also played a very important role in pushing my thinking and ensuring that the dissertation proposal I arrived at was achievable and realistic. Thank you to Mark Zbaracki, Fernando Olivera, and Rob Klassen.

Thank you to a variety of Ivey faculty members that have offered support to me over the years. I deeply appreciate the mentoring and support that Oana Branzei provided both from the perspective of research through collaboration but also teaching from the perspective of a coach. A special thanks to Charlene Zietsma who supervised me during the first two years of my degree; her ongoing support has been a welcome source of comfort. Thank you as well to Jeff Frooman at the University of New Brunswick who has been a strong support for me throughout my studies. I appreciate Mike Valente and Adam Fremeth both making a point to attend presentations that I gave and offering support, advice and commentary. Guy Holburn and Claus Rerup have each offered me valuable and insightful advice and guidance; thank you.

I would also like to acknowledge financial support that made my PhD journey more comfortable. I received funding from the Brock scholarship, made possible by Bill and Anne Brock's generous donation to the school. This scholarship provided welcomed financial support over the first four years of my degree. In addition, grants from the Ontario Graduate Scholarship Program and the Social Sciences and Humanities Research Council were greatly appreciated.

My fellow PhD students at Ivey, past and future graduates of the Ivey PhD program alike, have been a source of strength and support. There are too many to name here, but they know who they are. The community of scholars is strong at Ivey and that community made the journey both more intellectually stimulating and personally rewarding.

I am grateful also to Rob and Anna Esselment and their growing family, Janey, Heath and Bea, for graciously opening their home to me when I needed an overnight visit. Thank you as well to Starbucks store #4757 for providing me with a destination where I could be productive when I needed to get out of my home office. Both employees and regular customers alike offered a remarkable amount of support and encouragement throughout the process, particularly as the final milestone neared.

Finally, I would like to thank my family for their enduring support. My parents, Brian and Patricia, and Meaghan's parents, Gordon and Marylyn, have both been very supportive, providing help in a myriad of different ways big and small. Most important I would like to thank my wife Meaghan. Pursuing a PhD is a privilege and I am eternally grateful for the support that Meaghan has provided to me over the duration of my studies. When we began this journey, there was just the two of us. But over the journey our family became wonderfully more complicated - adding two beautiful children Liam and Owen. It is theirs and your love and compassion above all that provided the enduring foundation upon which this dissertation was written.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1 – Introduction

1.0 Introduction

The automotive industry has experienced significant disturbances over its long history. In the 1930s the industry was the site of violent and prolonged battles with labour movement and union organizers. Through depressions and recessions the automotive industry has been subject to the whims of economic cycles—booms and busts. Then in the 1970s the automotive industry was hit hard with oil crises and concerns over national security and fuel economy, followed closely by a national furor and government regulations regarding safety and smog-producing emissions. Throughout, North American automotive firms faced increasing threats from Japanese and other foreign competitors. What is most striking about these disturbances is that while automotive firms responded to them with new management practices and technologies, not only did the disturbances persist, but the North American automotive firms continued to be challenged by these disturbances. This research asks how firms build and further develop capabilities that permit adaptation to such persistent disturbances.

The literature on dynamic capabilities offers a strong starting point. Dynamic capabilities research addresses how firms respond to environmental change (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000; Winter, 2003; Helfat, et al 2007). Dynamic capabilities have been defined as a firm's "ability to integrate, build, and reconfigure internal and external competencies" to address changing environments (Teece, Pisano, and Shuen, 1997: 516). However, despite a robust understanding of how dynamic capabilities are influenced by different *dimensions* of environmental dynamism (eg. velocity), scholars have not explained how dynamic capabilities develop in the presence of different *configurations* or patterns of environmental dynamism, such as persistent disturbances.

To address this theoretical gap, I conducted a longitudinal, historical case study, analyzing Ford, Chrysler, and General Motors (GM) within the North American automotive industry between 1965 and 2010. I supported my study with a unique archival dataset comprising automotive firm annual reports, firm and industry analysis, Compustat data, and other data in order to construct rich case histories pertaining to how firms responded to the persistent disturbances in their environment. This longitudinal view permitted me to study how firms developed dynamic capabilities over time in response to persistent disturbances.

Guided by my data analysis, I focused on five persistent disturbances in the North American automotive context: economic cycles, labour disruptions, energy challenges, competitive pressures, and government regulations. I further focused on how firms built dynamic capabilities to adapt their manufacturing operations in response to three persistent manufacturing implications which resulted from the five persistent disturbances I found. The persistent manufacturing implications facing North American automotive firms were fluctuating consumer demand for vehicles, fluctuating consumer model preferences, and profit margin pressures. I found that firms addressed these persistent manufacturing implications over time by developing distinct dynamic capabilities in manufacturing flexibility. Figure 1 offers an organizing framework graphically depicting how persistent disturbances, persistent manufacturing implications, and dynamic capabilities relate to one another.

Figure 1 From Persistent Disturbances to Dynamic Capabilities

Three main findings emerged from my research. First, my research stressed the importance of incorporating not only *dimensions* of environmental dynamism such as velocity, but *configurations* of environmental dynamism. By configurations I am referring to patterns of environmental dynamism such as *environmental shifts,* which involve dramatic or discontinuous change to a firm's environment, and *ongoing environmental change,* which describes environments in a constant state of flux or churn. I focused my research, however, on an important third configuration of environmental dynamism called persistent disturbances, which I defined as *repeated temporary events confronting firms.*

Second, my research highlighted the importance of dynamic capability architecture, which refers to how capabilities relate to one another. By examining in detail the dynamic capabilities associated with manufacturing flexibility that developed over 45 years, I discerned that the dynamic capability architecture of manufacturing flexibility comprised a family of dynamic capabilities, which in turn comprised layers of capabilities that changed over time. This highly layered capability architecture serves a critical function in explaining how similar dynamic capabilities can function so differently.

Finally, building on my insights into dynamic capability architecture, my research shed light on how dynamic capabilities develop over time. I found that in environments characterized by persistent disturbances, instead of building dynamic capabilities in response to uncertainties and unknowns, firms built dynamic capabilities in response to repeated and predictable disturbances. Firms develop their dynamic capabilities by building entirely new dynamic capability layers and by adding or modifying the capabilities that functioned as building blocks supporting a dynamic capability. Development proceeds from early periods of coping, as firms struggle with deploying dynamic capabilities that exhibit poor technical fitness with respect to the type of change required, to periods in which the dynamic capabilities exhibit high technical fitness and are well adapted to the demands of the persistent disturbances.

This thesis is presented in six chapters. In the next chapter I review literature on dynamic capabilities and environmental dynamism, clearly articulating the gaps with respect to how dynamic capabilities research addresses environmental dynamism. In subsequent chapters, I review my case-based methodology, describing my research context, data sources, and data analysis, and present my findings. I organize the presentation of my findings by describing the history of the five persistent disturbances I found in the North American automotive context, three persistent manufacturing implications, and subsequently how the automotive firms developed dynamic capabilities in response. Following this I analyze these findings, building theory and formal propositions pertaining to how firms originate, develop, and deploy dynamic capabilities. Finally, I discuss my findings, clarify my contributions, and close by offering opportunities for future research into dynamic capabilities.

Chapter 2 – Literature Review

2.0 Literature Review

2.1 Dynamic Capabilities

Formal definitions of dynamic capabilities are plentiful. The earliest was proffered by Teece, Pisano, and Shuen (1997: 516), who described dynamic capabilities as the "ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments." Eisenhardt and Martin (2000: 1107) extended the definition to incorporate the ability of firms to initiate change, defining dynamic capabilities as "the firm's processes that use resources…to match and even create market change." These "firm processes" refer to routines that permit the integration, reconfiguration, acquisition, and release of resources in response to changing markets (Eisenhardt and Martin, 2000). Further, in a recent book taking stock of dynamic capabilities research to date, dynamic capabilities were defined as "the capacity of an organization to purposefully create, extend or modify its resource base, and consists of patterned and somewhat practiced activity" (Helfat et al 2007: 121).

While differing in some details, these definitions collectively highlight critical features of dynamic capabilities. First, prior literature has situated dynamic capabilities within a hierarchy of capabilities. Dynamic capabilities modify lower-order ordinary capabilities and resources (Helfat and Peteraf, 2003; Teece, Pisano, and Shuen, 1997; Collis, 1994; Winter, 2003; Salvato and Rerup, 2011). Ordinary capabilities are those that firms use in their day-to-day operations (Winter, 2003). They constitute a firm's ability to execute day-to-day tasks (Pavlou and El Sawy, 2011) and produce outputs of a particular type (Helfat and Peteraf, 2003). Dynamic capabilities permit firms to create new combinations of these ordinary capabilities (Pavlou and El Sawy, 2011). For example, product development processes or routines are higher-order dynamic capabilities that are employed to reconfigure the types of products a firm manufactures or the services the firm offers (Danneels, 2008). This reconfiguration involves creating, modifying, repurposing, and releasing a firm's internal (Eisenhardt and Martin, 2000; Danneels, 2010; Danneels, 2008) and external resources (Lichtenthaler, Ernst, and Hoegel, 2010; Capron and Mitchell, 2009).

Second, dynamic capabilities aim to achieve and maintain fit with a firm's changing external environment (Teece, Pisano, and Shuen, 1997; Helfat et al, 2007). Thus, dynamic capabilities address how firms deal with the environmental dynamism that threatens to make their existing capabilities obsolete (Winter, 2003; Tushman and Anderson, 1986). In this respect dynamic capabilities draw heavily on early contingency theory arguments that emphasize the importance of firms developing capabilities that are appropriate for a given environment (Pfeffer and Salancik, 1978). Environmental dynamism is at the core of dynamic capabilities, driving the very need to develop dynamic capabilities (Wang and Ahmed, 2007).

Third, dynamic capabilities are practised, patterned, and purposeful responses to environmental change. Similar to ordinary capabilities, dynamic capabilities imply that an organization can perform an activity in a reliable and satisfactory way (Helfat and Winter, 2011). Helfat and co-authors (2007) describe dynamic capability as a capacity, stressing that the performance of the capability must exceed some minimum threshold of proficiency. The dynamic capabilities literature argues that change due to dynamic capabilities should be distinguished from "ad hoc problem solving" (Winter, 2003:992). The latter refers to change that is not routine or patterned and that is often undertaken in response to unpredictable events (Winter, 2003: 992). In short, not all change to a firm's ordinary capabilities is a result of dynamic capabilities. Capabilities can change in an ad hoc manner as discussed above, but Helfat and Peteraf (2003) also stress that a firm's ordinary capabilities can also change in non-routine ways through what they articulate as a capability life cycle.

Dynamic capabilities draw from both the resource-based view of the firm and evolutionary economics (Di Stefano, Peteraf, and Verona, 2010; Barney, 1991; Nelson and Winter, 1982). From a resource-based perspective, dynamic capabilities were originally conceptualized to redress a gap in the ability of the resource-based view to explain sustainable competitive advantage in dynamic, Schumpeterian environments (Teece, Pisano, and Shuen, 1997). These are environments in which existing competences are destroyed, requiring the development and elaboration of new competences. Scholars adopting the resource-based view emphasize that dynamic capabilities are a critical component of a firm's ability to renew its competitive advantage over rivals, often through wholesale change and dramatic transformations (Rosenbloom, 2000; Tripsas and Gavetti, 2000).

From an evolutionary economics perspective, dynamic capabilities are hierarchically nested routines. In this view, a firm's zero-level routines are the ordinary capabilities that permit firms to make a living in the here and now. Dynamic capabilities are higher-order routines or capabilities that extend, modify, or create lower-order capabilities (Zollo and Winter, 2002; Winter, 2003; Danneels, 2008). This routine-based perspective clarifies that dynamic capabilities are built deliberately in areas where the need for regular change is strong and the benefits of building such a capacity outweigh its maintenance costs (Winter, 2003). This conceptualization of dynamic capabilities often emphasizes continuous, routine change.

There is much debate as to whether dynamic capabilities directly provide competitive advantage for organizations. Whether dynamic capabilities simply permit firms to reconfigure their resources, or whether they are also tied intimately to firm performance and sustainable competitive advantage, remains a matter of debate (Easterby-Smith, Lyles and Peteraf, 2009). Research by Teece and colleagues claims that dynamic capabilities contribute to competitive advantage (Teece, Pisano, and Shuen, 1997; Teece, 2007), while Shamsie, Martin, and Miller (2009) found no relationship between dynamic capabilities and firm performance in a sample of project-based firms. Research that makes performance claims has been accused of committing a tautology—defining dynamic capabilities in terms of the desired performance outcomes (Priem and Butler, 2001; Arend and Bromiley, 2009). The emerging consensus is that dynamic capabilities do not directly contribute to a firm's performance or its competitive advantage; instead dynamic capabilities permit a firm to manipulate its resources (Helfat et al 2007). Dynamic capabilities are a source of competitive advantage when "applied sooner, more astutely, and more fortuitously than competitors" (Eisenhardt and Martin, 2000: 1117; Wang and Ahmed, 2007).

While there is substantial theory pertaining to dynamic capabilities (eg. Teece, Pisano, and Shuen, 1997; Teece, 2007; Helfat et al, 2007), part of the challenge for scholars is that empirical research into dynamic capabilities remains nascent (Newbert, 2007; Barreto, 2010; Danneels, 2010; Helfat and Peteraf, 2009). Recently, research has begun to fill the void and provide the field with more substance. I provide empirical examples of different types of dynamic capabilities in Table 1 (an extended review of empirical dynamic capabilities research can be found in table A2 in the Appendix). These dynamic capabilities can be loosely grouped into dynamic capabilities that address relationship management, organizational structure, product and service development, and general management.

Table 1 Examples of Dynamic Capabilities

Topic	Examples
Relationship Management	• Alliance management (Anand, Oriani, and Vassolo, 2010; Kale and Singh, 2007; Schilke and Goerzen, 2010)
Organizational Structure	• Architectural innovation (Galunic and Eisenhardt, 2001) • Resource divestment (Moliterno and Wiersema, 2007) • Resource allocation (Coen and Maritan, 2011) • Diversification (Doving and Gooderham, 2008; Dixon, Meyer, and Day, 2010) • Foreign expansion (Luo, 2002)
Product and Service Development	• Research and development (Danneels, 2008; Helfat, 1997) • New product development capabilities (Henderson and Clark, 1990; Eisenhardt and Tabrizi, 1995)
General Management	• Dynamic managerial capabilities (Adner and Helfat, 2003)

Given the breadth of possible dynamic capabilities, Helfat et al (2007) encourage scholars to clearly and precisely specify the nature of a dynamic capability under analysis. Discussing dynamic capabilities with greater precision provides managers and academics with a stronger understanding of what dynamic capabilities are and, more important, what can be done to further develop them. Even still, much research into dynamic capabilities pertains to what are clearly very general dynamic capabilities, such as learning, knowledge transfer (Galunic and Rodan, 1998; Leonard-Barton, 1992; Zander and Kogut, 1995), integrative capabilities (Brown and Eisenhardt, 1997; Henderson and Cockburn, 1994), and absorptive capacity (Zahra and George, 2002). Marcus and Anderson (2006: 19) argue that general dynamic capabilities involve "searching for new ideas and methods, comparing company practices to the best in the industry, evaluating practices in other industries, and experimenting." Critics of this approach argue that these dynamic capabilities are described much too generally. They suggest that attempting to hedge against all contingencies by building general dynamic capabilities generates costs and complexity that may exceed the benefits provided by dynamic capabilities (Winter, 2003; Drnevich and Kriauciunas, 2011). Winter (2003) goes further, stating that there is no such thing as a general-purpose routine for dynamic change.

Scholars have also sought to understand the mechanisms that undergird dynamic capabilities. This work is still in its infancy (Moliterno and Wiersema, 2007). However, consensus has emerged that two broad mechanisms are at play: one for *sensing, search, and selection* and another for *reconfiguration and deployment* (Teece, 2007; Helfat et al, 2007). Sensing, search, and selection refer to the capabilities of firms to identify and take advantage of threats and opportunities in the environment (Teece, Pisano, and Shuen, 1997). For example, firms need to identify what new products and services they should produce for a given set of environmental changes before they can reconfigure their resources in response. An accurate understanding of a firm's resources, including their fungibility (Danneels, 2010; Dixon et al, 2010), is also important to the development of dynamic capabilities. Schreyogg and Kliesch-Eberl (2007) argue that firms must be capable of monitoring their own capabilities. Thus dynamic capabilities involve a significant decision-making component (Helfat et al, 2007). The second mechanism, reconfiguration and deployment, refers to the various ways in which firms create, extend, and modify their resource base. In the next section I discuss how firms build and develop dynamic capabilities.

2.2 The Origins and Development of Dynamic Capabilities

Dynamic capabilities are not readily purchased; they must be built, maintained, and developed by the firms that possess them. This is not a trivial challenge. It requires that firms make long-term commitments (Teece, Pisano, and Shuen, 1997). It follows that there is no single development path for dynamic capabilities. Instead, different paths are effective for different types of dynamic capabilities and in different contexts. In a study of Indian and Pakistani firms, Malik and Kotabe (2009) found that three capabilities formed the foundation for the dynamic capabilities they were studying. These included organizational learning through experience, reverse engineering in order to gain valuable product knowledge, and manufacturing flexibility in order to improve integration and coordination processes. Similarly, scholars have identified that a firm's idiosyncratic incumbent capabilities or "positions" directly influence the development of dynamic capabilities. These positions include technological, complementary, reputational, and structural resource endowments (Teece, Pisano, and Shuen, 1997). For instance, studies have found that prior experience (King and Tucci, 2002) and capability strengths (Wernerfelt, 1984) play significant roles in how a firm develops its capabilities. Firms are found to diversify and develop along firm strengths. Lavie (2006) extends this logic, arguing that large gaps between a firm's desired and existing capabilities lead the firm to acquire or substitute new capabilities in lieu of evolving or developing existing capabilities.

Sensing capabilities, a critical component of the processes or routines that undergird dynamic capabilities, also play an important role in the initial and ongoing development of dynamic capabilities. Sensing capabilities permit a firm to identify new development paths (Teece, Pisano, and Shuen, 1997) as well as provide an accurate understanding of the firm's existing capabilities, which can inform further development (Lavie, 2006; Capron and Mitchell, 2009). Danneels (2008) found that many organizational antecedents of dynamic capabilities are within managerial control. He cited slack resources, environmental scanning, willingness to cannibalize, and constructive conflict as factors that positively influence the development of dynamic capabilities.

Recent research has begun to discuss capability development in terms of life cycles (Keil, McGrath, and Tukiainen, 2009). This body of work argues that capabilities, like products or organizations, move through life cycles from founding through development and maturity (Helfat and Peteraf, 2003). As the capability proceeds through the life cycle, events can arise that are strong enough to alter the development trajectory of that capability. Helfat and Peteraf (2003) call these events *selection events*. Selection events are external to the capability but not necessarily the firm. Selection events can be as simple as a change of managerial priorities or a difficulty in obtaining critical raw materials. Following a selection event, a capability branches, developing in different ways. Helfat and Peteraf (2003) discuss six such development paths, encompassing retirement, retrenchment, renewal, replication, redeployment, and recombination. Dynamic capabilities, in that they are capabilities themselves, are also theorized to follow a life cycle (Helfat and Peteraf, 2003).

Underlying much of the development of dynamic capabilities are models of how organizations learn. While some learning can occur through passive experience accumulation, most of the learning associated with dynamic capability development is conceptualized as being intentional and deliberate (Zollo and Winter, 2002; Romme, Zollo, and Berends, 2010). Learning occurs through processes of knowledge articulation whereby knowledge is shared and communicated as well as knowledge codification which involves deliberate actions to develop useful repositories for knowledge such as manuals and reports (Zollo and Winter, 2002). Dynamic capability development must balance this knowledge articulation and knowledge codification must strike a balance between permitting firms to exploit this knowledge and allowing firms to explore new knowledge (March, 1991). Beyond what is highlighted in the above discussion, there is sparse treatment in the literature regarding how dynamic capabilities are built, developed, and maintained. However, some research effort has examined capability development more generally. Since dynamic capabilities are themselves capabilities, the insights from this more general research can be productively applied to dynamic capabilities. There are two broad views on capability development. The first conceptualizes capability development as emergent and gradual (Helfat and Raubitschek, 2000; Galunic and Eisenhardt, 2001). Firms build on prior successes and strengths, as well as close gaps or improve underperforming capabilities (Shamsie, Martin, and Miller, 2009). In this way, capabilities are built up from repeated interactions over time (Ethiraj et al, 2005). Capabilities are also developed deliberately and strategically through investments in critical infrastructure, systems, and processes (Ethiraj et al, 2005; Winter, 2003). Lavie (2006) views capability development as occurring at multiple levels of analysis: at the level of the portfolio of capabilities through substitution, at the level of capabilities through transformation, and at the level of routines through evolution.

2.3 Dynamic Capabilities and Environmental Dynamism

While differing in some details, definitions of dynamic capabilities highlight that their central purpose is to achieve and maintain fit with a dynamic environment (Helfat et al, 2007). Teece, Pisano, and Shuen (1997: 516) describe dynamic capabilities as the "ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments." Eisenhardt and Martin (2000: 1107) extended the definition to incorporate the ability of firms to initiate change, defining dynamic capabilities as "the firm's processes that use resources…to match and even create market change." These arguments flow from a long tradition of literature on fit and contingency between a firm and its environment (Lawrence and Lorsch, 1967; Pfeffer and Salancik, 1978; Pfeffer, 1982).

Despite the centrality of environmental dynamism to dynamic capabilities, a significant amount of research in dynamic capabilities is agnostic to the role of environmental dynamism. A review of the literature highlights that when researchers do incorporate environmental dynamism, it is most frequently viewed as a precursor to dynamic capabilities. What has been discussed as important is the *degree* of dynamism (Barreto, 2010). Highly dynamic environments drive the development of firms' dynamic capabilities (Wang and Ahmed, 2007) and justify the expense of developing dynamic capabilities (Winter, 2003). Eisenhardt and Martin (2000) further argue that the degree of dynamism influences the nature of the dynamic capabilities that firms build. In moderately dynamic environments, dynamic capabilities take the form of routines, while in highly dynamic environments, dynamic capabilities resemble simple rules or heuristics. In the next section I discuss environmental dynamism in more detail, highlighting three configurations of environmental dynamism that I argue are critical to studying dynamic capabilities.

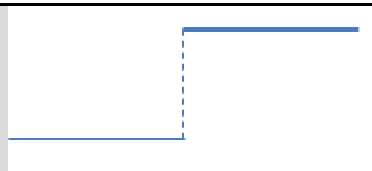
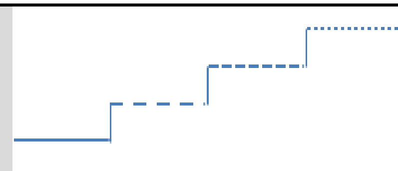
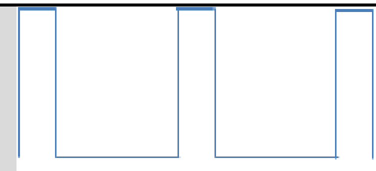
2.3.1 Environmental Dynamism

Environmental dynamism, in the simplest of terms, pertains to change in a firm's external environment. Environmental dynamism destabilizes a firm's competitive environment and is associated with heightened uncertainty that makes accurately understanding external environments challenging (Sirmon, Hitt, and Ireland, 2007; Milliken, 1987; Duncan, 1972). As a construct, environmental dynamism is often loosely defined and conceptualized along a uni-dimensional continuum from stability to ever greater dynamism. Despite this unidimensionality, scholars have attributed a wide variety of different characteristics to environmental dynamism, such that environments can be dynamic in many different ways (Duncan, 1972; Dess and Beard, 1984).

A recent study has summarized the body of research on environmental dynamism into a four-dimensional construct comprising unpredictability, ambiguity, complexity, and velocity (Davis, Eisenhardt, and Bingham, 2009). *Unpredictability* describes environments with little to no perceivable pattern. *Ambiguity* refers to the clarity with which environments can be interpreted and understood. *Complex* environments are characterized by interconnections among different facets of the firm's environment, such as from regulatory, competitive, and economic sources. Finally, *velocity* refers to the rate at which firms are presented with new opportunities (Eisenhardt, 1989) or face challenging disturbances.

While environmental dynamism comprises multiple dimensions, organizational scholars commonly conceptualize dynamic environments in terms of configurations of these dimensions. By configurations I mean recognizable patterns of environmental dynamism. Prior literature has emphasized two such configurations: environmental shifts and ongoing environmental change. Environmental shifts consist of a period of stability punctuated by dramatic, discontinuous, stepped change (Tushman and Anderson, 1986). In contrast, ongoing environmental change describes an environment undergoing continuous and unrelenting change (D'Aveni, 1994). My study is particularly interested in a third configuration of environmental dynamism, which I call persistent disturbances. Persistent disturbances constitute a pattern of repeated related disturbances that manifest over long periods of time. Below I discuss each configuration in turn, distinguishing them from one another (see Table 2).

Table 2 Configurations of Environmental Dynamism

Dimensions	Environmental Shifts	Ongoing Environmental Change	Persistent Disturbances
Graphically			
General Description	Dramatic, discontinuous environmental change	Continual environmental change	Specific aspects of environmental change are repeated
Example	Shift from mechanical to electronic typewriters	Semi-conductor industry, constant churn	Automotive industry, perennial problems
Severity of Change	Large, dramatic change	Small changes; unstable industry structure	Constrained change; aspects of change fixed or anchored
Dynamism: Unpredictable	Rarely predictable; no pattern in environmental dynamism	No pattern in environmental dynamism	Some pattern in environmental dynamism
Dynamism: Ambiguity	Highly ambiguous; difficult to understand shift early on	Highly ambiguous; difficult to make sense of shifting landscape	Diminishing ambiguity; repetition diminishes ambiguity surrounding disturbance
Dynamism: Complexity	Yes; multiple contingencies can create conditions for discontinuous change	Yes	Yes; multiple persistent disturbances
Dynamism: Velocity	Two gears: generally slow pace of change prior to and following shift; relatively rapid during shift	Fast; rapid pace of change	Slow or fast; velocity not especially relevant
Representative Authors	Punctuated Equilibrium (Gersick, 1991; Tushman and Anderson, 1986)	Hypercompetition (D'Aveni, 1994; Brown and Eisenhardt, 1997; Eisenhardt and Tabrizi, 1995)	Jolts (Meyer, 1982)

Environmental Shifts

Environmental shifts are dramatic or discontinuous environmental changes to a firm's environment. They occur infrequently and rarely repeat. This configuration of environmental dynamism can be driven by a number of factors. Scholars have studied environmental shifts due to disruptive technologies (Tushman and Romanelli, 1985), new competitors (Sirmon, Hitt, and Ireland, 2007), and major regulatory or political regime changes (Oliver and Holzinger, 2008; Dixon, Meyer, and Day, 2010; Pettus, 2001). For example, an environmental shift in the transition from mechanical to electronic products threatened the long-term viability of a number of firms and industries, including those manufacturing mechanical typewriters (Danneels, 2010). Similarly, Dixon, Meyer, and Day (2010) studied dramatic political and economic shifts in transition economies as they transformed from state-run to competitive-market economies.

Driven largely by their discontinuous nature, environmental shifts are rarely predictable and they often take organizations by surprise. While it is common knowledge that environmental shifts are possible, the exact nature and timing of the shifts are difficult to reliably predict. Further, because they are singular events with which firms will have had little experience, environmental shifts can be difficult to understand and interpret as they are emerging. This ambiguity is heightened when one considers that environmental shifts are often caused by a complex interaction of seemingly unrelated events combining in new and novel ways (Anderson, 1999). Environmental shifts often make more sense from a historical perspective once the shift is complete. The velocity of an environmental shift has two paces: a slow, measured pace prior to and following the environmental shift that is itself, typically relatively rapid. This two-pace pattern closely resembles that of punctuated equilibrium models of change (Tushman and Romanelli, 1985; Tushman and Anderson, 1986; Sastry, 1997; Gersick 1991). In these models, environments change from equilibrium to equilibrium.

Ongoing Environmental Change

Ongoing environmental change describes an environment that is in a state of constant flux or churn. The causes of this churn can include new competitors, technologies, or products. Firms are required to continuously evolve their basis of competitive advantage (Burgelman, 1994). Scholars have studied continuous and unrelenting pressures to reduce costs (Pablo, Reay, Dewald and Casebeer, 2007), and rapid innovation in products (Lee, Venkatraman, Tanriverdi, and Iyer, 2010) and product markets (Galunic and Eisenhardt, 2001; Rindova and Kotha, 2001). Ongoing environmental change is akin to hypercompetition (D'Aveni, 1994; Wiggins and Ruefli, 2005; Lee et al, 2010) or environmental turbulence (Easterby-Smith, Lyles, and Peteraf, 2009). The semi-conductor industry is often held up as an example of ongoing environmental change due to its high rate of technological and product innovation.

Ongoing environmental change is difficult to predict because firms are confronted with a series of unique challenges. Given the high state of flux, there are no readily identifiable patterns in the ongoing change. Further, since the environment is always changing, the incremental changes are highly ambiguous, making them difficult to understand. By the time a firm has made sense of its changed environment, the environment is changing again. The pace of change is of central importance in ongoing environmental change and can be very rapid.

Persistent Disturbances

Most studies conceptualize environmental dynamism either as environmental shifts or as ongoing environmental change. However, I argue that neither of these configurations fully captures the nature of the environmental dynamism that many firms experience. I argue that firms are often challenged not by a changed or changing environment, but by similar disturbances that repetitively affect the firm month after month and year after year. Good examples include economic cycles, changing customer fads, and fluctuations in customer demand. A third configuration of environmental dynamism that I call persistent disturbances, captures these repeated and patterned disturbances.

I define persistent disturbances as *repeated temporary events confronting firms*. By temporary, I mean that the disturbances do not bring permanent change to the environment. The impact of the disturbance is felt over a relatively short period of time and then dissipates. However, while each individual disturbance is temporary, such disturbances cumulatively affect the organization over a long period of time by repeating at either regular or randomly irregular intervals.

A small subset of prior literature has touched on concepts similar to persistent disturbances, albeit from different perspectives. In a classic study, Meyer (1982) introduced the concept of a *jolt*. Like disturbances, jolts are "transient perturbations whose occurrences are difficult to foresee and whose impacts on organizations are disruptive." However, in his work on jolts, Meyer focused on a single discrete jolt or disturbance, and not a series of repeated disturbances. Another related concept is that of *issues*. Issues are events or developments that organization members identify as having some important consequences to their firm (Dutton and Dukerich, 1991). While repeating over time, issues, unlike disturbances, are heavily influenced by the way in which organizational members make sense of them. Finally, the organizational resilience literature employs the concept of *adversity* or threats that challenge firms (Sutcliffe and Vogus, 2003). While these ideas form a foundation to better understand persistent disturbances, they have not been developed within the context of dynamic capabilities.

In terms of the four dimensions of environmental dynamism, persistent disturbances are distinct from the other two forms of change. First, they exhibit relatively predictable patterns of environmental change. Unlike studies of rare events (eg. Lampel, Shamsie, and Shapira, 2009; Rerup, 2009), studies of persistent disturbances focus on common disturbances. Disturbances repeat and that repetition means that the subsequent changes are easier to anticipate or predict. That same repetition means that persistent disturbances are less ambiguous. The repetition of relatively similar disturbances provides firms with greater opportunity to learn about and to better understand the disturbances. Persistent disturbances exhibit significant complexity when multiple such disturbances manifest concurrently. The greater the number of persistent disturbances facing a firm, the greater the complexity as these persistent disturbances interact.

2.4 Dynamic Capabilities and Configurations of Environmental Dynamism

Research has not theorized explicitly regarding a relationship between different configurations of environmental dynamism and the nature of dynamic capabilities that firms build. I argue that this is because scholars have tended to focus their studies on only one configuration of environmental dynamism at a time—either environmental shifts or ongoing environmental change. For instance, studies may examine environmental shifts, such as the transition from mechanical typewriters to electronic-based office equipment (Danneels, 2010; Rosenbloom, 2000), or the impact of radical technological developments like microprocessors (Burgelman, 1991; 1994), radial tire technology (Sull, 1999), and digital photography (Tripsas and Gavetti, 2000). Still other studies investigate how firms renew capabilities (Capron and Mitchell, 2009), enter new markets (King and Tucci, 2002), and make effective investment decisions (Shamsie, Martin, and Miller, 2009) in the face of rapid and ongoing change.

However, looking across studies, I found that how scholars describe dynamic capabilities differs according to the configurations of the environmental dynamism found in the study's context (see Table 2). Scholars studying environmental shifts describe dynamic capabilities that reflect the need for firms to prepare for a variety of scenarios to effectively respond to an environment that has become dramatically different following an environmental shift. These dynamic capabilities are also more oriented towards sensing, geared at identifying future possibilities. They are developed in anticipation of and deployed during and following an environmental shift. In contrast, scholars studying ongoing environmental change describe dynamic capabilities as being associated with highly routinized change processes. These processes continuously evolve a firm's underlying capabilities, matching ongoing environmental dynamism with ongoing organizational change. They are built in advance of, or in conjunction with, the emergence of a dynamic environment. The development of these types of dynamic capabilities is ongoing and continuous, such that higher-order dynamic capabilities modify lower-order dynamic capabilities (Collis, 1994; Winter, 2003). While scholars describe dynamic capabilities in different configurations of environmental dynamism, they have yet to incorporate those differences theoretically.

This review identifies two avenues to further develop dynamic capability theory. First, the dynamic capabilities literature has focused on *dimensions* of environmental dynamism and has paid little attention to the role of *configurations* of environmental dynamism. Second, there have been few empirical studies illuminating the development of dynamic capabilities (Shamsie, Martin, and Miller, 2009; Ethiraj et al, 2005; Narayanan, Colwell, and Douglas 2009). Thus, despite the central role of environmental dynamism to dynamic capabilities, we know surprisingly little about how environmental dynamism influences dynamic capability development. The need for research in this regard is reinforced by calls for increased adoption of longitudinal methods when studying dynamic capabilities (Easterby-Smith et al, 2009; Danneels, 2008). This study takes aim at these gaps in the dynamic capabilities literature, asking *how dynamic capabilities develop over time in the presence of a particular configuration of environmental dynamism—persistent disturbances*.

Chapter 3 – Methodology

3.0 Methodology

3.1 Case Study Approach

I have adopted a case study methodology to address the research question above with the aim of inductively building new theory and elaborating existing theory regarding how firms respond to disturbances (Eisenhardt, 1989; Yin, 2009). I situate my study within the North American automotive industry and focus on three key firms: The "Big Three" automotive manufacturers—GM, Chrysler, and Ford. My case study adopts a historical focus, commencing in 1965 and extending through to 2010. I compiled qualitative and quantitative data from archival sources including annual reports and firm and industry analysis.

I have adopted a case study method because the case method lends itself well to building new theory and elaborating existing theory (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Lee, Mitchell, and Sablynski, 1999; Yin, 2009). While dynamic capabilities have received attention in the field of strategic management, new, empirically derived theory is still needed to address how dynamic capabilities are built and developed. At least one scholar has called for longitudinal studies to improve scholarly understanding of how dynamic capabilities develop (Danneels, 2008). Case study analysis is highly amenable to addressing "how" type research questions because case analyses permit and even demand a focus on process and a strong contextual understanding (Pettigrew, 1990; Yin, 2009; Pratt, 2009).

My study focuses on the time period between 1965 and 2010. I have focused on historical rather than contemporary events owing to a desire to understand the processes of dynamic capability development over long periods of time. I chose this time period because it encompasses the major disruptions affecting the automotive industry that began in the 1970s, including oil crises, major regulatory invasions, and the emergence of environmental and safety concerns. While contemporary case studies benefit from the ability to examine events as they unfold, historically focused cases benefit from hindsight and refined accounts of historical occurrences.

In designing the study I identified my unit and level of analysis and incorporated these decisions into how I collected and analyzed my data. My level of analysis is the firm; I aim to understand the firm's responses to the disturbances they face. However, my unit of analysis is a disturbance. In this research, my variance comes from studying different persistent disturbances across a homogenous group of organizations.

3.2 Research Context

I chose my research context based on the principles of theoretical rather than random sampling (Eisenhardt, 1989). I elected to study a single industry so as to control for extraneous variation that may exist among firms in multiple industries (Eisenhardt, 1989). However, this single-industry focus also strengthened my understanding of the automotive context. A strong contextual understanding is critical when studying organizational change processes (Pettigrew, 1990) and capabilities, which can be context-specific (Ethiraj et al, 2005). Studying a single industry allowed me to devote sufficient time to understanding the complex social, ecological, political, cultural, and economic processes of a particular industry more deeply and over a longer period of time (Yin, 2009). Finally, a single-industry focus also facilitates comparisons among multiple organizations (Fox-Wolfgramm, Boal, and Hunt, 1998).

I situated my study in the North American automotive industry. This industry has been the site of a broad range of societal, economic, political, and environmental disturbances over its long history, including labour disputes, regulations pertaining to environmental and safety standards, and oil price fluctuations. The presence of these disturbances makes it a suitable context in which to study how firms respond to disturbances. The automotive industry also has a long and well-documented history, which is an important consideration in selecting a context, and in particular when dealing with long historical time periods (Yin, 2009). My case study of the automotive industry was made feasible by the attention the industry has attracted over its history.

I chose to study three automotive manufacturers: GM, Ford, and Chrysler. A critical reason for these choices is the depth of history each of these firms possess in North America. The founding of each of these firms dates back to the turn of the 20^{th} century. This temporal depth provided me with the ability to study these firms' responses to disturbances over a long period of time. Throughout their history, these three firms have formed an oligopoly that has dominated the North American market, collectively possessing greater than 90% market share right up until the 1980s, when their dominance began to be eroded by Japanese competition. As a result, much about these firms is well documented. They have readily accessible annual reports and are discussed by analysts in a majority of the reports pertaining to the North American automotive industry. My focus on this oligopoly meant the exclusion of the fourth and only other North American automotive firm in existence throughout my study period - American Motor Corporation (AMC). However data on its operations were difficult to obtain first because such data were sparse and inconsistent but also because AMC was acquired by Chrysler in 1987. I also excluded foreign firms such as Toyota and Volkswagen from my study because they appear 10 to 20 years into my story, and data pertaining to these firms were not as readily available.

3.2.1 North American Automotive Firms

Below I briefly discuss the long history of each of the automotive firms in my study.

Ford was founded in 1903 by Henry Ford with a vision of providing mobility for the masses. Ford's early focus was on low-cost automobiles that were relatively simple to use and maintain. To support this aim, Ford invented and elaborated early large-scale assembly lines that served as the foundation for today's modern manufacturing firms. A distinguishing feature of Ford is that the Ford family has maintained control of the firm for more than 100 years. Ford's revenues during the study period have always trailed those of GM, placing Ford a consistent but distant second place. However, Ford's profitability has regularly exceeded that of GM, particularly in the late 1990s and periodically into the 2000s. Ford is an international company with operations across the globe. Ford established their European presence early through Ford of Europe. Ford offers vehicles through 3 brands: Ford, Mercury, and Lincoln.

General Motors was founded in 1908 by William Durant. In stark contrast to Ford, GM based their success on providing differentiated products, producing “a car for every purse and purpose.” GM operated more as a holding company of differentiated brands that Durant acquired and loosely integrated. GM has dominated the North American automotive industry in terms of revenues over most of its history, and for the entire period of this study. Historically GM has been a large firm with an employee base twice that of Ford and three times that of Chrysler. Recently, however, GM’s labour force has been reduced to 243,000, close to the size of Ford’s at 213,000. GM established their international presence early with the acquisition of Germany’s Opel in 1929. GM’s current North American brands include Buick, Cadillac, GMC, and Chevrolet, having recently divested of their Pontiac, Saturn, Saab, and Hummer brands. In June of 2009, GM entered bankruptcy protection, and with the help of the US and Canadian governments, emerged one month later on more financially sound footing.

Finally, **Chrysler** was founded in 1925 following a reorganization of the Maxwell Motor Company and was renamed in honour of Walter Chrysler, a significant figure in North American automotive history. While Chrysler has consistently lagged behind GM and Ford in terms of revenues and profitability, Chrysler has often led the industry in innovative technologies and vehicles, such as the minivan. However, Chrysler has had more than their share of financial difficulties, requiring government support in 1979 and again in June of 2009 owing to its bankruptcy. Throughout this time foreign firms have played important roles for Chrysler. Daimler merged with Chrysler in 1998 before divesting their interests between 2007 and 2009. More recently, Fiat has acquired a 53.5% stake in Chrysler following their 2009 bankruptcy. Chrysler has less than half as many employees as Ford and GM and sells brands through their Chrysler, Dodge, Ram, and Jeep divisions.

Despite significant homogeneity among these firms, there are some differences as well. As outlined in Table 3, Ford and GM were both founded at the turn of the century, and Chrysler followed a couple of decades later. The table also highlights that, while each of the firms is publicly held, Ford has retained a strong family holding that sets it apart. Each of the firms also has international alliances with Japanese firms.

Table 3 Overview of Case Firms

Firm	Year Founded	Ownership	Key International Alliances
GM	1908	Publicly held	Isuzu, Suzuki
Ford	1903	Publicly held; strong family holding	Mazda
Chrysler	1925	Publicly held	Mitsubishi

Differences among the firms are further highlighted by Figure 2, Figure 3, and Figure 4. Figure 2 and Figure 3 illustrate how GM led the North American market both in terms of revenues and in production volume for the majority of the study period. GM's revenues were consistently double those of Ford and many times more than those of Chrysler. GM's production share (Figure 4) was greater than the combined production share of Ford and Chrysler up until the 1990s, when GM's production share suffered dramatic decreases. However, profitability was another matter. Ford frequently achieved greater profitability than GM, especially during tumultuous periods for the industry, such as the early 1990s, the late 1990s, and the late 2000s.

Figure 2 Inflation-Adjusted Net Income

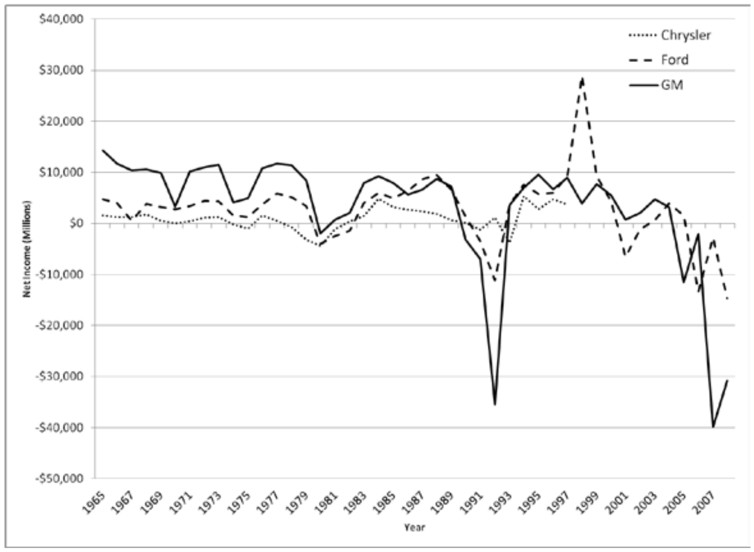


Figure 3 Inflation-Adjusted Revenues

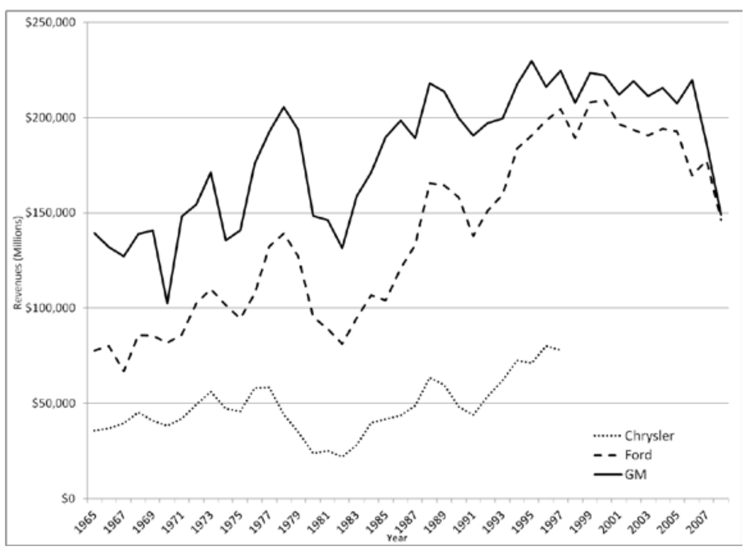
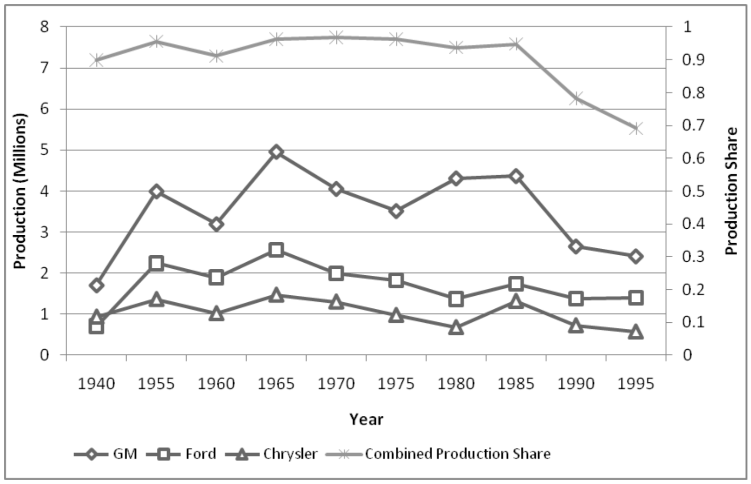


Figure 4 "Big Three" North American Production Share



3.3 Data Sources

My study employed qualitative archival data regarding the North American automotive industry between 1965 and 2010 from four data sources. These included the automotive firms' annual reports, Ward's Automotive Yearbook, Compustat, and other data sources required on an ad hoc basis. These are diverse data sources providing different information and describing events in the North American automotive industry from different perspectives. The dataset included both qualitative and quantitative data. This diversity was designed to strengthen my theorizing by allowing me to triangulate my findings using multiple data points (Jick, 1979; Eisenhardt, 1989). Specifically, I used quantitative data to validate qualitative findings through non-statistical methods. After identifying codes and themes through analysis of qualitative data, I found supporting quantitative data that both offered a more concrete understanding and also permitted me to graph these data longitudinally. Each data source is discussed below and summarized in Table 4.

Table 4 Summary of Data Sources

Data Source	Description	Location	Data Points	Volume of Text
Ward's Automotive Yearbooks	Expert firm and industry analysis regarding automotive firms	• Library collections and inter-library loans	• Expert firm-specific analysis • Production volumes split by firm, product category, vehicle prices, registrations	• 180 pages of editor summary; 157 pages of editorials on key disturbances; 337 pages of firm-specific analysis
Corporate Annual Reports	Security regulator mandated reports detailing a public firm's financial performance and other important metrics	• Edgar (1993-) at www.sec.gov • Proquest Historical Annual Reports (1844-) • Library collections and inter-library loans	• Text of the letters to shareholders	• 540 pages of letters to shareholders
Compustat	Critical business metrics for each firm	• WRDS – Compustat	• Firm revenues, profitability, capital expenditures, current ratios, employment, and other firm metrics	
Other Data Sources	Supplementing data from above with specific metrics that were identified as pertinent during the course of analysis	• National Highway Traffic Safety Administration • Environmental Protection Agency • The Federal Reserve • Department of Energy	• Safety and fatality statistics • Historical gasoline prices • Interest rates • Recessionary periods	• Dozens of spreadsheets

The use of archival data offered significant advantages for my study. Archival data permitted me to study organizational processes over my study's long 45-year historical time period; no other data source offers such a long reach into the past. My archival data also offered consistent yearly snapshots. Each of these yearly snapshots provided comparable data captured with consistent levels of detail; for the majority of the years in question, Ward's Automotive Yearbook was managed by the same editor. This permitted appropriate sequencing of events and improved the reliability of my data vis-à-vis contemporary case analysis by avoiding issues of retrospective biases that often result from the difficulty respondents have in accurately remembering past events (Golden, 1992). Below I provide additional details pertaining to the data sources I employed in this study.

3.3.1 Ward's Automotive Yearbooks

Ward's has been covering the automotive industry since 1938 and is one of the pre-eminent sources of automotive industry knowledge and insight. Each yearbook consists of hundreds of pages of textual analysis and data tables pertaining to the North American automotive industry. While the nature of the reporting changed over time, each report covers general industry trends; firm-specific analysis pertaining to Chrysler, Ford, and GM; detailed tables on production, sales, and registrations; as well as editorials detailing key government interventions, technological breakthroughs, and major industry events.

In order to make data collection and analysis of this large qualitative textual dataset manageable, I focused my attention on specific sections within the text. First, I read the 4-page editor's summary. This summary provided information pertaining to the key factors facing the automotive industry during a given year. Second, I read key editorial pieces pertaining to topics that represented major disturbances to automotive firms, such as government regulations and world events related to emissions, safety, labour, and fuel economy challenges. On average, pertinent editorial pieces constituted 3 to 4 pages of text for a given year. Third, I studied the firm-specific analysis for each of GM, Ford, and Chrysler. These sections were typically 2 to 3 pages in length for each firm and contained detailed information about the challenges the automotive firm faced during the year, major strategic actions they took, production-related decisions, and financial highlights. In summary, I read 180 pages of editor summary and 157 pages of editorials on key disturbances, and analyzed in more detail 337 pages of firm-specific analysis.

To support my qualitative analysis, I collected quantitative data from the tables within the Ward's reports. My selection of quantitative data was driven by my qualitative analysis. These data included production, registration, and sales figures split out by company and vehicle characteristics. It also included details of government regulations such as corporate average fuel economy (CAFE) standards and the per vehicle costs of regulated equipment. These quantitative data gave shape and structure to the qualitative data collected from the text, and they corroborated my findings (Jick, 1976).

3.3.2 Annual Reports – Letters to Shareholders

Annual reports are issued yearly by firms in order to communicate information to the public about the firms' activities in the past year. Annual reports have grown to include a great deal of information, including financial highlights, reports on products and operations, strategic initiatives, management discussion and analysis, and consolidated financial statements. For North American automotive firms these reports are typically 100 pages in length.

I focused my analysis of the annual reports on the letters to shareholders. Every annual report is prefaced with a letter to shareholders from the CEO or Chairman and other senior management. These letters are relatively short, consisting of approximately 4 pages each. These letters describe the major strategic initiatives, the difficulties and challenges the firm faced over the year, and how well the firm performed against stakeholder expectations. In these letters, management frequently discusses the disturbances their firm faces, and how the firm is responding (Staw, McKechnie, and Puffer, 1983). In my study, letters to shareholders provided an overview of the disturbances firms faced and of their responses to those disturbances.

Using letters to shareholders presents some difficulties. In recent years, these letters have often been prepared by public relations departments that tailor the entire annual report to convey specific messages (Barr, Stimpert, and Huff, 1992). As a result, relevant information can be selectively reported or suppressed. For instance, despite the publicity generated by the safety problems with Ford's Pinto, it did not feature prominently in the letters to shareholders in Ford's annual reports during the course of the controversy. Despite these potential biases, letters to shareholders are important vehicles for management to communicate with investors. Management often lends their pictures and signatures to the letters; and informal discussions suggest that managers spend significant amounts of time preparing communications to investors (Barr, Stimpert, and Huff, 1992). Further, there are few data sources that can provide such regular, consistent data pertaining to a firm's operations. Annual reports are written at annual intervals which alleviates retrospective biases that can hamper interviews. I triangulated insights gained from letters to shareholders with other data sources such as Ward's Automotive Yearbooks.

3.3.3 Compustat

Compustat is a database compiled by Standard & Poor's containing historical financial information on corporations. From this database I pulled basic historical financial data, including revenues, net incomes, return on sales, capital expenditure, number of employees, and current ratios, for GM, Ford, and Chrysler.

3.3.4 Ad Hoc Data Sources

During the course of data analysis I acquired additional data that had been identified as pertinent to my study. For instance, as I read about oil embargoes and oil crises, I found it useful to collect and analyze historical gasoline prices. Similarly, as the automotive industry is heavily dependent upon economic cycles, I found that data regarding recessionary periods and interest rates were useful when juxtaposed against financial and production data.

3.4 Data Analysis

Following Yin (2009), I settled on a strategy for my data analysis prior to commencing my case analysis. I approached my data analysis in three stages (see Table 5). In the first stage, I analyzed the letters to shareholders from each of the firm's annual reports and the firm-specific sections of Ward's yearbooks from 1965 to 2010, looking for and seeking to understand disturbances identified as affecting the firms under study. In the second stage, I focused on how firms responded to those disturbances, tying connections between the disturbances firms faced and the ways firms responded to those disturbances. In the final stage, I extend these analyses and built new theory and elaborated existing theory pertaining to how firms responded to disturbances, and in particular to persistent disturbances. While all stages were iterative in the sense that I returned again and again to the data for further analysis, the final stage also involved iteration between existing theory and my emerging theory (Eisenhardt, 1989; Yin, 2009).

Table 5 Data Analysis Stages

	Stage 1 – Disturbances	Stage 2 – Responses	Stage 3 – Theory Building
Stage Objectives	Identify and describe disturbances affecting the organizations	Describe firm responses to disturbances	Build and elaborate theory with respect to how firms respond to disturbances
Outputs	• Disturbance codes • Memos • Data tables	• Response codes • Memos • Data tables	• New theoretical models
Data Categories Employed	• Annual Reports (Letters to Shareholders) • Ward's Automotive Yearbooks • Compustat • Ad hoc data sources	• Annual Reports (Letters to Shareholders) • Ward's Automotive Yearbooks • Compustat	• Annual Reports (Letters to Shareholders) • Ward's Automotive Yearbooks • Compustat • Academic articles • Historical texts

Each stage was designed to accomplish distinct objectives, examine a clearly defined dataset, and culminate in outputs including qualitative codes, memos, and data tables (Gibbert, Ruigrok, and Wicki, 2008). Each stage also provided important context for subsequent analysis.

I employed an NVivo database to catalog and code the qualitative data from my data sources so as to ensure transparency (Yin, 2009). The NVivo database included raw text from the letters to shareholders in annual reports and key sections of the Ward's Automotive Yearbooks. I also graphed patterns of disturbances and responses over time. Below I discuss each of these stages in turn.

3.4.1 Stage 1 – Identify Disturbances Facing the Firm

The objective of this first stage was to identify and understand the disturbances facing the automotive firms in my study. I focused on those disturbances discussed by firm executives in the letters to shareholders from the annual reports and by the automotive experts who authored the Ward's Automotive Yearbooks. These executives and industry experts were immersed in the North American automotive industry and possessed a strong understanding of the challenges facing the industry. Focusing on the disturbances identified by these executives and experts improved the validity of my data analysis by increasing my confidence that I was focusing on disturbances that were truly important to and had material impact on firms. Further, these executives and experts recorded their analyses on a yearly basis, grounding their insights temporally. Employing this approach thus offered a reliable way to consistently identify disturbances at different points in time (Nunnally, 1978; Peter, 1979).

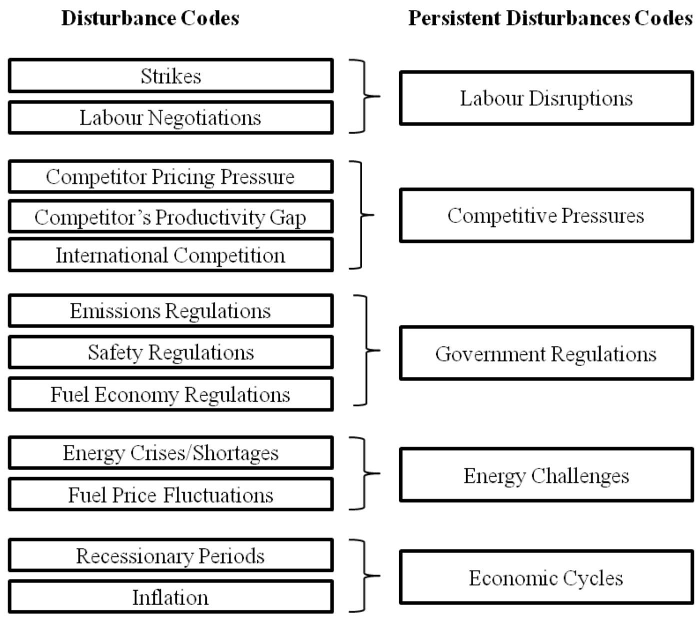
It was through the process of analyzing my data that I discovered the importance of persistent disturbances. I began my data analysis looking to identify discrete events, such as specific regulations, swings in customer demand and tastes, strikes, and major incidents like those caused by safety recalls or energy crises. However, as my analysis progressed, I found that the disturbances experts and executives described were often without readily delineated start and end points. The disturbances I found were connected to other disturbances that occurred at different points in time. For instance, in 1975 the US government enacted legislation to bring the CAFE standards into effect. These standards mandated more stringent fuel economy for cars sold in the United States and required automobile manufacturers to engage in massive research and development programs and to make significant investments in new technologies. Although this event itself was important, the CAFE standards were not enforced until 1978 and the standards increased in stringency over a period of 12 years, with mandated fleet fuel efficiency averages growing from 18 mpg in 1978 to 27.5 mpg in 1990. Further, CAFE standards were part of a broader issue pertaining to concerns over fuel economy, which were accentuated by energy crises, changes in customer taste and demand, and other regulatory actions, that stretched from before 1975 and remained a significant issue at the end of my study period in 2010. With this recognition, I shifted my analysis from identifying discrete disturbances to discerning patterns of persistent disturbances over time.

I analyzed my data looking for persistent disturbances that had affected the automotive manufacturing firms over my study period. I began by coding my qualitative data from Ward's Automotive Yearbooks and the letters to shareholders from annual reports for specific instances of disturbances. These disturbances included energy crises, high gasoline prices, strikes, wage increases, government regulations of various kinds, competitor cost structures, inflation, and recessionary periods. I sorted and grouped these disturbances into different categories denoting persistent disturbances. I sought persistent disturbances that were both distinct from one another and relevant to firms over the duration of my study period.

Some disturbance codes were dropped because they represented isolated disturbances that were not identifiable as being part of a persistent disturbance. Examples of dropped codes include trade fluctuations, traffic congestion, resource shortages, wars, and production overcapacity. I took measures to ensure that the codes I dropped did not materially impact my findings and theorizing. First, the five persistent disturbances I identified were those that manifested throughout my study period, whereas the codes there were dropped appeared over short temporal durations. Second, the five persistent disturbances that I identified constituted the largest volume of identified disturbances. They were referenced on average 49 times whereas codes there were dropped were referenced at most 9 times (resource shortages). Finally, I checked to ensure that dropped codes were not discussed as having a material or extended impact they had on the firm. As such, the most substantive disturbances in my study — for example oil crises or major regulatory initiatives — were always retained.

Figure 5 below illustrates this mapping of disturbance codes to persistent disturbances. This mapping provides a detailed picture of how persistent disturbances were identified. At the end of this process I arrived at a set of five persistent disturbances: economic cycles, labour disruptions, energy challenges, competitive pressures, and government regulations.

Figure 5 Mapping of Codes for Persistent Disturbances



I used the coding process to sensitize me to which persistent disturbances were important, and then I built a longitudinal picture of these disturbances. To do so, I drew on additional data from Compustat, Ward's Automotive Yearbooks, and ad hoc data sources to build visual displays to aid in making sense of my data. For example, with respect to the energy challenges category of disturbances, fluctuating gasoline prices were clearly of critical importance to automobile manufacturers. Higher gasoline prices put pressure on consumers to purchase more fuel efficient vehicles. I graphed historical gasoline prices collected from the US Department of Energy and mapped onto this graph critical events pertaining to energy crises and fuel economy regulations that I pulled from Ward's Automotive Yearbooks. These longitudinal depictions of the data provided a more complete perspective on each disturbance and served to triangulate my findings (Jick, 1976).

3.4.2 Stage 2 – Identify Firm Responses

The objective of stage two was to identify firms' responses to the persistent disturbances they faced over the study period. My first step in stage two was to focus my analysis on a specific set of firm responses. My decision to focus my research in this way followed advice from prior dynamic capabilities research. Winter (2003: 994) advises scholars to focus on a specific dynamic capability. He stressed that there is "no general rule for riches" and that it is not possible to hedge against every contingency. As a result, investments in dynamic capabilities are necessarily focused.

I chose to focus on how automotive firms built and deployed *manufacturing flexibility* in response to the five persistent disturbances identified above. This decision followed from my initial data analysis, in which I noted that industry experts placed a strong emphasis on how automotive firms adapted their underlying manufacturing resources and capabilities in response to environmental dynamism. Manufacturing flexibility has been studied extensively in the field of operations (Slack, 2005; Sethi and Sethi, 1990; Gerwin, 1993). It can be defined as a firm's ability to adapt to environmental changes by varying products, product mix, and production volumes (Upton, 1994). This definition highlights how manufacturing flexibility involves modifying the underlying manufacturing resources and capabilities with which firms produce products — a pattern of adaptation that is in keeping with that of dynamic capabilities.

Persistent Manufacturing Implications

In studying manufacturing flexibility, I found that the impact of persistent disturbances was felt more acutely within the automotive firms' manufacturing operations. While at the level of the firm, there were five distinct persistent disturbances, I found that these five persistent disturbances translated into three persistent manufacturing implications at the level of the firms' manufacturing operations. In my study these persistent manufacturing implications were fluctuating consumer demand, profit margin pressures, and fluctuating consumer model preferences. I treated these persistent manufacturing implications as external disturbances because they operated external to the dynamic capability in which I was interested. Table 6 highlights the translation process. A similar table in the appendix (Table A3) also provides representative passages associated with each of these persistent disturbances and highlights the translation between persistent disturbance and persistent manufacturing implication.

Table 6 Persistent Disturbances and Persistent Manufacturing Implications

Persistent Disturbance Codes	Description	Persistent Manufacturing Implication Codes
Economic Cycles	Economic cycles referred to the booms and busts of recessionary cycles as well as other economic factors such as high inflation	Fluctuating consumer demand Profit margin pressures
Labour Disruptions	Labour disruptions included strikes and labour negotiations	Profit margin pressures
Energy Challenges	Energy challenges included energy crises as well as fluctuating fuel prices	Fluctuating consumer model preferences Fluctuating consumer demand
Competitive Pressures	Competitive pressures included those from domestic competitors as well as international entrants from Japan, Europe, and Asia	Fluctuating consumer demand Profit margin pressures
Government Regulations	Government regulations covered a range of regulatory issues including fuel economy, safety, and emissions	Profit margin pressures Fluctuating consumer model preferences

Dynamic Capabilities

In stage two I began by systematically analyzing the responses that the three automotive firms in my study had, to the three persistent manufacturing implications which I had identified. I focused on the responses that automotive executives and automotive industry experts wrote about in the letters to shareholders and firm-specific analysis sections of the Ward's reports, respectively. By focusing on the responses identified by these automotive executives and automotive industry experts, I increased my confidence that I was identifying appropriate responses, thereby improving the validity of my study. Further, since responses were identified consistently at regular yearly intervals, attending to the analysis of automotive executives and automotive industry experts increased the reliability of my data collection (Nunnally, 1978; Peter, 1979).

This initial step yielded a substantial variety of responses (see Tables A4 through A12 in the appendix). I subsequently analyzed these responses in order to make better sense of them. I began by creating first-order codes. First-order codes are used to identify and group facts (Van Maanen, 1979). I used first-order codes to identify and group specific types of responses to each of the three persistent manufacturing implications. These first-order codes were given descriptive labels (Miles and Huberman, 1994). For example, in 1983 when GM was described as building N-cars for Oldsmobile, Pontiac, and Buick on a single line, I applied the first-order code *multiple divisions* (platforms) to denote that vehicle platforms were being shared across multiple automotive divisions within GM.

Next, I analyzed these data, grouping the first-order codes and applying second-order codes. Second-order codes are theoretical in nature, helping to explain the patterning of the first-order data (Van Maanen, 1979). For example, I grouped first-order responses related to increasing or decreasing plant capacity and opening new or closing existing plants as *alter sources of production.* A complete mapping of first-order and second-order codes is found in Figure 6, Figure 7, and Figure 8. These codes helped me subsequently, to build theory explaining how dynamic capabilities developed over time.

Figure 6 Mapping of Codes for Consumer Demand Fluctuation Responses

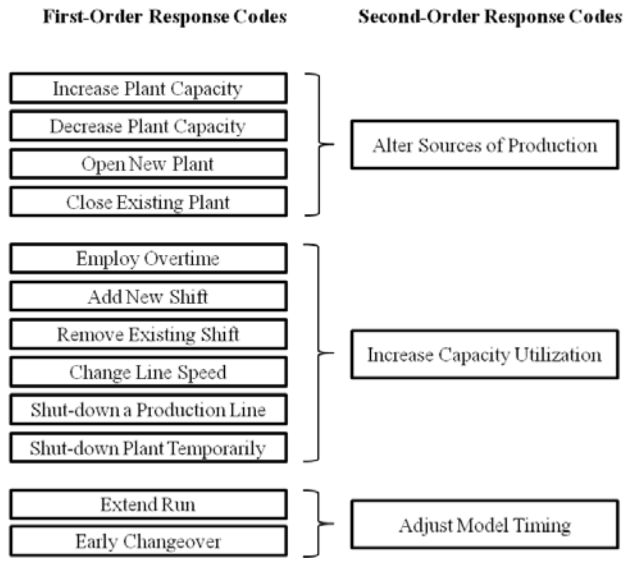


Figure 7 Mapping of Codes for Consumer Model Preference Fluctuation Responses

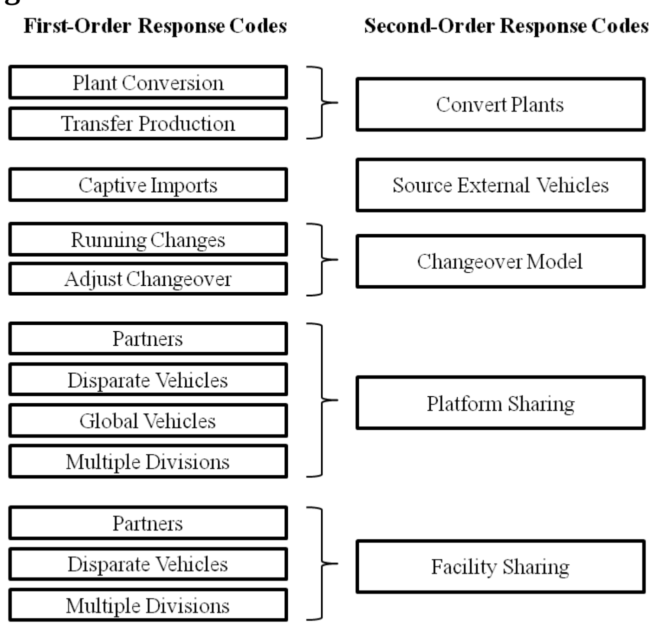
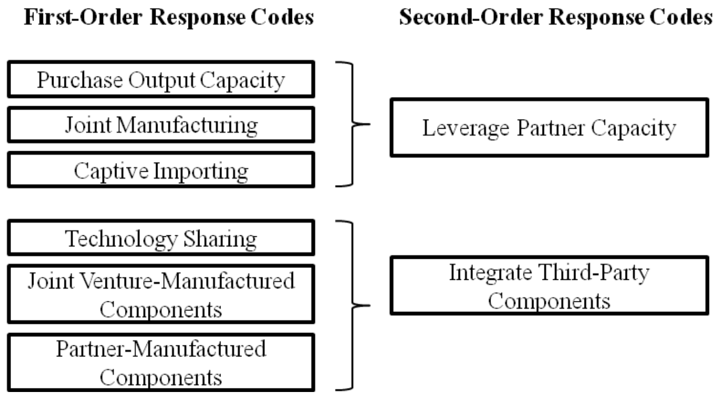


Figure 8 Mapping of Codes for Profit Margin Pressure Responses



3.4.3 Stage 3 – Theory Building

I built theory from the case data iteratively, moving back and forth among data, theory from existing literature, and my emerging theory (Eisenhardt, 1989; Langley, 1999). The main inputs to this theory building process were the data tables, coding, and figures I compiled during prior data analysis stages. However, in addition I built new interim tables (Miles and Huberman, 1984; Yin, 2009) and figures (Langley, 1999; Yin, 2009) to help me make sense of the data.

During this final stage I spent weeks comparing my emerging theory with prior literature on dynamic capabilities. I read this prior literature with specific intent, concentrating on two broad topics upon which my emerging theory was focused. First, I re-read prior research pertaining to the process of dynamic capability development. I focused in particular on processes of layering and the role of dynamic capability structure. Second, I examined prior research in dynamic capabilities paying attention to the role ascribed to environmental dynamism and, in particular, to mentions of different configurations of environmental dynamism. I also sought research that described environmental dynamism in terms that went beyond a description of speed or velocity (see Table A2 in the appendix).

This review of the literature offered two benefits. First, a focused review of prior dynamic capabilities literature provided me with the language to better understand and explain what I had found through my data analysis. A great example of this was identifying the term *dynamic capability architecture* (Jacobides, 2006). This term assisted me in better explaining the layered composition of dynamic capabilities that I had found. Second, the focused review identified connections to related concepts and allowed me to better position my emerging theory within the broader body of literature on dynamic capabilities. But perhaps more important, it reinforced my research and gave me confidence that what I was finding was consistent in the broadest sense with prior research. This served to build the internal and external validity of my emerging theory (Eisenhardt, 1989).

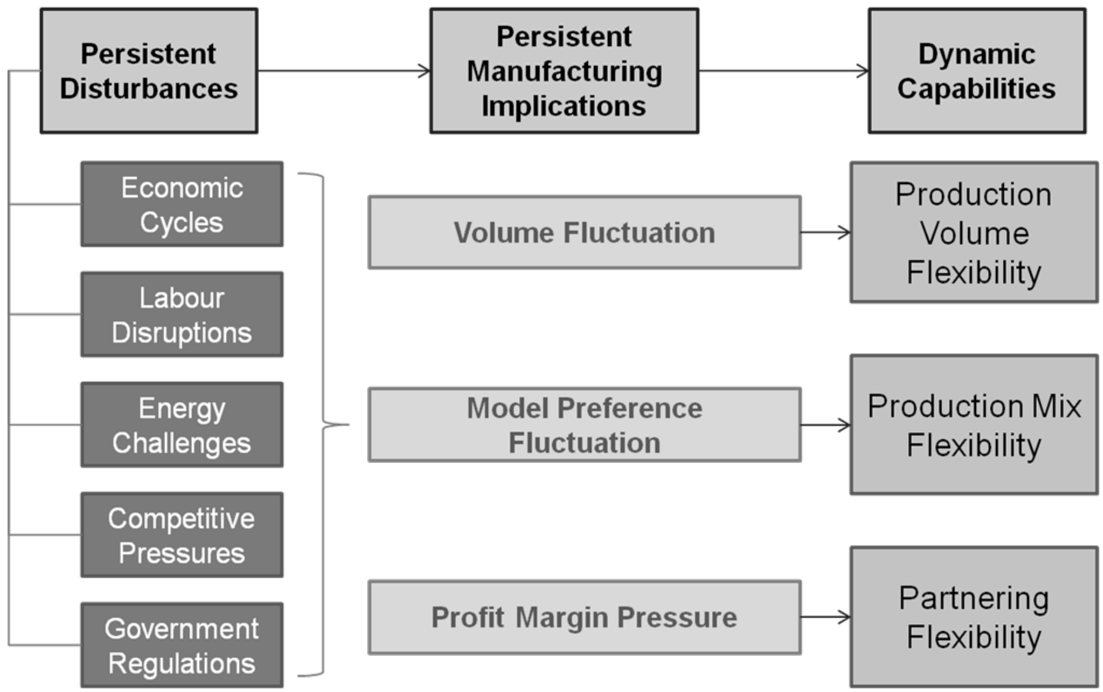
Chapter 4 – Findings

4.0 Findings

4.1 Overview

In this chapter I present my research findings, displaying and describing the data I collected and analyzed. I group this data presentation into three sections. The flow of these sections is depicted by Figure 9. First, I build narratives illustrating the history of the North American automotive industry through the stories of five different persistent disturbances from 1965 through to 2010. These persistent disturbances are economic cycles, labour disruptions, energy challenges, competitive pressures, and government regulation. In the second section I discuss the implications of these persistent disturbances with respect to the automotive firms' manufacturing operations. I identified three distinct implications: consumer demand fluctuations, consumer model preference fluctuations, and profit margin pressures. I describe these implications in detail. Finally I discuss the nature and development of three manufacturing-related dynamic capabilities: production volume flexibility, production mix flexibility, and partnering flexibility. I describe the development of these dynamic capabilities over time.

Figure 9 From Persistent Disturbances to Dynamic Capabilities



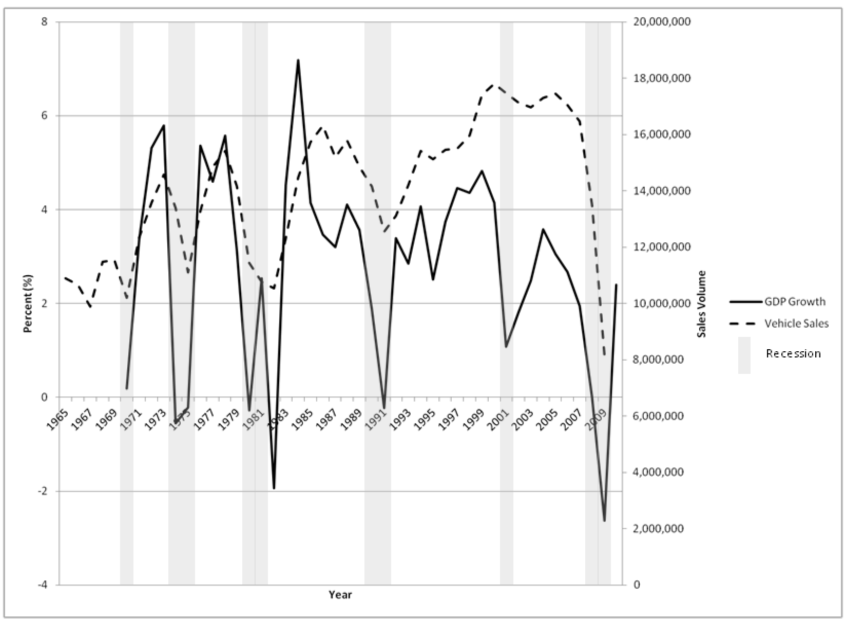
4.2 Persistent Disturbances in the Automotive Industry

The North American automotive industry has experienced a great number of disturbances over its long history. Below I describe these disturbances, organizing my telling of the history along the five different persistent disturbances I identified through my data analysis; economic cycles, labour disruptions, energy challenges, competitive pressures, and government regulations. For each I draw on my archival data to provide detailed illustrations.

4.2.1 Economic Cycles

The North American automotive industry is an industry that rises and falls with the conditions of the economy. During strong economic times vehicle sales tend to be strong. Conversely, when the economy is weak, consumers delay the purchase of large items or shift towards less expensive vehicles. Figure 10 graphically depicts this turbulence. This graph shows three things. First, the graph uses a solid line to display gross domestic product (GDP) growth as a percentage. Second, the dashed line shows sales of vehicles over the same period of time in units. Third, vertical gray stripes depict recessionary periods. The graph shows how during recessionary periods, and corresponding to low or negative GDP growth, sales volumes drop dramatically. Since automotive manufacturing is heavily reliant on large capital investments, these dramatic drops create significant difficulties. During down times, firms are often forced to operate these expensive plants substantially below capacity, putting strong downward pressure on profit margins. These cycles were borne out over six recessionary periods occurring during my study period, in 1970, 1974 to 1975, 1980 to 1981, 1990 to 1991, 2001, and 2008 to 2009.

Figure 10 Economic Cycles



4.2.2 Labour Disruptions

Labour disruptions have been a central disturbance for automotive manufacturers since well before 1965. What began as a fragmented labour movement in the 1930s developed into a highly organized and powerful union called the United Auto Workers, with membership stretching across automotive firms and into other related and unrelated industries. The current United Auto Workers organization is the result of years of hard-fought battles and increasing consolidation of local unions into a national presence. It boasts a membership of close to 400,000 active members and 600,000 retired employees.[1]

Figure 11 Employment and Labour Disruptions

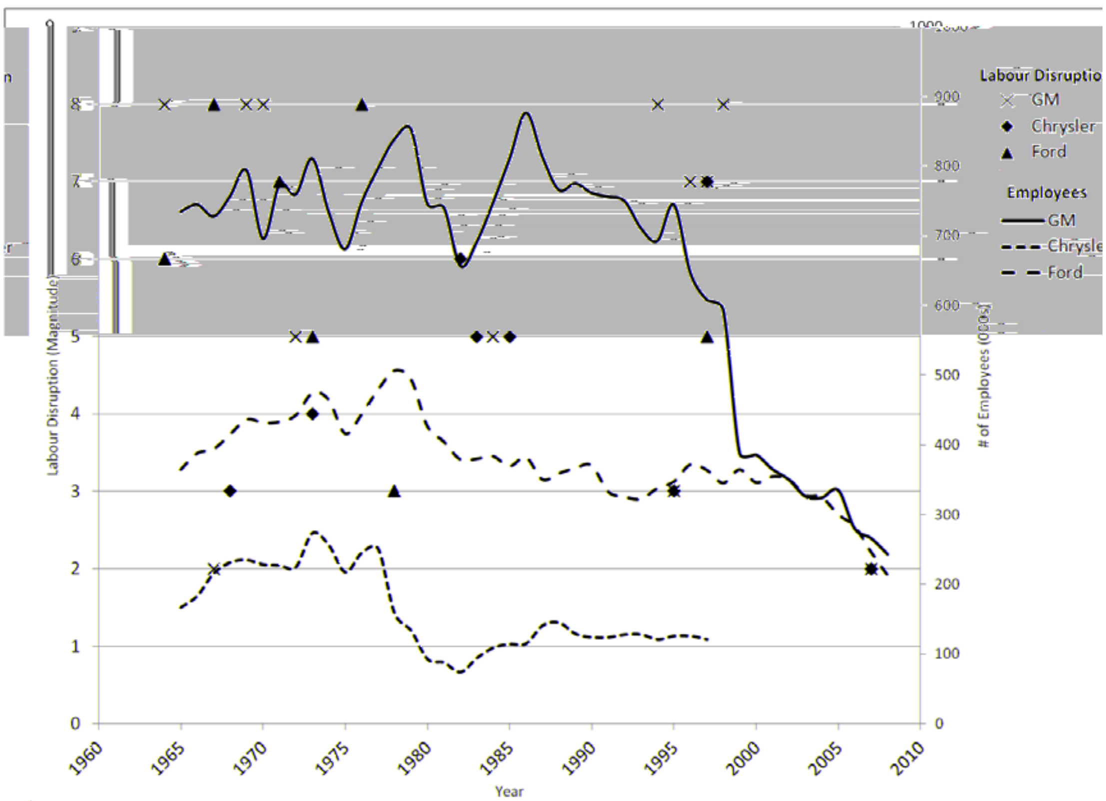


Figure 11 depicts the number of employees at each of the automotive firms under study and highlights labour disruptions over my study period. The lines illustrate the number of employees in thousands at each of GM, Chrysler, and Ford. This graph highlights how each of the automotive firms substantially reduced their employment levels over the duration of the

---

[1] http://www.uaw.org/page/who-we-are, Accessed December 9th, 2011

period under study. Since the late 1970s Ford and Chrysler respectively reduced their North American employee base from highs of 506,531 employees in 1979 and 250,833 employees in 1978. In the case of Ford, they ended 2008 with only 213,000 employees—42% of their previous high. More recently, GM's employment levels dropped from a high of 876,800 in 1986 down to 243,000 by 2008—28% of their 1986 high. It is interesting to note that these employment decreases were undertaken despite increasing domestic production, speaking to the significant improvements in productivity made by these automotive firms.

The markers in the graph indicate the severity of different labour disruptions experienced by the automotive firms over the study period. I calculated the severity of labour disruption on a scale of 1 to 10, basing my analysis on the volume of automotive production loss and the duration of the strike. Longer strikes and strikes that resulted in greater loss of automotive production received higher severity scores. The graph shows how labour disruptions are cyclical. Contracts bind parties to a given labour agreement for a period of between 3 to 4 years at which time the contract comes up for renewal or renegotiation. It was very common for unions to aggressively renegotiate labour contracts upon expiration. This set the industry up for regular confrontations every few years as unions pushed to negotiate increasingly favourable employment terms on behalf of their members.

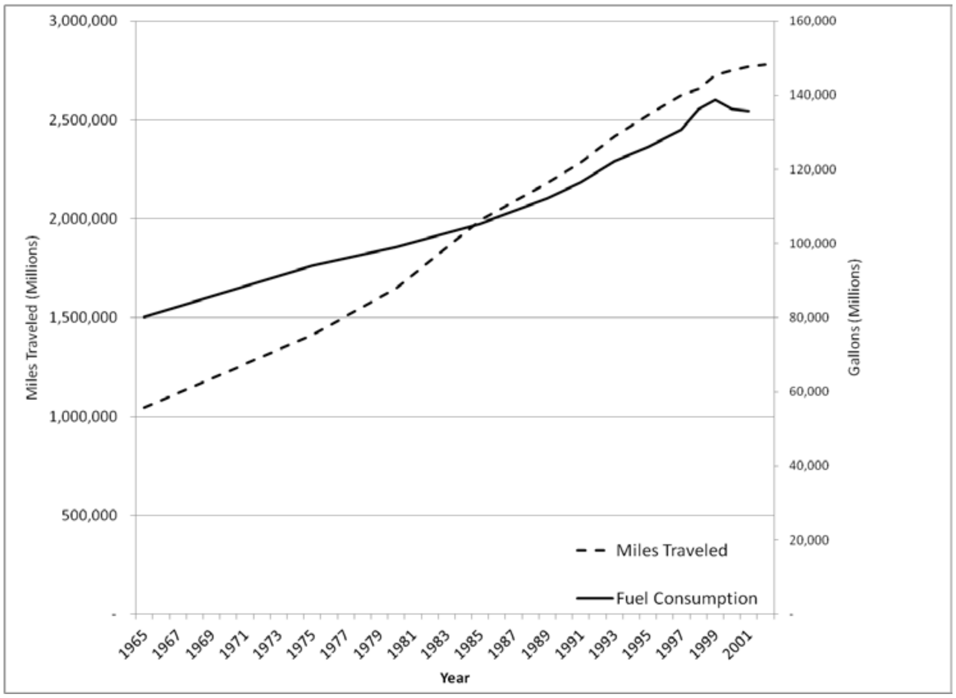
4.2.3 Energy Challenges

Intertwined with the history of the North American automotive industry has been the ongoing struggle for energy independence in the face of fluctuating fuel prices and sporadic energy crises. This struggle was first dramatized during the two oil crises of the 1970s. The first crisis, the Oil Embargo lasting from October 1973 to March 1974, was the result of an embargo by the Organization of Arab Petroleum Exporting Countries (OAPEC) that was undertaken in response to US military and financial assistance to Israel. This embargo caused challenges for motorists who were faced with standby gasoline rationing and driving restrictions (eg new speed limits). In 1979, the Iranian Energy Crisis caused similar dramatic concerns, including gasoline shortages and much higher gasoline prices.

Figure 12 Historical Gasoline Retail Price

Beyond energy crises, fluctuations in the price and availability of gasoline have been a significant factor driving the demand for more fuel efficient vehicles; both from the perspective of changing consumer demand as well as changing government regulations. Figure 12 shows the inflation-adjusted retail price of gasoline per gallon over the duration of the study period. Gasoline prices spiked during the Iranian Oil Embargo and, despite low prices during the 1990s, climbed rapidly through 2008 reaching a high of $3.31 per gallon before receding in 2009 and 2010.

Figure 13 Total Miles Driven and Fuel Consumption (Light Vehicles)



While much progress has been made in terms of improving the fuel efficiency of individual vehicles, fuel efficiency remains a perennial concern. This is because fuel efficiency improvements have corresponded with increasing consumption that has led to higher total consumption of fuel (Alcott, 2005), as illustrated by Figure 13. Americans are driving more miles every year, negating much of the fuel efficiency improvements, meaning that total fuel consumption has been rising steadily. Fuel efficiency improvements have not been dramatic enough to offset increased consumption meaning that energy challenges remain an ongoing problem for automotive firms.

4.2.4 Competitive Pressures

Automotive firms faced increasing international competition throughout the study period. Strengthening international competition was a concern beginning as early as the late 1960s [Ford Annual Report, 1968]. However, international firms intensified pressures in the early 1980s, and sales of imports briefly exceeded 25% of sales before backing off temporarily in the 1990s.[2] Evidence of the significance of foreign competition is noticeable by viewing the production share the Big Three enjoyed over the duration of the study. Their share dropped from a high of over 90% down to 70% in the late 1990s, as foreign firms began setting up production facilities in the US. Foreign firms enjoyed a significant cost advantage over domestic firms. Ford executives summed up the cost problem facing the Big Three in a 1984 annual report interview: “We require more hourly and salaried labour hours to make each car, and we pay more for each of those hours.” In 1980, the productivity gap between North American and Japanese automotive firms meant that Japanese competitors, on average, were able to produce vehicles for $1513 less per vehicle. Over the study period this productivity gap decreased to between $313 and $355 in 2002. However, the increasingly global economy continues to present competitive challenges for Ford, GM, and Chrysler.

4.2.5 Government Regulations

The 1960s marked the beginning of a period of increasing government involvement in regulating the North American automotive industry. A quote from Ford’s 1966 annual report illustrates this new reality well.

> *“In the past, our success has depended primarily on our response to the test of the marketplace. In the future, we shall be severely tested by the need to respond at the same time to the requirements of the market and the requirements imposed by the Federal governments' safety and air pollution regulations.”*

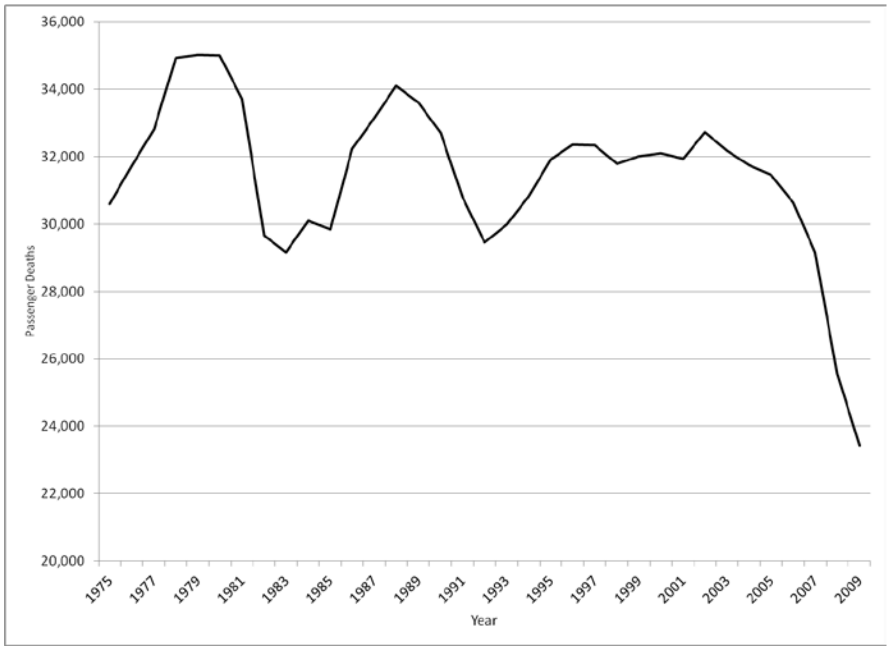
[2] Import figures are difficult to classify since Japanese firms set up production facilities in the United States effectively rendering the vehicles produced there domestic vehicles for the purposes of reporting.

The US government began regulating the automotive industry in a variety of areas, but most notably in safety, emissions, and fuel economy.

Safety

Safety-related concerns evolved over the study period beginning with public criticism and dissatisfaction, and evolving to encompass stringent and broad-sweeping regulations. In 1965, Ralph Nader released his book entitled *Unsafe at Any Speed: The Designed-In Dangers of the American Automobile.* This book offered a strong critique of industry practices, arguing that automotive firms actively avoided the issue of safety. At the time, this was surprisingly easy to do, as safety was not in the collective consciousness of automotive buyers (Gioa, 1992). However, shortly after *Unsafe at Any Speed* was released, concern over safety intensified. In 1966, the National Traffic and Motor Vehicle Safety Act became law and seatbelts were made mandatory. This started a series of government-mandated safety improvements including head rests, shoulder harnesses, high-mounted stop lights, and passive restraints such as airbags. In 1979, the government launched the New Car Assessment program, and the first cars were tested in a 35-mph front crash test. Crash testing has since evolved into a complicated set of procedures, the results of which are made publicly available to enable consumers to make informed safety-related decisions. The National Highway Transportation Safety Association was given responsibility for investigating safety issues and either initiating recalls or pressuring firms to voluntarily recall vehicles for safety-related problems. Government-initiated recalls for safety reasons became a common and costly problem for automotive firms. For instance, in 1977, 12.9 million vehicles were recalled for safety; in 1983, 6.1 million vehicles were recalled; and in 1984, 7.22 million recalls were made.

Figure 14 Passenger Vehicle Occupant Deaths



Despite government-mandated improvements to vehicles, safety concerns remained, and automotive firms were presented with safety-related challenges throughout the study period. For the majority of the study period, the improvements in vehicle safety served only to hold traffic casualties at a relatively constant level. This was still a meaningful accomplishment, given that Americans were driving their cars 33% more miles each year. However, notwithstanding a recent dramatic reduction in deaths, the issue of safety remained a concern throughout the study period (Figure 14).

Emissions

A major challenge for automotive firms has been addressing smog-inducing air pollution and caustic acid rain. Smog is a serious health concern in many cities, causing heart and lung problems, and acid rain can damage the health of water and soil systems as well as animal and human health. Automotive firms managed to comply with government regulations to reduce hydrocarbon emissions (by more than 80%) and carbon monoxide emissions (by almost 70%) [Ford Annual Report , 1969]. Despite these achievements, automotive firms continued to face stringent standards imposed by the Environmental Protection Agency (EPA) resulting from successive Clean Air Acts in 1977 and 1990. Automotive firms had repeated difficulties with these more stringent regulations and missed deadlines between 1975 and 1978, requiring delays, extensions, and interim standards. Dramatic improvements were made through cross-industry collaboration with the oil and gas industry that collectively moved towards a combination of unleaded fuel and catalytic convertors, dramatically reducing harmful emissions. Restrictions on sulphur dioxide content in gasoline and the adoption of alternative fuels such as ethanol helped to further reduce damaging emissions.

Despite these improvements, vehicle emissions have remained a significant problem for the automotive industry through the end of my study period. A report by the Ontario Medical Association issued in 2008 estimated that smog causes 9,500 premature deaths in the province yearly.[3] More recently, the definition of emissions has been broadened in the United States to include carbon dioxide, raising further emissions-related challenges for automotive firms.

Fuel Economy

A number of government regulatory initiatives followed the oil crises of the 1970s. In 1973, the EPA took initial steps to rank the fuel efficiency (in mpg) of all cars. This marked a first effort to understand the scope of the problem. Then, in 1975 the Energy Policy

---

[3] Ontario Medical Association, https://www.oma.org/Mediaroom/PressReleases/Pages/PrematureDeaths.aspx, Accessed September 14th, 2011

Conservation Act was passed, mandating that automotive car fleets average 27.5 mpg by 1985. These standards were regulated by the National Highway Traffic Safety Administration (NHTSA), while the EPA was responsible for measuring vehicle fuel efficiency. National sentiment continued to build against larger cars, which had been dubbed "gas guzzlers"—a term that highlights the growing moral and social aspects of car buying [Ward's, 1979]. In 1980, the government imposed a "Gas Guzzler Tax" on cars that exceeded a minimum threshold in order to help shift consumption patterns. The tax started at $500 in 1980 and grew to $7700 in 1991. More recently in 2007, the Energy Independence and Security Act was passed aiming at even higher CAFE standards of 35 mpg by 2020.

All of these regulations have added substantially to the cost of individual vehicles. Table 7 illustrates the cumulative[4] inflation-adjusted costs associated with vehicle production resulting from emissions and safety regulations. While these numbers depict a dramatic increase in costs, their rise is even more dramatic when considered as a percentage of the cost of an average vehicle. The average cost of emissions and safety regulatory requirements as a percentage of the average expenditure on a new vehicle rose quickly from only 0.34% in 1967 to 18% in 1981. It has remained at approximately 19% since that time.

---

[4] These numbers are cumulative in the sense that they include the costs as stated in prior years.

Table 7 Cumulative Costs per Vehicle (in US dollars) of Emissions and Safety Regulatory Requirements

Year	Costs
1967	11
1969	107
1971	176
1973	331
1975	586
1977	699
1979	861
1981	1611
1983	1871
1985	2056
1987	2257
1989	2457
1991	3097

Year	Costs
1992	3174
1993	3522
1994	3904
1995	3874
1997	3970
1999	4079
2001	4286
2002	4199
2003	4127
2004	4166
2005	4605
2006	4661
2007	4638

4.3 Persistent Manufacturing Implications

While automotive firms were confronted with five persistent disturbances over the course of the study period, the implications of those persistent disturbances from the perspective of the firm's manufacturing operations were more focused. I found a translation process between the persistent disturbances at the level of the firm, and how those persistent disturbances impacted the firm's manufacturing operations. I called these more focused disturbances *persistent manufacturing implications*. I define persistent manufacturing implications as the *manufacturing-related implications of repeated temporary events confronting firms*.

My data analysis revealed three persistent manufacturing implications; fluctuating consumer demand, fluctuating consumer model preferences, and profit margin pressures. In what follows I review each of these persistent manufacturing implications in turn. I describe the persistent manufacturing implication, showing how each was driven by persistent disturbances stemming from economic cycles, labour disruptions, energy challenges, competitive pressures, and/or government regulations. This relationship between persistent manufacturing implication and persistent disturbance is depicted in Table 8**.**

Table 8 Persistent Manufacturing Implications and Persistent Disturbances

Persistent Manufacturing Implications	Persistent Disturbances
Fluctuating Consumer Demand	Economic cycles Energy challenges Competitive pressures
Fluctuating Consumer Model Preferences	Energy challenges Government regulations
Profit Margin Pressures	Economic cycles Labour disruptions Competitive pressures Government regulations

4.3.1 Fluctuating Consumer Demand

Fluctuating consumer demand refers to changes in the volume of vehicles demanded by customers over time. Below I review how consumer demand fluctuated over my study period. In doing so, I draw a connection between fluctuating consumer demand and the persistent disturbances the firms faced, in particular, economic cycles, energy challenges, and competitive pressures. My analysis begins with total vehicle sales, and then breaks out both car and truck sales over the study period because cars and trucks have historically represented distinctly different markets and because doing so highlights consumer demand volatility more clearly.

Consumer demand for vehicles was volatile over my study period. In Figure 15 I illustrate this volatility, employing unit volume sales as a proxy for changing consumer demand. The spikes and valleys in vehicle sales highlight swings in vehicle demand. There are substantial consumer demand fluctuations. Vehicle demand grew through the early 1970s from just over 10 million cars to 14.5 million vehicles in 1973—a 43% growth in just three short years. Following this rise, vehicle sales by unit volume fluctuated for several decades. Between 1973 and 1975 volumes tumbled to 11 million before rising again to 15.4 million in 1978. Subsequently, sales volumes dropped again down to 10.5 million in 1982 before rising quickly to 16.3 million in 1986. Sales rose to historic highs of 17 to 18 million vehicles in the early 21st century before collapsing in 2009 to 8.1 million vehicles, the lowest in many decades.

Figure 15 Industry Vehicle Sales

Source: Ward's Automotive Yearbooks, US Domestic and Imports

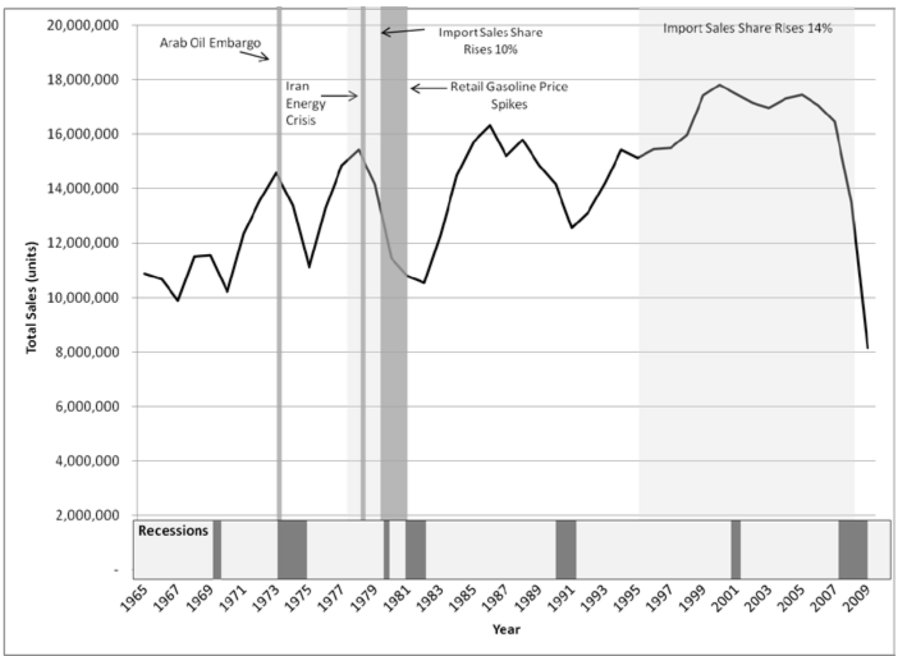


Figure 15 highlights how diverse events contributed to volatility in vehicle sales. As depicted in the vertical bars at the bottom of Figure 15, recessionary periods depress demand as consumers scale back purchases of large-ticket items like vehicles. Major world events such as the Arab Oil Embargo in 1973, the Iran Oil Crisis in 1979, as well as rising gasoline prices in the early 1980s, have significant impacts on consumer demand for vehicles. Similarly, as the sales of imports rose over my study period, the demand for domestic vehicles declined. These events are depicted in Figure 15 with tall vertical bars and identified with text and arrows. Sometimes these events span multiple years.

Fluctuating consumer demand is even more pronounced when considering the swings in demand experienced by individual firms. In Figure 16 each of GM, Ford, and Chrysler's unit volume sales of cars are graphed over the duration of the study period. GM unit volume sales of cars are particularly volatile throughout the study period, with volume sales fluctuations of over 1 million units taking place within the span of only a few years and often in only a single year. For instance, sales dropped from 4.4 million to 3.3 million units between 1969 and 1970 before climbing again to 4.7 million in 1971. Similarly, sales dropped from 5.1 million in 1973 to 3.8 million in 1974. Between 1975 and 1976 car sales rose over 1 million units from 3.8 million to 4.8 million. Volume sales dropped by almost 2 million units between 1978 and 1982 from 5.4 million to 3.5 million. From the graph it is clear that Ford and Chrysler experienced dramatic swings as well. What is also noticeable is the dramatic and continuous decline from the mid-1980s through until the end of the study period in 2009. While this decline is most notable at GM, Ford and Chrysler mimic this decline as well.

Figure 16 Big Three Car Sales (Units) – 1965 to 2009

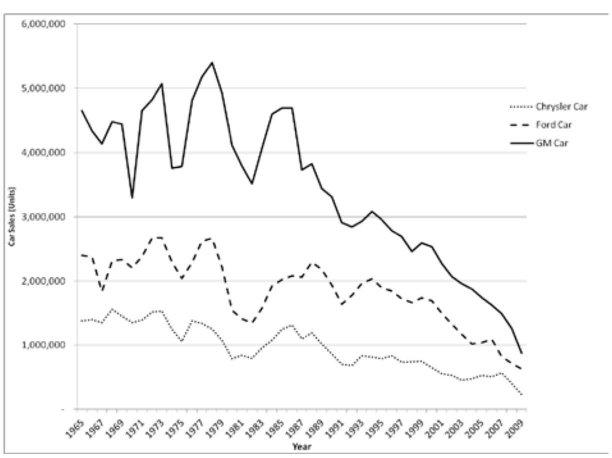
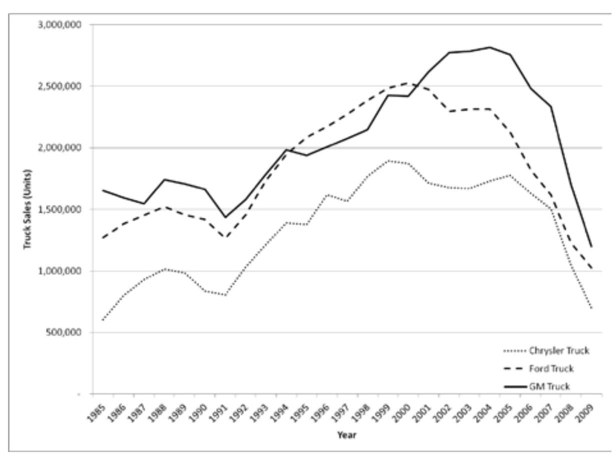


Figure 17 Big Three Truck Sales (Units) – 1985 to 2009

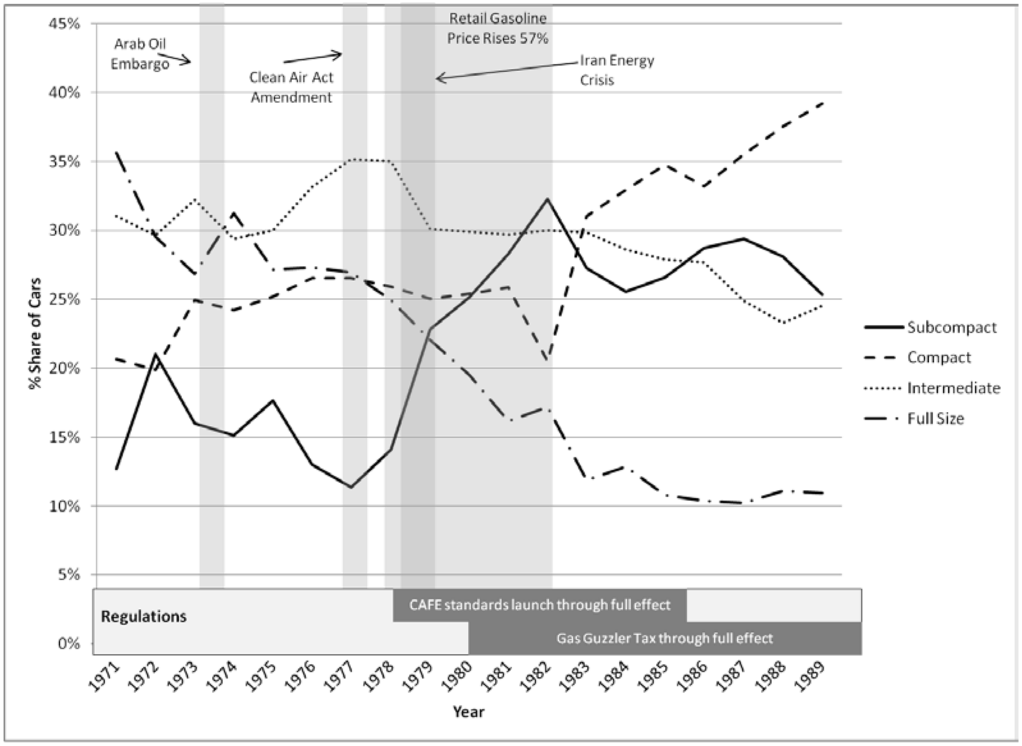


While less pronounced than with cars, trucks, SUVs, and vans also experienced fluctuating consumer demand (see Figure 17). Sales were relatively flat through the 1980s until the demand for SUVs rose in the early 1990s, almost doubling from 3.5 million combined units of trucks in 1990 to 6.8 million units in 2000. This trend crested at the mid-point of the first dcade of the 2000s and then dropped dramatically from a combined Big Three sales of 6.7 million in 2005 to only 2.9 million unit sales of trucks in 2009, a decline more rapid than the rise of the class through the 1990s.

4.3.2 Fluctuating Consumer Model Preferences

The second persistent manufacturing implication is fluctuating consumer model preferences, involving swings in the demand for vehicles with different properties. The most critical property that fluctuated was the class of vehicles demanded. Below I discuss how demand for different classes of vehicles fluctuated over time—from big cars to small cars and from trucks to SUVs and then CUVs. I discuss these fluctuations in the context of the persistent disturbances related to government regulations and energy challenges facing automotive firms over my study period.

Figure 18 Customer Demand for Cars by Vehicle Type as Share of Cars – 1971 to 1989



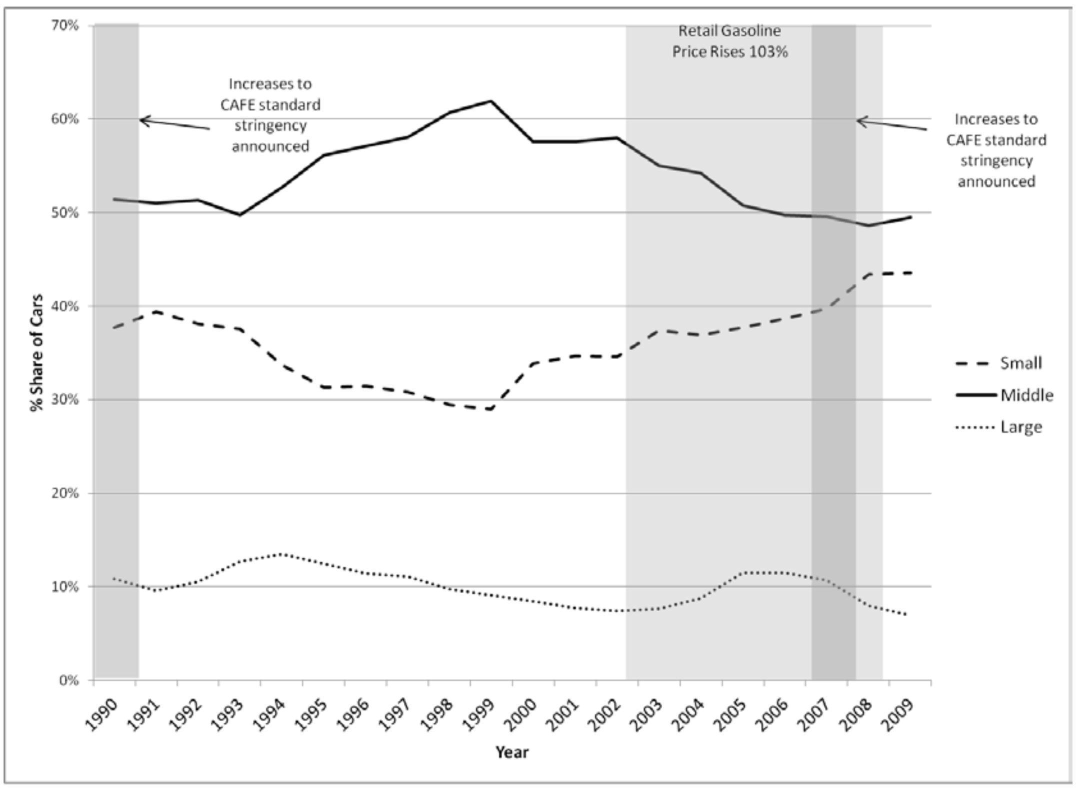
The demand for different types or classes of vehicles fluctuated over the study period. Cars and trucks are both classified using criteria related to size and function. Figure 18 and Figure 19 show swings in demand for different classes of cars as a share of total cars over two different time periods: between 1971 and 1989 and between 1990 and 2009.[5] Similarly, Figure 20 shows the swings in demand for different classes of trucks as a share of total trucks over the study period. Taken together, these figures illustrate how firms faced fluctuating consumer model preferences from year to year. To illustrate, the share of full-size cars dropped from 36% of automotive sales in 1971 to 16% of automotive sales in 1981. Correspondingly, sales of

---

[5] Across different years in the Ward's Automotive Yearbooks, different labels are used to describe different types of vehicles. For instance, the terms subcompact, compact, intermediate, and full-size or regular were used between 1971 and 1989. From 1990 onwards, the labels became small, middle, and large. Since some compact vehicles became classified as small and others as middle, I split my analysis into two time periods.

subcompact cars rose from 13% to 28%, and sales of compact cars rose from 21% to 26% in the same time period. There were significant year-to-year increases as well. Sales of subcompacts jumped 8% from 1971 to 1972 before dropping 5 points to 16% in the subsequent year. Between 1978 and 1979 subcompact sales rose 9 points from 14% to 23% of car sales. During the 1990s and 2000s, sales of small and middle-sized vehicles traded off from one another, fluctuating 10 percentage points over a decade.

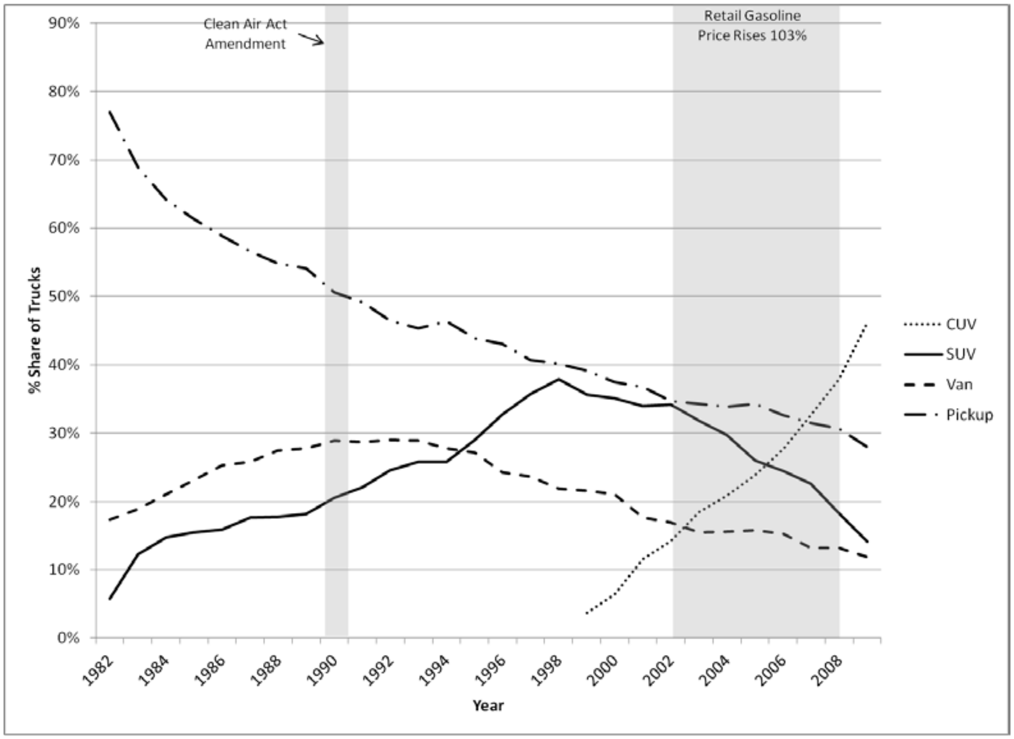
Figure 19 Customer Demand for Cars by Vehicle Type as Share of Cars – 1990 to 2009



Trucks and SUVs experienced similar swings. Demand for pickup trucks has been in decline since the early 1980s, with SUVs and vans growing in the share of truck sales. SUVs grew from no share of trucks in 1982 to encompass 25% of vehicles a decade later. During the mid-1990s, SUV sales as a percentage of total truck sales grew another 10 points. Recently however, sales of SUVs have dropped off considerably from a high of 38% in 1998 to a current low of 14%. Much of this swing can be explained by the increased share taken by a new class of crossover utility vehicles (CUVs) that has grown to encompass half of the market of trucks in 10 short years. CUVs possess a smaller footprint than SUVs, pickup trucks, or vans while retaining some of the cargo and handling characteristics, meaning that they have developed into substitutes for larger, more expensive trucks.

These three figures also display events associated with changing model preferences that occurred throughout the study period. Energy-related issues such as the Arab Oil Embargo in 1973 and the Iranian Energy Crisis in 1979 as well as spikes in retail gasoline prices appear to be associated with fluctuations in consumer model preferences from larger to smaller vehicles. Similarly, significant regulatory actions, including the launch and development of CAFE standards from 1978 through 1985 and the Gas Guzzler Tax launched in 1980, coincide with periods of increasing adoption of subcompact cars and abandonment of full-size vehicles.

Figure 20 Customer Demand for Trucks by Vehicle Type as a Proportion of Trucks – 1982 to 2009



Fluctuating consumer model preference also includes changes in other vehicle properties. For instance, the use of four-cylinder engines rose quickly in the 1970s from 0.03% of cars in 1970 to comprise 39.85% of cars in 1981 before stabilizing at 50% from the mid-1980s onward [Ward's Automotive Yearbooks]. In the same time period, the proportion of US cars produced that were smaller than 250 CID [cubic inch displacement] grew from 12.9% to 70.7% [Ward's Automotive Yearbooks]. Similarly, shifts occurred in the move from rear-wheel drive to front-wheel drive vehicles. GM, Chrysler, and Ford produced few front-wheel drive vehicles prior to the CAFE standards being introduced in 1975. However, a report by Arthur Anderson and Co in 1980 predicted that the number of front-wheel drive cars sold in North America would grow to 50% by 1985 [Ward's, 1980]. By the mid-1990s and through to 2009, only a handful of high-performance sports cars remained rear-wheel drive.

Fluctuating consumer model preferences were also pronounced when considering swings in the demand for individual vehicle models as compared with projections. For example, sales of Chevrolet's Citation dropped from 209,545 in 1982 to half of that in 1983 following a NHTSA safety investigation into alleged brake problems. Over that year, Chevrolet sales increased by 5.8%, meaning that production of other models was increased to compensate [Ward's, 1984]. At Ford, sales of the Mercury Villager minivan never came close to capacity production, and the joint venture with Nissan to produce these vehicles was ultimately called off in 2002 [Ward's, 1999; 2003]. Similarly, in 1982 Chevrolet's Chevette widely missed projections of 350,000 units, registering only 233,858 sales. In short, demand for different vehicles varied widely from year to year and, perhaps more important, frequently deviated from manufacturers' expectations.

4.3.3 Profit Margin Pressures

The third persistent manufacturing implication consists of persistent profit margin pressures on North American automotive firms to maintain and decrease vehicles costs while maintaining or increasing quality and other vehicle features. Below I discuss these pressures in the context of the persistent disturbances from competitive pressures, labour disruptions, government regulations, and economic cycles.

Japanese competitors, who were operating with significantly lower costs than GM, Ford, and Chrysler, were important drivers of these profit margin pressures. Estimates produced by Harbour and Associates show that this cost differential was driven largely by differences in the number of hours it took North American firms to manufacture vehicles compared with their Japanese competitors. In 1980, Japanese firms assembled smaller classes of vehicles in 17.4 hours, and their total manufacturing time was 30.8 hours. In contrast, North American firms took 33.2 hours to assemble and 59.9 hours for total manufacturing. These differences in assembly and total manufacturing time (15.8 and 29.1 hours, respectively) contributed to a cost advantage enjoyed by the Japanese of approximately $1513 per car [The Original Harbour Report, 1980/1981]. Significant differences persisted over the study period, although North American firms made considerable progress in reducing this spread. By 1998, the cost differential per car as compared with Japanese firms was between $500 and $989; by 2002 it had fallen to between $313 and $355 [Harbour Reports, 1980/1981; 1999; 2003].

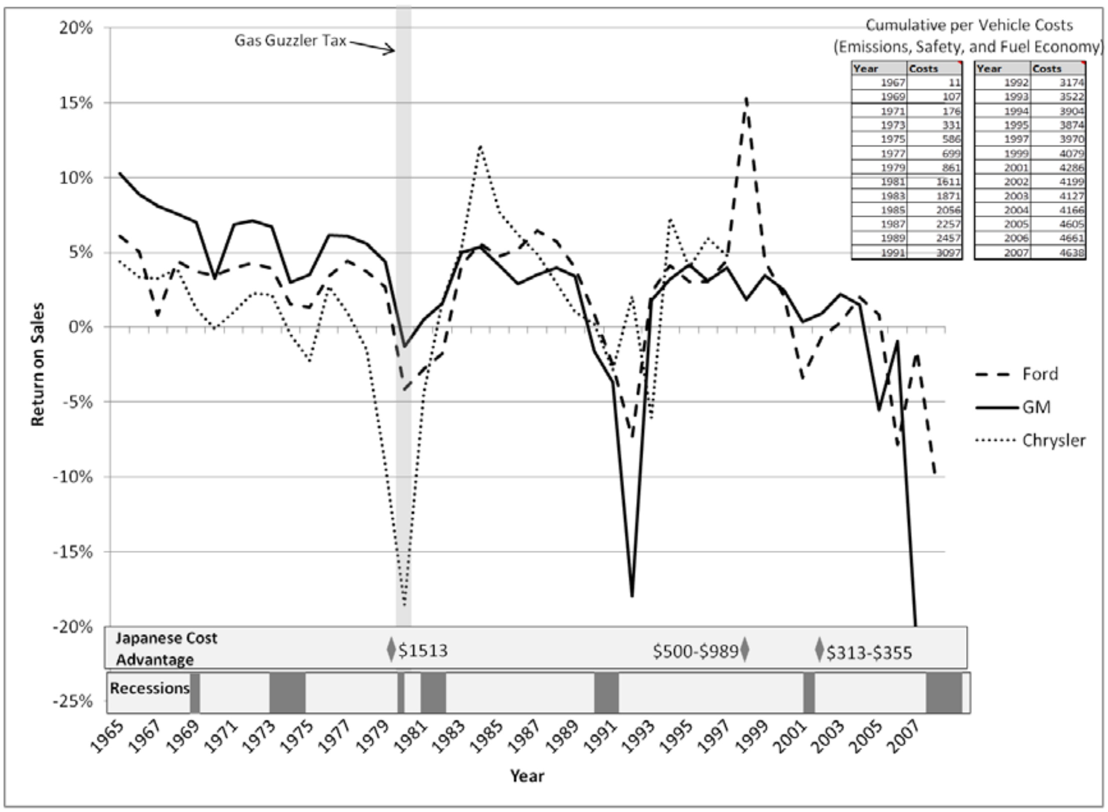
While profit margin pressures came from competitors as described above, the regulations imposed on North American automotive firms in terms of reduced emissions and improved safety and fuel economy added significant costs to the development and manufacturing of vehicles as well over the span of decades. As Table 7 illustrated, the cumulative costs attributed to meeting emissions and safety requirements were considerable, constituting 19% of the total cost of a vehicle from the early 1980s on. Since automotive firms were concerned about consumer price inelasticity, these costs were rarely passed onto consumers in their entirety.

While cost pressures were an ongoing concern, owing largely to economic cycles of boom and bust, cost inefficiencies became most apparent during economic downturns. I employed return on sales figures as a proxy for cost challenges experienced during the study period. Return on sales is a measure that automotive executives themselves deployed in expressing concern about declining profit margins. This concern is illustrated in the following excerpt from Ford’s 1970 annual report:

> *“Throughout the world, the automobile industry is challenged by rapidly rising labor and material costs and by intense competition which precludes price increases sufficient to cover rising costs. These challenges are reflected in our after-tax return on sales, which declined last year to 3.5% from 3.8% in 1969 and 6.7% ten years ago.”*

Return on sales is depressed when costs rise relative to revenues. As Figure 21 illustrates, each of the automotive firms in my sample had regular difficulties in maintaining a healthy return on sales, reflecting the challenges that these firms were having in managing their costs. Each of the major dips corresponds to economic recessions where higher costs led to depressed return on sales made worse when automotive firms dropped prices, as they often did, to maintain market share. During economic booms cost advantages were less problematic as margins were retained.

Figure 21 Big Three Return on Sales



4.4 Dynamic Capabilities

My research focused on the responses firms took to adapt their manufacturing operations to the persistent disturbances and associated persistent manufacturing implications they were facing from their environment—that is, how firms built and developed manufacturing flexibility.

Manufacturing flexibility has been studied extensively in the field of operations (Slack, 2005; Sethi and Sethi, 1990; Gerwin, 1993). Manufacturing flexibility can be defined as a firm's ability to adapt to environmental changes by varying products, product mix, and production volumes (Upton, 1994). This definition highlights how manufacturing flexibility fits the description of a dynamic capability in that it is a capability through which firms adapt their underlying manufacturing operation to changing environmental conditions.

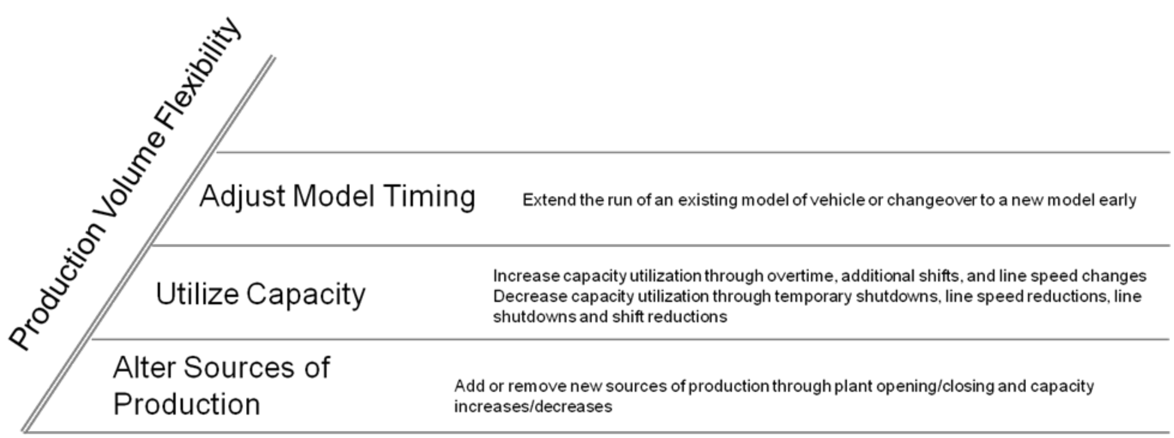
Manufacturing flexibility comprises different types of flexibility that permit different forms of adaptation. While the operations literature recognizes different types of flexibility, the dynamic capabilities literature has largely treated manufacturing flexibility as a unitary dynamic capability (see Malik and Kotabe, 2009). In analyzing my data, I found three types of manufacturing flexibility pertinent in my study. The first was production volume flexibility, which enabled firms to adjust the total volume of product produced. The second was production mix flexibility, which enabled firms to switch among different classes of vehicles or vehicles with different properties or characteristics. Finally, partnering flexibility enabled firms to modify how they relied on partners with respect to satisfying their manufacturing obligations.

My data analysis revealed that each of these dynamic capabilities was aligned with a particular persistent manufacturing implication. Figure 9 illustrated the relationships among persistent disturbances, persistent manufacturing implications, and dynamic capability development. As the figure highlighted, while my data analysis found that multiple persistent disturbances translated into three persistent manufacturing implications, my data analysis also showed that a one-to-one relationship existed between a persistent manufacturing implication and a specific dynamic capability in manufacturing flexibility that firms built in response. In my study, these dynamic capabilities developed over decades. In this section I build narratives describing how each of these dynamic capabilities developed over my study period. The raw data for these narratives can be found in the appendix in Tables A4 through A12.

4.4.1 Production Volume Flexibility

Production volume flexibility refers to a firm's capability to increase or decrease the volume of vehicles the firm produces over a given time period. This was a dynamic capability in that it was through production volume flexibility that the firm's underlying manufacturing capability was modified and adapted to meet changing environmental conditions. I found that it was possible to discern the capabilities that comprised a firm's dynamic capability in production volume flexibility. These capabilities functioned as building blocks for the dynamic capability. Figure 22 illustrates these capabilities as they pertain to the dynamic capability of production volume flexibility. Below I discuss how these capabilities comprise an automotive firm's dynamic capability in production volume flexibility. These capabilities are *alter sources of production*, *utilize capacity,* and *adjust model timing*.

Figure 22 Development of Production Volume Flexibility



Alter Sources of Production

The first capability, alter sources of production, pertains to the ability to increase or decrease plant capacity and to open or close entire plants. For instance, in 1994 Ford increased the capacity of their St. Louis plant from 135,000 units to 445,000 units so as to build Ford Explorer SUVs alongside Aerostar vans. This was accomplished through a 700,000-ft^2 expansion [Ward's, 1995]. Alternatively, adding new sources of production can involve opening new plants, such as the Sterling Heights facility opened by Chrysler in 1984 to build the Chrysler LeBaron and the Dodge Lancer [Ward's, 1985], or unshuttering idled plants like the St. Louis South plant in 1995, revived to produce Dodge Rams [Ward's, 1996].

To adjust production volume down, manufacturing plants may also be closed or idled for defined periods of time. For instance, between March 1980 and March 1981, GM idled their South Gate plant [Ward's, 1981], and in 1997 Ford shut down their Lorain plant for two years [Ward's, 1998]. Plants may also be closed indefinitely. In these cases, manufacturing firms retain ownership over the facility and are able to re-open the plant should conditions warrant. Finally, plants may be closed permanently, and the property sold and converted to other uses.

Utilize Capacity

The second capability, utilize capacity, involves increasing or decreasing the utilization of a firm's manufacturing plants. Capacity utilization can be increased through the use of overtime by requiring employees to work longer days and by extending weeks to include Saturdays. Adding new shifts to an existing plant also improves capacity utilization since facilities are used for more hours of the day. Manufacturing firms increased the number of shifts employed for a given facility from one or two shifts a day to two or three shifts a day. This requires hiring additional employees to work the new shifts. Finally, capacity utilization can be increased by speeding up the production schedule at a facility, by increasing assembly line speeds which may or may not involve hiring additional employees.

Reducing capacity utilization can be done in various ways. First and very simply, it can involve temporary shutdowns to control inventory and reduce production volumes. In 1990, Ford closed their plants for a total of 85 plant weeks to control inventory levels [Ward’s, 1991]. In the same year Chrysler engaged in sporadic one- and two-week plant shutdowns [Ward’s, 1991]. A second way to decrease capacity utilization is to reduce manufacturing line speeds so as to produce fewer vehicles. This approach is typically associated with laying off employees. A third way is to shut down lines within a plant. For example, in 2005 GM shut down a production line in Oshawa and idled one in Spring Hill [Ward’s, 2006]. Finally, manufacturing firms may reduce the number of shifts active at a given plant; for example, GM eliminated a second shift at their Buick City in 1987 [Ward’s, 1988].

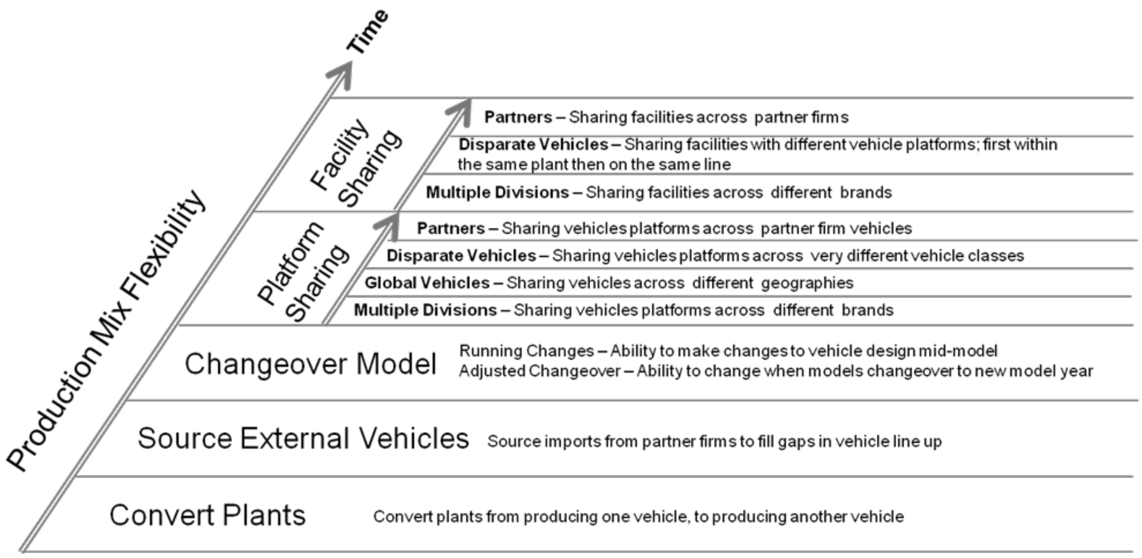
Adjust Model Timing

The final capability pertains to adjusting model timing. The automotive business is seasonal, with new vehicle models released annually. New models may constitute dramatic revisions of a vehicle including new specifications and features or they may involve small updates in styling. Typically, new models are announced and displayed at annual automotive shows early in the calendar year and manufacturing begins during the latter part of the summer. At times when demand for the vehicles of a given model year is high, firms change models over later, extending the run of the existing model and delaying the launch of new models. In 1984 GM extended the production run of the Fiero and 2000 Sunbird into November to satisfy sustained customer demand [Ward's, 1985]. Similarly, a firm may delay plans to end the production of certain models when demand warrants. In 1986, Ford delayed plans to drop the Grand Marquis in response to stronger than expected market demand [Ward's, 1987]. Conversely, when demand for vehicles is low, manufacturing firms cease production of a model earlier than originally planned. This may involve an idle period for a plant, experienced as unscheduled downtime, or it may involve commencing production on new models earlier than originally anticipated.

4.4.2 Production Mix Flexibility

The repeated oil crises of the 1970s were catalyzing events for the automotive industry. However, these crises were just the beginning of significant turmoil in the industry and marked the start of fluctuations in consumer model preference. Despite the difficulty in doing so, North American automotive firms were often required to make dramatic changes to the mix of vehicles they manufactured from one year to the next. Customer demand swung between vehicles of different classes, properties, and models. North American automotive firms initially responded to these swings by leveraging their existing capabilities; converting plants, sourcing external vehicles, and changeover models. As the need to rapidly adjust production mix persisted, firms developed new and increasingly sophisticated capabilities in platform sharing and facility sharing. Below I discuss how this dynamic capability developed over the course of my study period from 1965 to 2010. I pull much of the data for this narrative from the annual analyses of Ford, GM, and Chrysler found in Ward's Automotive Yearbooks, supplementing the telling of the story with facts from a variety of additional sources. Figure 23 depicts this development graphically.

Figure 23 Development of Production Mix Flexibility



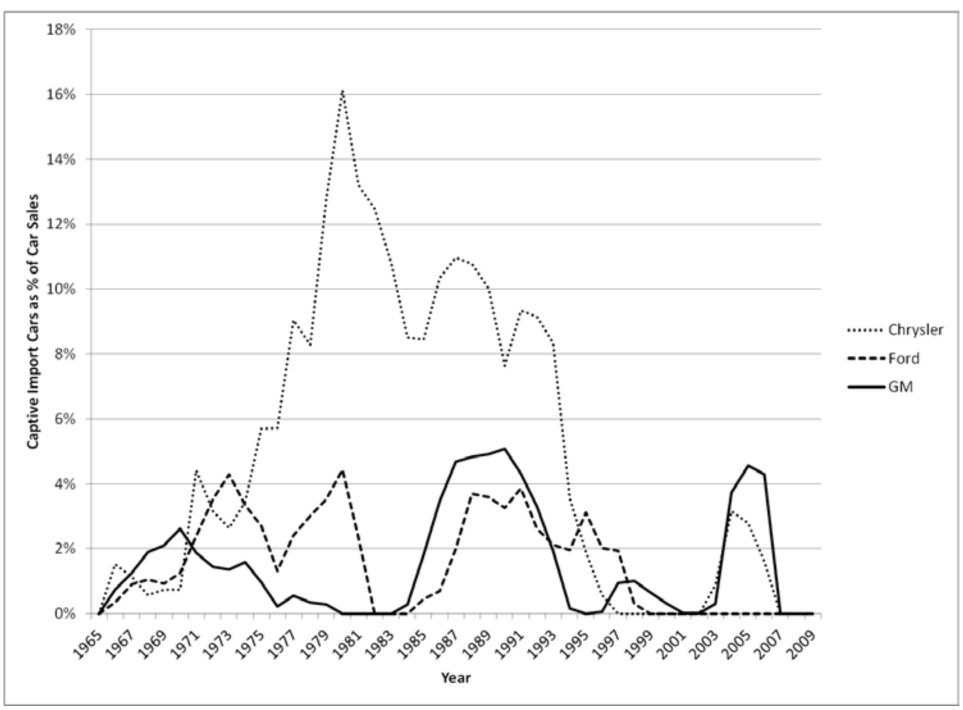
The 1970s proved especially challenging for automotive firms. The repeated oil crises in 1973 and 1979 shocked the automotive industry, each causing large swings in demand from big to small cars. Combined sales of compact and subcompact cars increased from 33% in 1970 to over 50% of automobiles sold through the 1980s. Corresponding decreases in larger-automobile sales were also recorded. Making matters worse, the swing towards small cars was not direct. Following each of the crises the sales of larger automobiles bounced back when gasoline prices temporarily declined, gasoline rationing was suspended, and national concern over energy security diminished. The result was that firms were faced with swings in demand between large and small cars over a 10-year period.

In response, firms were forced to change their production mix from one weighted with large cars, to one that favoured smaller, more fuel efficient vehicles. Changing a firm's production mix involved either introducing new vehicles to fill a gap in the firm's product line-up or shifting production among existing vehicles. During the 1970s, GM, Ford, and Chrysler deployed capabilities that were poorly developed. These firms relied on smaller, more fuel efficient captive imports from Japanese partners, engaged in production changeover, and dramatic and costly plant conversions. I discuss each of these in turn.

Captive Imports

Captive importing is the practice of importing vehicles from third parties manufacturing in foreign countries and selling them under domestic brands. The term "captive" refers to how the foreign cars are sold under the importer or domestic automaker's own brand. North American automotive manufacturers largely partnered with Japanese firms for their captive importing programs. Ford partnered with Mazda, Chrysler with Mitsubishi, and GM with Suzuki and Isuzu. GM and Ford also had extensive European subsidiaries (Opel and Ford of Europe) and thus relied on imports of small cars from these subsidiaries as well.

Figure 24 Captive Import Cars as Proportion of Firm Car Sales



Chrysler was particularly reliant on captive imports. Possessing no domestically produced subcompact car, Chrysler was left with few options when responding to the shifts in demand towards small cars that occurred during the 1970s [Ward's, 1974]. Over this time, Chrysler imported an increasing volume and variety of vehicles from Mitsubishi, including the Dodge Colt, Plymouth Arrow, Dodge Challenger, and Plymouth Sapporo. Chrysler relied on captive imports so much during the oil crises of the 1970s that units of captive imports more than doubled from 6% to 16% of car sales between 1975 and 1980 (Figure 24). Ford and GM initially relied on captive imports from their European subsidiaries. GM imported the Opel-manufactured Kadett, Manta, and GT; Ford, the Capri and Fiesta. Both firms subsequently contracted the manufacture of these small European cars to their Japanese partners.

In all cases, North American automotive firms used captive imports to bolster their underdeveloped small-car programs that had been struggling to compete with low-cost Japanese competitors. Many small-car programs run by North American automotive firms were still in the planning stages when the second oil crisis hit [Ward's, 1981]. Chrysler Chairman Lee Iacocca said it plainly when describing the impact Japanese firms were having on North American automotive manufacturers: "they're murdering us" [Ward's, 1990: 15]. Making use of captive imports allowed firms to avoid the years of research and development and millions of dollars of investments to bring a new vehicle from concept through to production readiness. A single engine plant alone can cost $600 million [Ward's, 1982], and it was reported that Ford's world car program, the basis for the Ford Contour and Mercury Mystique, cost $6 billion and took upwards of 10 years (from 1985 to 1995) to complete [Ward's, 1995].

Convert Plants

Each of the Big Three automotive firms struggled to adjust their production mix by increasing the production of small cars to meet demand and decreasing the production of large cars to slow the accumulation of inventories. Firms shifted their production in two ways. First, they converted plants on a massive scale to adjust their production mix in favour of small cars. Second, they adjusted model changeover times to permit the continued production of larger or smaller cars as necessary. I discuss each approach below.

Each of the Big Three underwent massive plant conversions to replace big-car capacity with small-car capacity. They shut down and reduced the capacity of large-car plants, and then converted and opened new small-car plants or increased the capacity of existing small-car plants. At Ford this conversion was perhaps the most dramatic. Ford increased production rates for their small car, the Pinto, at Ford's Metuchen and San Jose plants. Ford also converted Dearborn and San Jose to the production of the Mustang II, Chicago to the intermediate-sized Torino, and Wayne to the smaller Maverick. For Ford, these conversions added 1 million units of small cars—a conversion of 40% of Ford's annual sales [Ward's, 1974]. This feat was referred to as the "fastest and most expensive production model-mix shift in history" [Ward's, 1973]. It was a brute force approach to a dramatic problem. These are signs that firms were attempting to find the right mix of vehicle and facility during this time. GM engaged in a number of plant conversions as well, shifting the production of vehicles to different plants. In 1971, they moved their Nova to their Van Nuys and Norwood plants and moved the Camaro from Van Nuys to Norwood [Ward's, 1972]. In 1977, they added the LeMans to their Baltimore plant and dropped it at their Lakewood facility. They added the Sunbird to their Lordstown plant and the Phoenix to both the Willow Run and North Tarrytown plants, while dropping the Ventura from their Van

Nuys plant [Ward's, 1978]. During significant conversion from big to small cars in 1973, GM was forced to lay off workers while plant conversions occurred [Ward's, 1974].

Production Changeover

New and updated vehicle models are introduced on a yearly schedule that starts in the late summer. At this time, manufacturers may introduce entirely new vehicle models or make smaller cosmetic or incremental adjustments. During the 1970s, automotive firms used these model changeover periods to adjust the volume of a given vehicle or class of vehicles that was produced. For instance, in 1977, as large-car sales rebounded, Ford shut small-car plants earlier than scheduled so as to reduce the number of small cars produced. Simultaneously, they delayed the changeover of full-sized cars until August of that year, thereby increasing the number of larger cars produced [Ward's, 1978]. GM engaged in similar activities during 1978, ending production of their full-size vehicles several months early so as to convert the plant to new front-drive E-body vehicles that were more fuel efficient [Ward's, 1979].

I contend that these activities deployed a set of dynamic capabilities that had been developed, and which were better suited to changing production volumes up or down than to shifting production mix. Following the deployment of these poorly developed capabilities, the automotive firms built new capabilities that enabled them to more effectively adapt to changing consumer model preferences. Below I discuss the development of platform sharing and facility sharing.

Platform Sharing

Platform sharing refers to a practice whereby automotive firms design a vehicle platform that can be used to build multiple vehicle models. A good example is the platform supporting Chrysler's popular Plymouth Reliant, Dodge Aries, and Chrysler LeBaron cars. These were known as K-cars because they were built on Chrysler's K-platform. As was the case with Chrysler's K-cars, vehicles built from the same platform were often shared across different car divisions and, in time, different automotive partners.

Platform sharing served a number of purposes. One critical purpose was to spread the cost and effort of producing new vehicles across a larger production volume. Engineering effort and manufacturing complexity were dramatically reduced when a single vehicle platform was customized and tailored to the needs of different car divisions, rather than having to build unique vehicles for each division. Thus shared vehicle platforms served to reduce costs. Shared platforms were first employed to manufacture two or three very similar vehicles branded with different nameplates in order to satisfy the demands of different customer groups. This capability provided firms with the flexibility to shift production mix among brands based on varying demands and the changing tastes of customers. GM employed this strategy with many of their new car launches, often building three vehicles from a single platform such as their N- and E/K-platforms, which each produced vehicles for Oldsmobile, Pontiac, and Buick [Ward's, 1984; 1987]. Similarly, Ford built the Mustang, Thunderbird, and Fairmont off the same platform [Ward's, 1980], and, as discussed above, Chrysler's sister K-cars, the Reliant, Aries, and LeBaron, were all built on the K-platform [Ward's, 1982].

Vehicle platforms played a critical role in manufacturing flexibility as well. Shared platforms permitted firms to fill critical gaps in product line-ups faster as new technology became available and to more readily shift production among platform vehicles owing to the strong overlap in parts and manufacturing knowledge required. Sharing platforms meant that a firm's limited technology offerings for vehicles in high demand could be spread more effectively across the firm's brands. For instance, automotive firms could take a fuel efficient subcompact vehicle model, or a fuel efficient front-wheel drive vehicle model such as GM's X-car, and better leverage valuable engineering to satisfy fluctuations in consumer model preferences across multiple brands.

Platform sharing also meant that automotive firms could focus engineering effort on a reduced set of platforms. Ford was successful in reducing their platforms from 24 to 16 [Ward's, 1995]. At first this was done by taking existing vehicles and combining them onto the same platform. For instance, in 1979 Ford built both the Mustang and the Thunderbird from the Fairmont platform, eliminating the body platform previously used by the older model of the Thunderbird [Ward's, 1980]. Subsequently, further platform reduction was accomplished as new vehicles were designed and produced on existing platforms. Engineering effort was concentrated in other ways as well. Ford had reduced the number of engines they used from 30 to 14 by 1996 [Ward's, 1997]. GM began centralizing engine manufacturing to a greater extent, with divisions sharing their engines. Chevrolet shared their V-8 engine with other divisions; Oldsmobile provided their diesel engines to other divisions; and Pontiac shared their fuel efficient 4-cylinder engines [Ward's, 1979; 1980]. Further engine and transmission consolidation occurred when GM created a central Powertrain Division [Ward's, 1992]. In this way, shared platforms made it easier to disseminate cutting-edge technology as it became available.

Over time, platform sharing became more sophisticated, permitting firms to achieve an increasing diversity of models from a single platform. The Chevrolet Lumina platform is a great example of a single platform that permitted GM to produce a coupe, sedan, and minivan [Ward's, 1990]. Similarly, Chrysler built the new Pacifica platform originally to manufacture a station wagon, but it also became the basis for Chrysler's next generation of minivans [Ward's, 2003]. GM's GMT800 program enabled GM to produce 40 different models of SUVs and pickups from a single modularized vehicle platform [Ward's, 1999].

In addition to sharing platforms across brands, firms began to share platforms across partner firms. Chrysler engaged in joint platform development with Mitsubishi for their C- and D-segment vehicles that included the Dodge Neon [Ward's, 2003], and Ford's Probe was based on Mazda's 626-platform [Ward's, 1986]. In other instances, Ford and Nissan teamed up to share a platform to build small vans, including the Mercury Villager and the Nissan Quest [Ward's, 1992]. GM's joint venture with Toyota at their NUMMI manufacturing plant produced a variety of vehicles, including the Toyota Matrix and the Pontiac Vibe.

Platform sharing was not without its challenges. A critical challenge arose as consumers had difficulty differentiating among vehicles that looked increasingly similar to one another. Figure 25 shows three different vehicle models, the 1986 Oldsmobile Toronado, the 1986 Cadillac Eldorado, and the 1986 Buick Riviera. Each of these vehicles is based on the same underlying platform—what GM refers to as their E/K-platform. The pictures in Figure 25 show how the vehicles look very similar. Since each of an automotive firm's brands is carefully cultivated to appeal to specific market segments, this was a very real challenge. This was particularly challenging when platforms were shared across firms or across distinctive divisions within a firm, such as GM's Chevrolet, Opel, and Saturn [Ward's, 1998]. By this point shared platforms were not only heavily ingrained into the automotive firms, they were a financial necessity keeping costs lower. Chrysler responded to these criticisms by separating Chrysler and Plymouth into distinct brands, although the brands continued to share platforms. GM's SUV and pickup truck program, the GMT800, tried to get around some of the problems of undifferentiated platform vehicles by using a variety of modules that could be mixed and matched to produce greater variety of output from a still greatly reduced set of parts [Ward's, 1999].

Figure 25 GM E/K Model Vehicles

1986 Oldsmobile Toronado | 1986 Cadillac Eldorado | 1986 Buick Riviera

This practice of sharing platforms became so pervasive that it would be difficult to find a vehicle manufactured by GM, Chrysler, or Ford that is not built on a platform shared with another vehicle within the firm or with one of its subsidiaries or partners.

Facility Sharing

In addition to sharing vehicle platforms, North American automotive firms developed the capability to share facilities among automotive divisions and across subsidiaries and partners. Automotive firms frequently shared plants among their varied brands. This gave these firms the ability to more quickly adjust production based on which brands and vehicles were selling well. For instance, GM's N-cars were built for Buick, Oldsmobile, and Pontiac on a single production line [Ward's, 1984], and Chevrolet, Pontiac, and Oldsmobile split output for all-purpose vehicles

(APV) being produced at the North Tarrytown facility [Ward's, 1990]. At Chrysler, the Laser was built on the same line as the Reliant and LeBaron [Ward's, 1984]. Similarly, the New Yorker and the LHS shared output, and the Ram and Dakota trucks both shared a production line at Warren [Ward's, 1993]. Thus automotive firms could adjust their production output based on changes in market demand by shifting among their various brands.

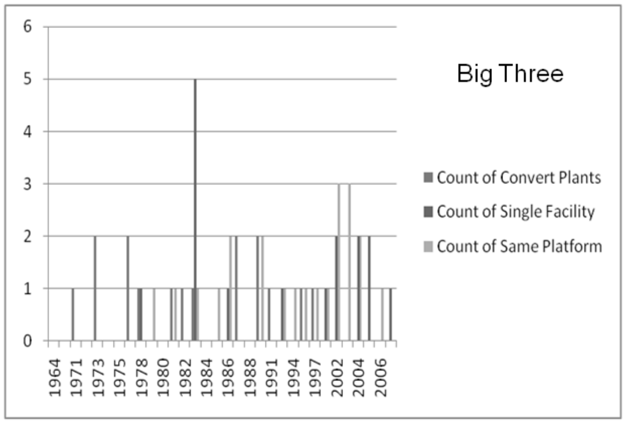
Facility sharing developed further such that automotive manufacturing facilities were able to produce very different vehicles in the same plant and even on the same line. For instance, during the move from rear-wheel drive to front-wheel drive vehicles, Ford developed the ability to manufacture both rear- and front-wheel drive vehicles at the same plant—a feat that had not previously been accomplished. Since front-wheel drive provided superior fuel economy performance, this permitted Ford to make adjustments to production output based on market demand for fuel efficient vehicles [Ward's, 1984]. Similarly, Ford and Chrysler, at their St. Thomas and Sterling Heights facilities respectively, developed the ability to produce both big and small vehicles [Ward's, 1984; 1987].

Subsequently, automotive firms built capabilities in flexible manufacturing, permitting them to manufacture models from multiple platforms on the same assembly lines. Such flexible plants became more commonplace. Ford's Chicago plant comprised a multi-supplier park and assembly line that could produce eight models from two platforms by 2003 [Ward's, 2004]; Ford's Rouge plant was redone to accommodate three distinct platforms up from two [Ward's, 2003]; and Ford's Dearborn plant was capable of producing nine models from three platforms [Ward's, 2005]. Ford prepared for their CUV production by creating a flexible truck campus in Oakville [Ward's, 2008]. Chrysler developed similar capabilities, with 60% of their assembly plants featuring advanced flexible manufacturing capabilities that permitted production of multiple models from various platforms on the same assembly line [Ward's, 2006]. GM bulldozed inefficient plants to build state-of-the-art facilities, such as new flexible manufacturing facilities in Oshawa [Ward's, 2005], and a 500-acre, state-of-the art facility named Buick City [Ward's, 1984].

Finally, firms began sharing facilities across partner organizations. One of the most well-known facility-sharing arrangements occurred between GM and Toyota, which invested jointly in a production facility called NUMMI in California. GM and Toyota split the output of this facility, co-producing one vehicle, the Pontiac Vibe and Toyota Matrix, while using additional capacity at the facility for other vehicles. Similarly, in 1986 Chrysler announced a joint venture with Mitsubishi to assemble cars in Illinois under the banner of Diamond Star Motors, despite selling their stake 2 years later [Ward's, 1987]. Ford shared facilities with partners as well, including an arrangement with Nissan to jointly manufacture minivans [Ward's, 1992] and a joint production facility with Mazda at their Flat Rock plant, Auto Alliance International [Ward's, 1993].

As demonstrated above, firms developed and then elaborated increasingly sophisticated capabilities, which enabled GM, Ford, and Chrysler to exhibit a dynamic capability in flexibly adjusting production mix. Figure 23 illustrated and summarized these capabilities, depicting how they developed over time. Early capabilities included *plant conversion,* whereby firms converted plants from producing one vehicle to producing another vehicle; *external vehicle sourcing,* in which vehicles were acquired from external sources through captive importing; and *model changeover,* with running changes and adjusted changeover times to take advantage of a changing production mix. Subsequently, firms developed capabilities in *platform sharing,* which evolved from an ability to share across multiple divisions to one where firms were sharing platforms across disparate vehicles and partner firms. Finally, firms developed *facility sharing* that permitted firms to allow multiple divisions to share a single facility and, ultimately, to share facilities across disparate vehicle types and partner firms.

Figure 26 Production Mix Flexibility Capability Deployment – Big Three



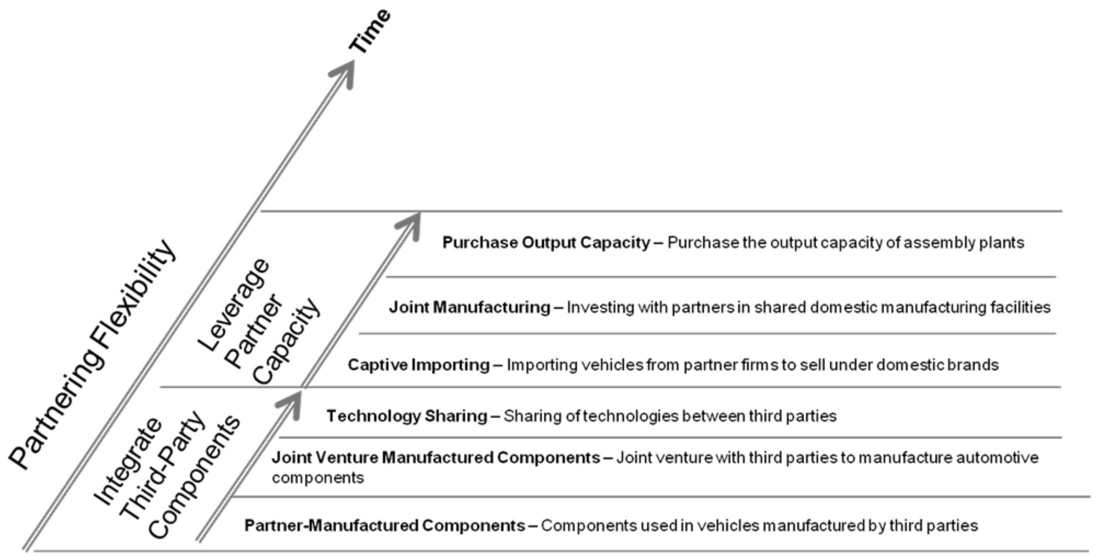
Despite the development of new capabilities in shared platforms and shared facilities, firms continued to deploy prior capabilities in converting plants, importing, and model changeover. Figure 26 shows how the use of plant conversion, facility sharing, and platform sharing continued over the study period. What is striking about the graph is the continued reliance on older capabilities. For instance, Ford continued to sell captive imports through 1997, and both GM and Chrysler sold captive imports to the end of the study period.

In broad strokes, a firm's ability to respond to production mix fluctuations developed substantially over the study period. This development was characterized by a move from being concerned with building production capacity for a specific vehicle, such as the Ford Mustang or the Chrysler Intrepid, to building production capacity for classes of vehicles, such as small cars, large cars, SUVs, or CUVs [Ward's, 1998; 2005]. Firms regularly discussed exchanging car class capacity among brands. As an example, Oldsmobile exchanged some if their H-body car capacity for additional X-car allocations [Ward's, 1980].

4.4.3 Partnering Flexibility

The third persistent disturbance, profit margin pressures, led firms to develop dynamic capabilities that allowed them to build and adapt partnerships with third parties in new and innovative ways. Firms developed and then elaborated increasingly sophisticated capabilities over the course of my study period. This development enabled GM, Ford, and Chrysler to exhibit a dynamic capability in partnering flexibility. Figure 27 illustrates and summarizes the capabilities which comprise partnering flexibility, depicting how these capabilities developed over time. Firms began by incorporating partner-manufactured components into their vehicles, subsequently developing this capability to facilitate sharing technology among partners. Similarly, firms began leveraging partner capacity through captive imports and subsequently developed this capability to support joint manufacturing and purchasing output capacity. I pull much of the data for this narrative from the annual analysis of Ford, GM, and Chrysler found in Ward's Automotive Yearbook, supplementing the narrative with data from additional sources.

Figure 27 Development of Partnering Flexibility



Leverage Partner Capacity

North American automotive manufacturers became increasingly reliant on partners to fill gaps in their vehicle line-ups. This reliance began as firms leveraged *captive importing* partners. Both GM and Ford began by using captive imports from their European division: Opel and Ford Europe, respectively. GM received 669,626 units from Opel between the mid-1960s and the mid-1970s. GM was particularly reliant on imports of subcompact vehicles from Opel [Ward's 1974], owing to their poorly developed domestic small-car program. Similarly, Ford imported 495,695 units from Ford Europe over the same period.

Both GM and Ford subsequently moved the manufacturing of their small-car models from their European subsidiaries to their Japanese partners, Isuzu (in 1976) and Mazda, respectively. GM sourced the Sprint and Spectrum vehicles from Suzuki and Isuzu, respectively, which helped GM bolster their small-car program starting in the mid-1980s. While Ford had their strongest captive import relationship with Mazda, purchasing vehicles such as the Lynx

[Ward's, 1987], they did source vehicles from Korean manufacturer Kia, such as the mini-compact Ford Festiva [Ward's, 1987], and from Merkur in Germany [Ward's, 1985;1988].

Chrysler, possessing no European subsidiary, partnered with Mitsubishi early and began importing multiple Mitsubishi models in 1970, including the Challenger, Colt, Sapporo, and Arrow, to fill out their smaller-car line-ups for the Dodge and Plymouth brands. Between 1970 and 1996, Chrysler imported over 2,130,000 vehicles from Mitsubishi. Captive importing was an early effort by automotive firms to access the capacity of partners skilled at producing small cars and trucks.

However, GM, Ford, and Chrysler's Japanese partners became increasingly eager to get a manufacturing foothold in North America in order to circumvent the voluntary import quotas imposed on Japanese automobiles. The relationship GM, Ford, and Chrysler enjoyed with their partners developed from one of captive importing to one of *joint manufacturing*. Each of the North American automotive firms developed joint manufacturing operations with Japanese partners on North American soil. Chrysler partnered with Mitsubishi in 1984 to form Diamond Motors, which produced vehicles out of Illinois. Through this partnership, Chrysler purchased vehicle output from this plant, including the Eagle Talon, Dodge Avenger, Chrysler Sebring, and Dodge Stealth over the duration of its existence. Ford agreed to purchase a share of output from Mazda's new manufacturing facility at Flat Rock in 1985 [Ward's, 1986], and subsequently in 1992 purchased a 50% equity stake [Ward's, 1993]. Finally, a well-documented joint manufacturing initiative called NUMMI Motors began between GM and Toyota in the 1980s (Adler, Goldoftas, and Levine 1999; Adler, 1993). GM and Toyota reached an agreement to deploy Toyota's production system in an idled GM plant in Fremont California [Ward's, 1984], in which they built a variety of vehicles to be sold under both brands. GM's share of the vehicles was initially the Chevrolet Nova, and then the Prizm and Geo Storm. These joint manufacturing moves benefited the Big Three as well as their Japanese partners, since their own captive imports had been capped by voluntary government quotas and they were having difficulty acquiring captive import vehicles.

The North American automotive manufacturers developed additional joint manufacturing arrangements as well. Ford partnered with Nissan in the late 1980s to build small vans—the Mercury Villager and the Nissan Quest—with Ford adopting the role of assembler and Nissan taking on the design and engineering [Ward's, 1988; 1992]. This joint venture lasted until 1998 [Ward's, 1999]. Further, Ford's Hermosillo plant in Mexico was originally a joint venture between Ford and Mazda. GM increased their integration with supplier partners, who took on a more integral role in the assembly of GM's automobiles. In 2001 GM named "lead interior integrators" to manage the development of passenger compartments in every North American vehicle, and these partners assumed overseeing and benchmarking roles. These deals were often international in nature. A deal between Daimler Chrysler, Mitsubishi, and Kia was struck in 2000 to manufacture high-quality, low-cost cars for multiple world markets—vehicles like the Dodge Neon [Ward's, 2001]. A further relationship between Chrysler and Volkswagen was struck to build minivans at Chrysler's St. Louis plant [Ward's, 2006].

These joint manufacturing relationships often involved substantial equity investments. Ford held equity stake in Mazda that reached 35% in 1996 [Ward's, 1996] before being reduced to 13% in 2008 [Ward's, 2009]. Similarly, GM held equity stakes in Isuzu (49%), Fuji (20%), Suzuki (20%), and Fiat (20%) over the study period. GM ended the Fiat and Fuji relationship in 2005 [Ward's, 2006] and the Suzuki and Isuzu relationships in 2006 [Ward's, 2007]. Chrysler purchased a 15% stake in Mitsubishi in 1971 [Ward's 1972], and the then merged Daimler-

Chrysler, increased that ownership to 37% before ending the relationship in 2005 [Ward's, 2006]. Joint ownership of facilities was also common. Ford, for example, purchased 50% of Mazda's facility in Flat Rock [Ward's, 1993].

North American automotive firms moved even more towards the use of third-party manufacturing plants, with North American automotive manufacturing firms purchasing *output capacity* from partners. These partners included other automotive manufacturers. Ford's Probe was built at Mazda's Flat Rock, based on Mazda's 626-platform. While its production included engineers from both companies, it was not a joint venture. Similarly, Mazda produced the front-wheel drive version of the Ford Mustang at the same plant. A Suzuki plant in Canada produced GM's Tracker [Ward's, 1990]. Chrysler negotiated with American Motor Company (AMC) to produce Chrysler's full-size rear-wheel drive cars at their AMC's Kenosha plant starting in 1987 [Ward's, 1987].

These partners also include major suppliers such as Magna International, which styles itself a Tier 0.5 supplier. Magna has the ability to conduct much of the full manufacturing and assembly of vehicles for automotive firms. They can leverage highly flexible facilities across multiple automotive clients. Chrysler is one firm to have taken advantage of this capability, selling an assembly plant to Magna International in 2002, which then began assembling vehicles for Chrysler [Ward's, 2003].

In summary, relationships that began through captive importing with foreign partners, moved first towards joint manufacturing and subsequently towards an inter-related system of manufacturing capacity that was shared among partners. Firms moved from assembling entire vehicles themselves, to partnering with others, to outsourcing the full assembly of automobiles in some cases.

Integrating Third-Party Components

A similar trajectory of development occurred with respect to how automotive firms purchased and integrated *partner-manufactured components*. This began with relatively straightforward relationships, as firms purchased manufactured components from suppliers. GM, Ford, and Chrysler each sought components to satisfy demand for smaller and more fuel efficient cars. For instance, GM sourced a diesel engine from Isuzu for their vehicles [Ward's, 1980], and more recently GM's Chevrolet Equinox featured a Chinese-built engine [Ward's, 2003]. Chrysler sourced small engines and manual transaxles from Volkswagens to support their efforts to build a domestic subcompact car [Ward's, 1975], and regularly sourced parts and components from external companies [Ward's, 1981]. Chrysler used Mitsubishi engines to power their New Yorker vehicles [Ward's, 1988]; by 1995 they reversed the trend, looking to move all engines in-house [Ward's, 1996]. Ford received small engines from Mazda [Ward's, 1985]. The liberalization of parts sourcing is well evidenced by Ford's decision to source sliding doors for a new minivan from GM's parts department, as opposed to Ford's own Visteon parts arm [Ward's, 1999].

Automotive firms built on these initial relationships with suppliers to develop *joint ventures* with foreign and domestic partners to produce parts for shared projects. Ford was involved in joint ventures with Alfa Romeo for aluminum engine components at their Windsor plant [Ward's, 2001], with Peugeot for two power plants [Ward's, 2006], and with Changan and Mazda in China for an engine plant [Ward's, 2006]. Chrysler created a joint venture with

Mitsubishi to build engines in Germany for use in Smart and Mitsubishi cars [Ward's, 2002]. Chrysler also created a partnership with Hyundai and Mitsubishi to produce four-cylinder engines [Ward's 2003], increasing the extent of this relationship in 2004 [Ward's, 2005]. Domestically, the Big Three also collaborated on projects, including one joint venture between GM and Chrysler on four-wheel drive transfer cases, manual transmissions, and various driveline products [Ward's, 1998].

Some automotive firms took partnering beyond component sourcing and joint ventures to the next level through *technology sharing*. Ford, for instance, developed and maintained a relationship with Mazda that involved Ford using Mazda's platforms to build vehicles, such as a B-segment car that was based on Mazda's Mazda2 architecture [Ward's, 2009]. However this collaboration went both ways, with Mazda designing their Mazda 626 in Ford's Small Vehicle Center in Cologne, suggesting that the 626 would share a platform with Ford's next world car [Ward's, 1999].

Chapter 5 – Analysis

5.0 Analysis

5.1 Overview

The purpose of this study was to examine how firms developed dynamic capabilities in response to a specific form of environmental dynamism: persistent disturbances. In conducting my research, I undertook an inductive theory-building approach, analyzing a longitudinal archival dataset detailing the activities of Ford, Chrysler, and GM in the North American automotive industry between 1965 and 2010. In what follows, I build on the findings presented in the section above, formalizing propositions that capture insights about dynamic capability development in the context of persistent disturbances. The propositions are summarized in Table 9 and are developed in detail in the remainder of this chapter.

Table 9 Proposition Summary

Proposition 1: The architecture of dynamic capabilities comprises capabilities. These capabilities function to increase the speed, reduce the cost, or increase the flexibility of firms' dynamic capabilities.
Proposition 2: When responding to persistent disturbances, firms that build dynamic capabilities develop them so as to adapt to the more predictable, rather than stochastic, elements of the environmental dynamism that the firms face.
Proposition 3: When responding to newly emerging persistent disturbances, firms initially deploy existing capability endowments that have been developed for other persistent disturbances. This response has low technical fitness.
Proposition 4a: When responding to newly emerging persistent disturbances in increasingly complex environments, firms that build dynamic capabilities develop their dynamic capabilities through a process of dynamic capability layering.
Proposition 4b: When responding to persistent disturbances, firms that develop dynamic capabilities do so by building new capabilities and refine existing capabilities, which increase the technical fitness of firms' dynamic capabilities over time. The resulting dynamic capabilities develop in a path-dependent manner along a trajectory that is reinforced by persistent disturbances.

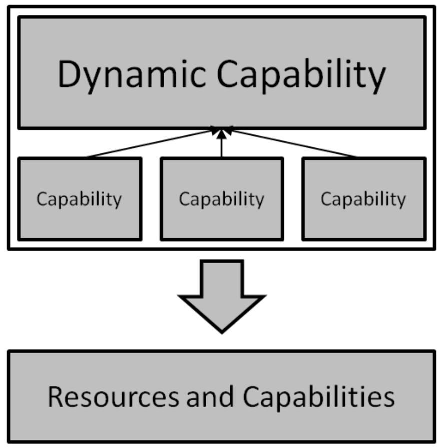
5.2 Dynamic Capability Architecture

My findings build on previous research that has stressed how dynamic capabilities comprise assemblages of heterogeneous elements (Salvato and Rerup, 2011; Helfat et al, 2007). In my study, I found that these heterogeneous elements consisted of a portfolio of capabilities that underpinned each firm's dynamic capabilities. For example, I found that five capabilities underpinned production mix flexibility: *convert plants, source external vehicles, changeover models*, *platform sharing,* and *facility sharing*. Similarly*, utilize capacity, adjust model timing,* and *alter sources of production* were capabilities that comprised a dynamic capability in production volume flexibility. These capabilities are akin to the building blocks of dynamic capabilities. Other research has noted how dynamic capabilities comprise collections of routines and capabilities (Schilke and Goerzen, 2010; Salvato and Rerup, 2011).

More important than the composition of dynamic capabilities are the relationships among those heterogeneous elements. The concept of dynamic capability architecture stresses the importance of these relationships. Dynamic capability architecture refers to how different elements associated with a dynamic capability fit together or relate to one another (Jacobides, 2006). On this topic, there is existing research from which to draw. Most well understood is the hierarchical relationship between dynamic capabilities and underlying ordinary capabilities. Dynamic capabilities modify lower-order ordinary capabilities, which in the case of my study were the manufacturing capabilities firms used to manufacture automobiles (Collis, 1994; Winter, 2003; Salvato and Rerup, 2011). The microfoundations research by Teece (2007) proposes three generic capabilities that undergird dynamic capabilities: seizing, sensing, and transforming. Other research describes different modes through which firms can alter their underlying resources and capabilities. Eisenhardt and Martin (2000) describe four ways in which firms adapt their resource bases: leveraging existing resources, creating new resources, accessing external resources, and releasing resources. This approach has received some preliminary empirical support (Danneels, 2010).

The capabilities that I found stressed a supportive role for those capabilities comprising a dynamic capability architecture. Figure 28 illustrates this architecture, distinguishing between the capabilities that comprise a dynamic capability, and the *ordinary* capabilities that dynamic capabilities are built to adapt. This role draws support from prior research, which has stressed how capabilities can complement dynamic capabilities (Anand, Oriani, and Vassolo, 2010; Helfat, 1997), serving both operational and dynamic purposes to "make change possible" (Helfat and Winter, 2001: 1248). What distinguished the capabilities that I found is that they were not necessarily geared towards change or adaptation themselves. Instead, capabilities facilitated change processes, making change faster or less expensive or providing a range of alternatives. Below I use examples from my study to illustrate how capabilities supported dynamic capabilities in adapting underlying ordinary capabilities. Table 10 summarizes the different ways in which the capabilities I found supported their respective dynamic capabilities.

Figure 28 Dynamic Capabilities Architecture



Increase Speed

The capabilities that comprised a dynamic capability can increase how quickly a firm can deploy a dynamic capability—in the case of my study, how quickly they could exhibit manufacturing flexibility. Two examples of this from my study are *platform sharing* and *facility sharing* capabilities. While these two capabilities did not directly modify lower-order manufacturing capabilities, they enabled firms to more flexibly and much more quickly shift between different vehicle models. Recall that in the 1970s and early 1980s, Ford, Chrysler, and GM each engaged in months of effort to convert existing large-car plants to be able to produce smaller cars. In the 2000s, with the development of platform sharing and facility sharing, this same scale of conversion is unnecessary. Instead, the automotive firms are now able to adjust their production schedule by switching among vehicles on the same platform and among different platforms at a facility that is trained and capable of producing many different vehicles from many different platforms.

Decrease Costs

Similarly, while they were initially costly to build, *platform sharing* and *facility sharing* capabilities dramatically reduced the costs associated with shifting production across different vehicle models. Prior to the development of platform sharing and facility sharing, firms would convert a plant, substituting the capability to manufacture one type of vehicle with the capability to manufacture another type of vehicle (Lavie, 2006). These conversions involved new tools and manufacturing equipment, as well as extensive training, all of which can be very expensive. However, after building these two capabilities, firms could switch production among different vehicles with minimal conversion costs.

Table 10 Capabilities Comprising Dynamic Capabilities

	Capability	Description	How it Supports
Production Volume Flexibility	Utilize Capacity	Adjusting plant utilization through overtime, number of shifts, line speed, and temporary shutdowns	Increases range of alternatives
	Adjust Model Timing	Adjust length of production runs; extend to increase volume and end to decrease volume	Increases range of alternatives
	Alter Sources of Production	Change sources of production through plant opening or closing and capacity increases or decreases	Increases range of alternatives
Production Mix Flexibility	Convert Plants	Change which vehicles are produced in a given plant	Increases range of alternatives
	Source External Vehicles	Source vehicles from foreign (or domestic) partners	Increases range of alternatives
	Changeover Models	Selectively adjust length of production runs; extend popular models and end undesired models	Increases range of alternatives
	Platform Sharing	Sharing multiple vehicle models across a single vehicle platform	Increases adaptation speed Decreases costs of adaptation
	Facility Sharing	Sharing multiple vehicles or platforms within a single facility	Increases adaptation speed Decrease costs of adaptation
Partnering Flexibility	Integrate Third-Party Components	Source components from third parties through purchase, joint ventures, and technology sharing	Increases range of alternatives
	Leverage Partner Capacity	Source vehicles from third parties through captive importing, joint manufacturing, and purchasing output capacity	Increases range of alternatives

Diversity of Alternatives

The different capabilities that comprise a dynamic capability reveal a broad diversity of response alternatives, each with different properties. This diversity of response alternatives increases the flexibility with which a firm can respond to persistent disturbances. I illustrate the importance of this diversity by considering production volume flexibility. This dynamic capability comprised three distinct capabilities that permitted a firm to alter sources of production, adjust capacity utilization, and adjust model timing. Two of these capabilities, utilize capacity and alter sources of production, could be deployed in a variety of ways. These capabilities offered many different ways to respond to fluctuating consumer demand. Firms could increase the capacity of existing facilities through overtime, new shifts, or changing line speeds. With more time, or as disturbances became more severe, the firm could add or remove new plants or adjust the capacity of existing plants through investments. As an additional illustration, consider the capability leveraging partner capacity, which is part of a dynamic capability in partnering flexibility. This capability provided firms with a variety of partnering options, ranging from sourcing fully manufactured components from partners, to engaging in joint manufacturing of components, to technology sharing initiatives. I argue that this diversity facilitates dynamism in the face of persistent disturbances because the firm is prepared to respond to a variety of contingencies.

This preceding discussion is summarized in the following proposition:

> ***Proposition 1****: The architecture of dynamic capabilities comprises capabilities. These capabilities function to increase the speed, reduce the cost, or increase the flexibility of firms' dynamic capabilities.*

5.3 Persistent Disturbances and Dynamic Capability Development

5.3.1 Environmental Dynamism – Unpredictability and Dynamic Capabilities

The dynamic capabilities literature presents a bit of a paradox. On the one hand, dynamic capabilities exist to deal with environmental dynamism (Teece, Pisano, and Shuen, 1997). Firms are challenged to build dynamic capabilities today that help them respond to future challenges (Teece, 2007; Doving and Gooderham, 2008). This dynamism, however, means that the dynamic capabilities firms build today may not be useful tomorrow. The result is that, while highly dynamic environments create futures where dynamic capabilities are thought to be most valuable, the same dynamism simultaneously makes it difficult to anticipate whether a particular dynamic capability will be useful in the future. Given that building and maintaining dynamic capabilities is expensive (Winter, 2003), building dynamic capabilities is most practical when firms are relatively confident that the dynamic capabilities in which they invest can be deployed in the future—in short, that investments in dynamic capabilities will be paid back (Pacheco-de-Almeida, 2010).

Unpredictability is a key dimension of environmental dynamism (Davis et al, 2009). My research highlights the importance of unpredictability in a firm's environment with respect to the development of dynamic capabilities. Environments are unpredictable when future events cannot be anticipated based on past events (Farjoun and Levin, 2011). Unpredictability is associated with higher levels of disorder that make identifying patterns in a firm's environment difficult or impossible (Davis et al, 2009). All configurations of environmental dynamism are unpredictable in some respect. Environmental shifts are unpredictable because they are dramatic, one-time, discontinuous events that are difficult to predict and that can take organizations by surprise (Danneels, 2010). Ongoing environmental change is unpredictable owing to the rapid pace of change that makes the future difficult to anticipate (Teece, Pisano, and Shuen, 1997). Eisenhardt and Martin (2000) picked up on the central role of unpredictability in environmental dynamism when they defined moderately dynamic markets as those exhibiting some predictability with respect to direction and frequency of future changes.

I argue and find evidence to support that persistent disturbances exhibit lower levels of unpredictability than environmental shifts or ongoing environmental change do. There are two reasons for this lower level of unpredictability. The first is repetition. Persistent disturbances often comprise relatively homogeneous disturbances that have been repeated over time, and which appear likely to continue repeating. For instance, the socioeconomic and political dynamics underlying past oil and gasoline price fluctuations are harbingers of future gasoline price fluctuations in the same way that the increasing encroachment of government regulators in the 1960s and 1970s led firm executives and industry analysts to expect increasing regulation. Managers recognized that the increasing encroachment of government through regulations on emissions, safety, and fuel economy were becoming a part of the fabric of the industry:

> *"In the past, our success has depended primarily on our response to the test of the marketplace. In the future, we shall be severely tested by the need to respond at the same time to the requirements of the market and the requirements imposed by the Federal governments' safety and air pollution regulations." [Ford Annual Report, 1966]*

Automotive firms demonstrated that they were concerned about and predicted future disturbances throughout the period of my study. For instance, in 1983, Ford's annual report contained the following excerpt predicting a cyclical economy:

> *"[W]e are in a cyclical industry and must be prepared to face economic recessions down the road. We must husband our resources and spur our progress during times of favorable business conditions so we will be prepared for future downturns."[Ford Annual Report, 1983]*

It is reasonable to assume that managers at automotive firms also viewed the occurrence of future labour difficulties and energy challenges as highly predictable given the nature of fixed-duration labour contracts and the regular fluctuations in oil prices that occurred. In each of these instances, the persistent disturbances in question were predictable owing both to past repetition and to a reasonable expectation that this repetition would continue.

However, persistent disturbances also exhibit increased predictability when, through a process of translation, a diverse set of persistent disturbances affect particular firm functions, such as the firm's manufacturing capability, in a more focused manner. This translation process was highlighted in Figure 9. Consider, for example, one set of translation processes from my study. Fluctuations in consumer model preference were driven by different persistent disturbances: first, by energy-related challenges such as oil or energy crises and gas price increases that pushed consumers to purchase smaller, more fuel efficient vehicles; second, by regulations that tinkered with the incentives to purchase particular vehicles, including the Gas Guzzler Tax, and the crash testing program that changed public opinion regarding vehicle safety; third, by competitive activities, such as when firms launched new types of vehicles like minivans, SUVs, and CUVs. Even fashion trends can drive fluctuations in consumer model preferences. While these diverse disturbances at first glance appear disparate, the impact that they had on the firm's manufacturing operations was surprisingly consistent. Each forced the firm to adapt their production mix to changing preferences. In the process, a diverse set of persistent disturbances was translated into a more *predictable* persistent manufacturing implication.

I found that firms built dynamic capabilities specifically to address the predictable patterns that emerged from these persistent disturbances. Prior theorizing supports this finding

(Davis, Eisenhardt, and Bingham, 2009). In the North American automotive industry, I found three persistent manufacturing implications: fluctuating consumer demand, fluctuating consumer model preferences, and profit margin pressures. In my study I drew links among these three persistent manufacturing implications and three dynamic capabilities: production volume flexibility, production mix flexibility, and partnering flexibility. I argue that in each case, automotive firms built dynamic capabilities that helped them respond to the predictability inherent in these persistent manufacturing implications.

Persistent disturbances, owing to their homogeneity and repetition, attract the attention of managers and justify deliberate investments in dynamic capabilities. I argue that what drove firms to develop new dynamic capabilities was not the dynamism of the firm's environment, but instead its relative stability. The presence of persistent disturbances draws attention to those disturbances that are predicted to repeat in the future, and simultaneously justifies the investments in dynamic capability formation owing to greater certainty that the dynamic capability will be required in the future. In short, I found that firms built dynamic capabilities not in preparation for unpredictable futures but, instead, for persistent disturbance that were, and which continue to be, prevalent in their environments—persistent disturbances that can be predicted. This leads me to propose the following:

> ***Proposition 2****: When responding to persistent disturbances, firms that build dynamic capabilities develop them so as to adapt to the more* ***predictable****, rather than stochastic, elements of the environmental dynamism that the firms face.*

5.3.2 Coping with Newly Emerging Persistent Disturbances

On occasion, firms are confronted with new disturbances that threaten to become persistent. My analysis identified two such disturbances during the study period: the first when consumer model preferences began fluctuating more substantially in the 1970s, coinciding with the two oil crises; the second when profit margin pressures intensified as Japanese firms brought and sustained strong competition at about the same time. These newly emerging persistent disturbances presented challenging environments to which firms were required to adapt.

My data analysis revealed that firms were poorly prepared for these new disturbances. The automotive firms redeployed pre-existing capabilities (Zollo and Reuer, 2010), or what Helfat and Peteraf (2003) would call endowments. In the case of consumer model preference fluctuations, my study shows that GM, Chrysler, and Ford each redeployed *plant conversion* and *model changeover* capabilities that had been built to enable the firms to adapt to fluctuations in consumer demand. Firms responded with massive plant conversions to remove large-car capacity and replace it with small-car capacity. They shut down and reduced the capacity of large-car plants, and then opened up new (or converted) small-car plants or increased the capacity of existing small-car plants. At Ford this conversion added 1 million units of small-car capacity—a conversion that amounted to 40% of Ford's annual sales. Similarly, as profit margin pressures threatened to affect sales, firms turned to *captive imports* and *sourcing third-party components*; both of these approaches that firms were already deploying to satisfy the increased demand for smaller cars due to consumer model preference fluctuations. The above discussion highlights how the effectiveness of a firm's dynamic capabilities is contingent on the environment in which the firm is operating (Helfat et al, 2007). In my study, this contingency meant that the effectiveness of different dynamic capabilities was contingent upon the specific persistent disturbance being addressed. A well-developed capability exhibiting strong technical fitness in response to one type of persistent disturbance may be poorly suited to other persistent disturbances and may perform ineffectively (Helfat et al, 2007).

These repurposed dynamic capabilities permitted adaptation, but at great cost. These dynamic capabilities exhibited poor *technical fitness* (Helfat et al, 2007). The concept of fitness addresses the concern that not all dynamic capabilities are created equal (Winter, 2000). Scholars use the concept of fitness to capture differences between dynamic capabilities of higher and lower effectiveness. The literature on dynamic capabilities distinguishes between two different forms of fitness: evolutionary fitness and technical fitness (Helfat et al, 2007). Evolutionary fitness refers to how well a dynamic capability enables a firm to survive and even grow in changing environments. It is akin to whether or not firms are performing the right set of activities (Mie and Teece, 2009). Technical fitness pertains to how effective a dynamic capability is at performing its intended function (Teece, 2007; Martin, 2011). Dynamic capabilities with greater technical fitness enable firms to respond to disturbances at less cost (Helfat et al, 2007).

My data suggested that as new persistent disturbances emerged, firms deployed primitive dynamic capability endowments that exhibited low technical fitness. They satisficed, deploying the first capability that provided an acceptable solution to the new challenge (Winter, 2000). Early periods of ineffectiveness or temporary underperformance are well documented in the research on dynamic capabilities. Rosenbloom (2000), in his study of NCR Corporation's efforts to adapt to the introduction of electronics in the field of business equipment, described how NCR experienced a painful crisis because NCR's capabilities were poorly suited to adapt to these changes. Salvato (2009), in his study of an Italian design firm, similarly identified an initial period of temporary underperformance when the firm was confronted with new challenges, followed by a permanent increase in performance. These findings are consistent with the idea that firms may at first simply cope with new challenges. This reinforces a view of dynamic capabilities as emergent and evolving (Rindova and Kotha, 2001; Eisenhardt and Martin, 2000; Danneels, 2008), and initially fragile (Narayanan, Colwell, and Douglas 2009). Dynamic capabilities are not always built fully formed in advance of a disturbance. Instead, they need to be developed and enabled (Pablo et al, 2007; Rosenbloom, 2000).

This leads me to formalize my third proposition:

> ***Proposition 3:*** *When responding to newly emerging persistent disturbances, firms* ***initially*** *deploy existing capability endowments that have been developed for other persistent disturbances. This response has* ***low technical fitness****.*

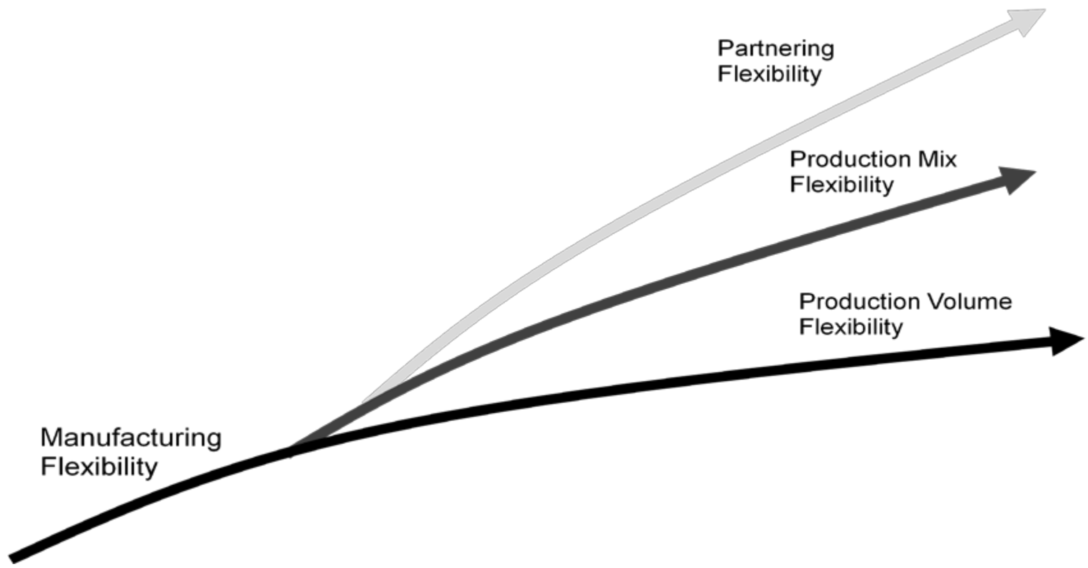
5.3.3 Dynamic Capability Development Through Layering

Prior to the 1970s, firms in the North American automotive industry possessed a dynamic capability in manufacturing flexibility that consisted largely of production volume flexibility. Firms deployed this dynamic capability to adjust production volumes in different ways, such as by opening and closing plants, changing line speeds, adding or removing shifts, and adjusting overtime. Initially, production volume flexibility was the extent of the North American firms' dynamic capability in manufacturing flexibility.

However, beginning in the 1970s and 1980s, the environment facing North American automotive firms became increasingly complex. Environments are complex when they comprise multiple heterogeneous contingencies that need to be addressed (Davis, Eisenhardt, and Bingham, 2009; Dess and Beard, 1984). Complexity manifested in my study as multiple concurrent persistent disturbances confronting the automotive firms. In addition to facing significant fluctuations in consumer demand, the automotive firms faced new disturbances: fluctuations in consumer model preferences and profit margin pressures.

As discussed above, firms initially coped with these new disturbances. However, as these disturbances persisted, firms responded to this complexity by building new *layers* of dynamic capabilities. Initial coping gave way to deliberate investments in improving the technical fitness of the dynamic capabilities that the automotive firms were deploying (Helfat and Peteraf, 2003; Keil, McGrath, and Tukiainen, 2009; Arikan and McGahan, 2010). I refer to this process as layering because at the core of each new dynamic capability was the set of initial capabilities that the firms had deployed in coping with the new disturbance. These existing capabilities served as the core around which new dynamic capabilities were elaborated. In the case of production mix flexibility, this core set of capabilities consisted of plant conversion capabilities, upon which layers of platform-sharing and facility-sharing capabilities were added. Similarly, a dynamic capability in partnering flexibility grew out of early captive importing and from sourcing partner manufactured components. The new dynamic capabilities were layered on top of existing capabilities, accumulating over time (Dosi, Nelson, and Winter, 2000). Thus the process of layering builds from a base capability, adding new layers to improve the efficiency and effectiveness of the firm's dynamic capabilities (Rindova and Kotha, 2001; Lampel and Shamsie, 2003). Figure 29 depicts this process of dynamic capability layering.

Figure 29 Dynamic Capability Layering



The foregoing discussions lead to my fourth proposition:

> ***Proposition 4a:*** *When responding to newly emerging persistent disturbances in increasingly complex environments, firms that build dynamic capabilities develop their dynamic capabilities through a process of dynamic capability* ***layering****.*

5.3.4 Dynamic Capability Development: Nested Layering

In addition to layering that occurred at the level of dynamic capabilities, I found that this layering process nested, extending down to the capabilities that comprised dynamic capabilities. For example, a capability in platform sharing began as a comparatively simple capability permitting firms to share vehicle platforms across different brands. This capability enabled firms to share innovative technology, such as front-wheel drive or smaller-car designs, more broadly across the firm's product line-up. Over time this capability evolved further to also enable firms to share similar vehicles that were customized to different geographies through Ford and GM's global car programs, and then to share platforms across disparate vehicle classes, such as Chevrolet's versatile Lumina platform that supported both a sedan and a van. Subsequent refinements extended the platform-sharing capability beyond organizational boundaries to incorporate partner firms. Ford and Mazda offer an excellent example of a platform-sharing partnership. Similar patterns of capability refinement occurred in facility sharing, integrating third-party components, and leveraging partner capacity capabilities. Refining existing capabilities, as opposed to acquiring new capabilities, permits firms to build on their strengths and have been found to provide greater payoffs with lower investments (Helfat et al, 2007; Lavie, 2006; Shamsie, Martin, and Miller, 2009).

In my context, what motivated this layering at the levels of both dynamic capabilities and the capabilities they comprised was the nature of the environmental dynamism firms were facing. Persistent disturbances repeated, exposing firms time and again to disturbances that had similar impacts. The effects of this exposure were three-fold. First, the continued repetition of persistent disturbances provided firms with ongoing *opportunities* to improve their ability to respond. Repetition has been shown to be an effective learning mechanism (Eisenhardt and Martin, 2000), and dynamic capabilities have been conceptualized as learned capabilities (Teece, Pisano, and Shuen, 1997). Firms get more proficient when dynamic capabilities are used more frequently.

Second, persistence disturbances *justified* continued investment in dynamic capability development. Each time firms were exposed to the persistent disturbance they had another opportunity to improve the performance of their response. Managers thus more readily recognized and could more easily justify the need to build and refine dynamic capabilities to respond to persistent disturbances.

Third, the persistent disturbance reduced *ambiguity* by enhancing what the firm knew about the persistent disturbance. Disturbances to which firms have not been exposed are more ambiguous because firms have a poor understanding of the disturbance. Firms confronting a one-time environmental shift are unlikely to have developed a sophisticated understanding of this new disturbance. Similarly, firms facing ongoing change are continuously being presented with disturbances, but the disturbances are different and thus affect the firm in a myriad of new and different ways. In contrast, persistent disturbances repeat relatively homogeneously over time and thus with each repetition firms are able to improve their understanding of the persistent disturbance. Understanding the disturbance a firm is facing is critical to developing an effective response (Zollo and Winter, 2002).

This is consistent with current theorizing regarding how firms both accumulate new capabilities and deliberately improve their existing capabilities. Zollo and Winter (2002) argue that firms learn what does and does not work by trial and error, and that these firms may then deliberately articulate and codify that knowledge to improve their ability to adapt. High levels of complementary knowledge can positively moderate this effect (Helfat, 1997), and this is consistent with descriptions of dynamic capability development as path dependent (Teece, Pisano, and Shuen, 1997; Vergne and Durand, 2011). In this way, dynamic capability development displays a tendency towards continuous improvement, always striving for better fit.

This leads me to state my final proposition:

> ***Proposition 4b:*** *When responding to persistent disturbances, firms that develop dynamic capabilities do so by building new capabilities and refine existing capabilities, which increase the technical fitness of firms' dynamic capabilities over time. The resulting dynamic capabilities develop in a path-dependent manner along a trajectory that is reinforced by persistent disturbances.*

Chapter 6 – Discussion

6.0 Discussion

6.1 Overview

In this study I sought to understand how firms developed dynamic capabilities in dynamic environments that were characterized by persistent disturbances such as government regulations, energy crises, labour disruptions, economic cycles, and competitive pressures. I focused my analysis on the manufacturing flexibility of the North American automotive firms I was studying. I identified and further analyzed the dynamic capabilities that these firms were building in response to persistent disturbances.

To do this, I adopted a longitudinal, inductive case-based approach to studying the North American automotive industry between 1965 and 2010. I focused on three key firms: GM, Ford, and Chrysler. I built a qualitative archival dataset primarily from industry and firm analyses found in Ward's Automotive Yearbooks and the letters to shareholders in firms' annual reports. I complemented this dataset with firm-specific financial information from Compustat and industry data from a variety of sources. I analyzed these data first by identifying the disturbances that were salient to the firms under study, and subsequently by examining the responses that the firms had to these salient disturbances. My analysis was designed so as to better understand the patterns of disturbances and responses occurring in the North American automotive industry over my 45-year study period.

In this section, I discuss the theory that I presented above, positioning it firmly within the dynamic capability and strategic management literatures. My discussion proceeds in two sections. The first pertains to how dynamic capabilities develop over time. To begin this discussion, I pay particular attention to dynamic capability architecture. I show how the architecture that I found offers insights regarding how dynamic capabilities develop. In the second section, I offer insights into the role played by different configurations of environmental dynamism in the formation and development of dynamic capabilities. I discuss differences in the dynamic capabilities firms build in environments characterized by ongoing environmental change, environmental shifts, and persistent disturbances.

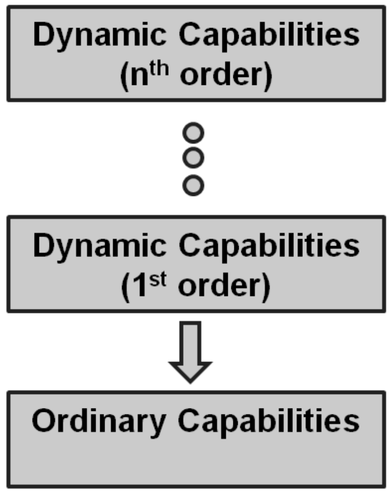
6.2 Dynamic Capability Development

I begin by discussing the importance of dynamic capability architecture (Jacobides, 2006). My research casts new light on what the architecture of dynamic capabilities looks like, particularly in the context of persistent disturbances. In turn, I use this capability architecture to offer insights into how dynamic capabilities develop over time.

6.2.1 Dynamic Capability Architecture

Capability architecture pertains to how different capabilities relate to one another (Makadok, 2001; Jacobides, 2006). Prior research into dynamic capabilities has addressed capability architecture in a variety of ways. Most common is the expression of dynamic capabilities as comprising part of a hierarchy of capabilities, distinguishing between dynamic and ordinary capabilities. Figure 30 highlights how dynamic capabilities are higher-order capabilities, the purpose of which is to modify underlying resources and lower-order ordinary capabilities (Danneels, 2008; Collis, 1994; Winter, 2000; Salvato and Rerup, 2009; Helfat et al, 2007). In my study, the firms' ordinary capabilities were their abilities to manufacture particular products, such as a model of a car (Helfat and Peteraf, 2003), while dynamic capabilities referred to manufacturing flexibility (Malik and Kotabe, 2009).

Figure 30 A Hierarchy of Dynamic Capabilities



While there is broad agreement on this hierarchy and where dynamic capabilities fit with respect to ordinary capabilities, the architecture of dynamic capabilities themselves has been discussed with less consistency and in less detail (Salvato and Rerup, 2009). Some work has attempted to address this gap. In their seminal article on dynamic capabilities, Teece, Pisano, and Shuen (1997) discussed how dynamic capabilities comprise coordination, learning, and reconfiguration routines. More recent research has refined this, arguing that three generic capabilities—seizing, sensing, and transforming—underpin dynamic capabilities (Teece, 2007). Despite this, research into dynamic capability architecture remains nascent.

My research highlights the importance of considering how dynamic capability architectures comprise capabilities. These capabilities largely comprised the building blocks of a dynamic capability offering a greater variety of ways in which to respond to disturbances that the firm faced. However, these capabilities do not necessarily engage in change to underlying resources and capabilities. Instead, these capabilities often enable a firm's dynamic capabilities to change underlying ordinary capabilities faster and at less cost. Two examples include platform sharing and facility sharing which both made shifting production among different vehicle models much faster and less costly.

Prior research has hinted at the capabilities that comprise dynamic capabilities but has offered little empirical elaboration. Helfat and Winter (2011) very briefly discuss the concept of dual purpose capabilities—capabilities that serve both ordinary and dynamic purposes. These dual purpose capabilities are described as those that "make change possible" (Helfat and Winter, 2011: 1248). However that research stream is at an early stage. Dual purpose capabilities are mentioned at the conclusion of a more expansive article on dynamic capabilities, and few empirical details are offered. Other research in this regard explores the microfoundations of dynamic capabilities. Microfoundations are defined as those "skills, processes, procedures, organizational structures, decision rules and disciplines…which undergird" sensing, seizing, and reconfiguring (Teece, 2007: 1319). These microfoundations include governance, research and development, and building loyalty and commitment, and they are theorized to span all dynamic capabilities across different contexts.

However, whereas the concept of microfoundations as put forth by Teece is independent of context, my findings strongly emphasize the importance of context. Prior research is split in this regard, with some research encouraging the study of very general dynamic capabilities (Teece, 2007; Marcus and Anderson, 2006) and other research stressing the difficulties with separating dynamic capabilities from their context (Ethiraj et al, 2005; Winter, 2000). This latter camp argues that dynamic capabilities have very specific purposes and support very specific activities, such as acquisitions, alliances, and new product development (Helfat and Winter, 2011). The arguments for context cast some doubt on whether it is even possible to identify a common set of microfoundations that undergird all dynamic capabilities. My own research pertained to a focused set of dynamic capabilities in manufacturing flexibility.

One consequence of the search for a common underpinning of dynamic capabilities may have been a homogenization of how dynamic capabilities are viewed. Salvato (2009) has lamented that capabilities are often discussed as though they are homogeneous across firms and time. A case in point comes from well-cited research by Eisenhardt and Martin (2000), who argue that dynamic capabilities are akin to best practices and possessed by many firms. Picking up on this discussion, my research shows how dynamic capabilities that seem very similar can in fact be very different. These differences are revealed by their capability architecture and the different capabilities each dynamic capability possesses. Two firms possessing dynamic capabilities that appear similar but that possess different capability architectures respond to disturbances in heterogeneous ways. For example, my study highlights how automotive firms responded to similar disturbances in different ways at different points in time throughout my study period. In the 1970s the automotive firms shifted their production mix by converting big plants to small plants, completely retooling facilities (plant conversion). Flash forward 20 years and these same firms responded to consumer model preference fluctuations by adjusting manufacturing schedules in flexible manufacturing facilities (facility sharing, platform sharing). Similarly, at different points in time the firms' manufacturing flexibility included production volume flexibility, production mix flexibility, and then partnering flexibility. Each of these modified the firms' same underlying manufacturing capability, but in different ways. They modified, respectively, how much product was produced, what product was produced, and with which partners. In short, I found that similar dynamic capabilities adapted lower-order ordinary capabilities in different ways. My research stresses the layered nature of dynamic capabilities, offering a new granularity with which to understand differences in dynamic capabilities among firms and over time.

These differences in dynamic capability architecture can help to explain differential abilities in similar dynamic capabilities. For instance, firms may have a strong dynamic capability in partnering flexibility but possess weak production volume or production mix flexibility. Further, firms may have strong platform sharing capabilities but inferior facility sharing capabilities, each of which can influence how well a firm responds to consumer model preference fluctuations. Deeper still, firms may have mastered how to share platforms across similar vehicles sold under different brands within the same firm, but not yet figured out how to share platforms across very disparate vehicles or partner firms, a gap that would negatively effect the technical fitness of the firm's production mix flexibility.

In short, not all firms exhibit manufacturing flexibility in the same way or at the same point in time. Malik and Kotabe (2009) illustrate this point, identifying how in an emerging market context, handling fluctuating consumer demand and reducing process inventories were challenges of critical importance while other challenges, such as handling consumer model preference fluctuations, were less critical. By conceptualizing dynamic capabilities at finer-grained levels of analysis, scholars will be in a better position to more clearly understand the dynamic capabilities that firms possess. McKelvie and Davidsson (2009) have suggested that the difficulty in identifying supportable hypotheses (a concern also shared by Leiblein, 2011) may be due in part to pursuing an understanding of dynamic capabilities that is too general. My research suggests that scholars should dig more deeply into the architecture of dynamic capabilities, attempting to achieve greater understanding through a more detailed view of the nature of a firm's dynamic capability.

6.2.2 Changing Dynamic Capabilities

In the analysis chapter above, I built theory pertaining to how dynamic capabilities developed over time. I argued that dynamic capability development began with firms coping in response to newly emerging persistent disturbances by redeploying dynamic capabilities that were designed and better suited for addressing other persistent disturbances (*Proposition 3*). Subsequently, while developing dynamic capabilities, firms responded to the predictable aspects of persistent disturbances in their dynamic environment (*Proposition 1*). Over time firms built additional *capabilities* that improved the technical fitness of the dynamic capability by making it increasingly better suited to addressing a particular persistent disturbance (*Proposition 4a and 4b*). In what follows, I place this theorizing within the context of prior research on dynamic capability development. I draw on the above discussion pertaining to dynamic capability architecture to do so.

Dynamic Capability Development: Initial Development

A debate in the dynamic capabilities literature centers on whether dynamic capabilities are developed in anticipation of future environmental dynamism and then deployed, or developed in parallel as environmental dynamism unfolds. Early definitions of dynamic capabilities seemed to suggest the former. Dynamic capabilities "address rapidly changing environments" (Teece et al, 1997: 516) and permit firms to "match…market change" (Eisenhardt and Martin, 2000: 1107). However, more recent research has found that dynamic capabilities develop substantially when firms encounter change in the nature of environmental dynamism facing the firm (Danneels, 2010; Helfat, 1997). For instance, a study of firms that had recently undergone initial public offerings found that capabilities for conducting acquisition and alliance deals crystallized quickly, but then evolved substantially over time (Arikan and McGahan, 2010). Promising research into the origins of dynamic capabilities has found that dynamic capabilities may at first be latent, requiring strong development from managers who identify and subsequently develop them (Pablo et al, 2007; Rosenbloom, 2000).

My research lends support to the argument that dynamic capabilities are built in parallel as the environmental dynamism unfolds. More specifically, I found that initially firms *coped* with new environmental dynamism. That is, they responded to the new environmental dynamism but in a technically inefficient manner. This finding is similar to prior research that found that as dynamic capabilities developed, firms experienced an initial period of poor performance (Rosenbloom, 2000; Salvato, 2009). My research builds on this by showing that firms initially underperform because they redeploy existing capabilities that were developed for different environmental dynamism. The strongest illustration from my study was the dramatic plant conversions in which the automotive firms engaged. Ford converted 40% of their production capacity from large to small cars. Similarly inefficient was the North American automotive firms' reliance on captive imports from Japanese partners. This reliance led North American firms to give up much of their autonomy and control over their small-car programs. Both examples illustrate how firms did not necessarily deploy poor capabilities to address new environmental dynamism, but rather inappropriate capabilities.

In related research, scholars have found that firms are often required to maintain multiple capabilities simultaneously as environments change (Gilbert, 2006). In environments characterized by environmental shifts or ongoing change, this is because firms need to operate in both the existing environment and the changed or changing environment. The firm requires a capability for each environment. When the change to a new environment is complete, the firm can presumably shed the prior capabilities. For instance, Daneels (2008) studied how Smith

Corona responded to a shift from mechanical to electric typewriters. As this shift progressed, capabilities in designing, manufacturing, selling, and servicing mechanical typewriters became less and less important. However, in an environment characterized by persistent disturbances, I found that firms maintained multiple capabilities over longer periods of time. This is because persistent disturbances persist and thus firms respond to these disturbances by redeploying familiar dynamic capabilities at a later point in time.

A key insight from my research is that, in an environment characterized by persistent disturbances, a firm's dynamic capability architecture reflects the past responses the firm took in response to the persistent disturbances they faced. It follows then that firms that have been exposed to different persistent disturbances, or which have experienced persistent disturbances in different ways, are likely to develop different dynamic capabilities and thus have built capabilities that permit the firm to adapt their underlying ordinary capabilities in different ways. This finding reinforces research that has suggested that a firm's ordinary capabilities are developed through different strategies—in short that dynamic capabilities develop their capabilities in nonlinear ways (Shamsie, Martin, and Miller, 2009). This result can explain differences between firms that each possesses some variant of a dynamic capability; such as the different manufacturing flexibility dynamic capabilities the automotive firms possessed over the study period. This insight may help to explain differences in technical fitness among similar dynamic capabilities by providing the language, dynamic capability architecture, with which to understand these idiosyncratic differences.

Dynamic Capability Development: Change

The literature on dynamic capabilities suggests that dynamic capabilities are changed by other dynamic capabilities (Helfat et al, 2007). Just as dynamic capabilities act on ordinary capabilities, higher-order dynamic capabilities (2nd, 3rd, 4th, and so on) modify lower-order dynamic capabilities (Collis, 1994). These higher-order capabilities are such that they allow firms to overcome the path dependence that led to the rigidity of lower-order capabilities. While simple in concept, this approach suffers from the problem of infinite regress because firms are required to have an infinite number of higher-order dynamic capabilities (Collis, 1994). This can quickly become intractable.

My study offers an alternative perspective on how dynamic capabilities are changed, articulating how dynamic capabilities are developed through a process of layering at both the level of dynamic capabilities, and the capabilities that comprise them. I found that a firm's manufacturing flexibility comprised layers of dynamic capabilities (production volume flexibility, production mix flexibility, and partnering flexibility). In turn, I found that each of these dynamic capabilities was supported by layers of capabilities. I argue that change to a dynamic capability was accomplished not by higher-order capabilities or managerial oversight, but as firms respond to persistent disturbances by building new or developing existing capabilities.

This process shares some similarities with the concept of resilience capacity. Lengnick-Hall and Beck (2005) coined the term resilience capacity to refer to a firm's ability to choose appropriate responses from a collection of possible responses that the firm already possesses. Similarly, Capron and Mitchell (2009) highlighted the importance of the firm's ability to appropriately select between internal and external sourcing in the development of new capabilities. I found that a firm's portfolio of layered dynamic capability functioned in a similar manner, providing a memory of past responses from which firms can select when responding to persistent disturbances.

The layering process that I found helps to reconcile conflicting research on changing dynamic capabilities. On the one hand, scholars question the very nature of dynamic capabilities. Schreyogg and Kliesch-Eberl (2007) argue that since capabilities are highly practised and purposeful, it does not make sense that they should be dynamically changeable. Even dynamic capabilities scholars acknowledge that when environments are changing too much, dynamic capabilities can become fragile and improvisational (Eisenhardt and Martin, 2000). Similarly, Rindova and Kotha (2001) have described dynamic capabilities as emergent and evolving (Rindova and Kotha, 2001). It is a classic debate pertaining to the plasticity of organizations—how much of the organization is predetermined and how much is changeable (Levinthal and Marino, 2011)?

The process of layering, and the resulting dynamic capability architecture, demonstrates how dynamic capabilities can both be practised and purposeful while simultaneously being emergent and evolving. This is because dynamic capabilities consist of a relatively stable core, and are developed by adding new capabilities which elaborate the existing dynamic capability. For example, in my study, production mix flexibility began as a rudimentary dynamic capability in plant conversion and developed over time into a sophisticated dynamic capability that involved plant and facility sharing. Similarly, partnering flexibility began with outsourcing arrangements, whereby firms purchased parts and entire vehicles from their Japanese partners. This developed into much more sophisticated dynamic capabilities in sharing technologies and facilities. Thus, the dynamic capability architecture and layering process illustrate how the dynamic capability changed, often quite dramatically, but did so by modifying a relatively stable core.

6.3 Environmental Dynamism and Dynamic Capabilities

While environmental dynamism is central to dynamic capabilities, the dynamic capabilities literature has overemphasized a firm's internal abilities, at the expense of the external environment (Vergne and Durand, 2011). A dynamic environment is always present when studying dynamic capabilities, yet it is rarely formally incorporated into dynamic capability theory. When environmental dynamism is modeled, the focus has been on individual dimensions of environmental dynamism such as velocity or degree (Eisenhardt and Martin, 2000; Rindova and Kotha, 2001; Drnevich and Kriauciunas, 2011). Not surprisingly, research studying the impact of these dimensions of environmental dynamism has found significant effects. Dynamic capabilities are less effective than ordinary capabilities in stable settings (Drnevich and Kriauciunas, 2011), but increase in value and effectiveness when the degree of environmental dynamism increases.

My research extends the study of the impact of environmental dynamism on dynamic capabilities from its current focus on *dimensions* to incorporate *configurations* of environmental dynamism. By configurations I am referring to patterns of environmental dynamism. Two common configurations include environmental shifts and ongoing environmental change, each of which has attracted significant research attention in the field of strategic management (Tushman and Anderson, 1986; D'Aveni, 1994). Dynamic capabilities have been studied in both contexts: environmental shifts (Agarwal and Helfat, 2009; Anand, Oriani, and Vassolo, 2010; Danneels, 2008; Gilbert, 2006; Danneels, 2010) and ongoing environmental change (Capron and Mitchell, 2009; Drenevich and Kriauciunas, 2011; Lee et al, 2010). A third configuration that I call persistent disturbances has been defined in this study. Unlike environmental shifts and ongoing environmental change, persistent disturbances depict an environment that, while dynamic and challenging, presents firms with similar challenges repetitively.

Dynamic capability theory has not formally incorporated the role of configurations of environmental dynamism. Instead, configurations of environmental dynamism have remained research contexts. This presents a difficulty. Scholars may be inappropriately generalizing research that applies in a context characterized by one configuration of environmental dynamism, to a context characterized by another configuration of environmental dynamism. Prior research lends credence to this concern. For instance, King and Tucci (2002) argue that in environments of rapid change, firms are unlikely to engage in dramatic transformation as such transformation is likely to take too long. Conversely, in Danneels (2008) study of the shift between mechanical and electronic business equipment, a dramatic transformation at Smith Corona was required. Thus, it follows that firms responding to different configurations of environmental dynamism would build very different dynamic capabilities. I argue that dynamic capabilities research needs to explicitly incorporate the impact of different configurations of environmental dynamism on the characteristics of dynamic capabilities themselves.

In what follows I discuss this theoretical gap, pulling from both my study and prior literature to distinguish from one another, dynamic capabilities built under different configurations of environmental dynamism. I discuss the implications in terms of the nature of the dynamic capabilities developed, the origination of dynamic capabilities, the development of dynamic capabilities, and the deployment of dynamic capabilities. I also offer some suggestions on appropriate research methods with which to study dynamic capabilities in each configuration of environment dynamism. Table 11 highlights these insights and the following paragraphs expand on them in more detail.

Table 11 Configurations of Environmental Dynamism and Dynamic Capabilities

Dynamic Capability Characteristics	Environmental Shift	Ongoing Environmental Change	Persistent Disturbances
Nature	Sensing oriented – identify future possibilities and act quickly to prepare and respond; vertical capability architecture	Highly routinized change processes that continuously evolve the firm's underlying dynamic and ordinary capabilities; vertical capability architecture	Highly specific, targeted, and multi-layered collection of capabilities that firms deploy during disturbances; horizontal capability architecture
Origination	Originated well in advance of environmental shift; anticipation of unknowns	Originated in advance of or in conjunction with emergence of dynamic environment; anticipation of unknowns	Originated when disturbance becomes persistent; dealing with knowns; initial development involves period of expensive coping
Development	Developed in anticipation of future challenges	Development is ongoing, modified by higher-order capabilities	Development occurs as disturbances are repeated
Deployment	Deployed through a combination of sensing and adaptation	Deployed continuously as processes of ongoing adjustment	Firms select appropriate capabilities to deploy for given disturbance
Literature Tradition	Resource-based view; disruptive technologies	Routines; learning	Jolts
Research Method	Case based – interviews; retrospective	Case based – ethnographic, interviews; real-time	Case-based – archival; retrospective and real-time

6.3.1 Nature of Dynamic Capabilities

Prior research has argued that the nature of dynamic capabilities differs based on different dimensions of environmental dynamism, such as velocity, that the firm is facing. Eisenhardt and Martin (2000: 1105) theorize that in highly dynamic environments, dynamic capabilities take the form of "simple, highly experiential and fragile processes with unpredictable outcomes," while in moderately dynamic environments they are stable and predictable processes. Similarly, Lavie (2006) argues that under conditions of high uncertainty, akin to unpredictability, dynamic capabilities are evolutionary in nature such that they modify capabilities incrementally.

In this paper I argue that different *configurations* of environmental dynamism play an important role in shaping the nature of dynamic capabilities. Above, my study highlights how dynamic capabilities built in response to persistent disturbances comprised a layered capability architecture. Each dynamic capability in that architecture in turn comprised a set of capabilities. This nested architecture was built as firms responded to the persistent disturbances in their environment. The resulting dynamic capabilities permitted firms to adapt to multiple, concurrent persistent disturbances that each affected firms in different ways. In contrast, dynamic capabilities associated with environmental shifts emphasize the important role of sensing (Mie and Teece, 2009) or environmental scanning (Danneels, 2008) to identify and prepare for future possibilities. Once an environmental shift occurs, firms activate latent dynamic capabilities to respond quickly (Danneels, 2010; Teece, 2007). Dynamic capabilities built in the context of ongoing environmental change take the form of highly routinized processes that continuously evolve a firm's underlying ordinary capabilities (Teece, Pisano, and Shuen, 1997; Zollo and Winter, 2002). These dynamic capabilities are routines that modify routines (Winter, 2003; Collis, 1994).

6.3.2 Origination of Dynamic Capabilities

I argue that different configurations of environmental dynamism influence how dynamic capabilities originate. Environments that are characterized by persistent disturbances provide continuity and relative stability that facilitate dynamic capability origination. I argue that in these environments, firms build new dynamic capabilities in response to those facets of the underlying environment that become predictable due to repetition. Thus, the origination of dynamic capabilities in response to persistent disturbances is more about responding to disturbances that have become stable and commonplace, than to change and dynamism

(Levinthal and Marino, 2010). In contrast, dynamic capabilities built in response to either environmental shifts or ongoing environmental change pertains to preparing for the unknown. With respect to environmental shifts, firms originate dynamic capabilities well in advance of, and in anticipation of environmental shifts. Similarly, in contexts of ongoing environmental change, firms build dynamic capabilities so as to keep pace and stay ahead of environmental dynamism, building and then deploying dynamic capabilities "faster and more fortuitously" than competitors (Eisenhardt and Martin, 2000).

One implication of this focus on unknowns which is associated with environmental shifts and ongoing environmental change, is that this research has been less concerned with the early development of dynamic capabilities. Most literature on dynamic capabilities has emphasized how firms build dynamic capabilities that are fully formed and effective at responding to the shifts and the ongoing environmental change that the firms may face. In contrast, my study captures this early dynamic capability development period, highlighting how nascent dynamic capabilities initially struggle and perform poorly. Nascent dynamic capabilities exhibit poor technical fitness, permitting firms to cope with dynamic environments but in inefficient ways. The two oil crises of the 1970s and early 1980s illustrate this well. In responding to these crises, firms reacted strongly by converting, slowly and at great expense, automotive capacity geared to producing big cars to small-car capacity. Lacking well-developed dynamic capabilities which would have offered more sophisticated responses, the firms spent large sums of money and a great deal of time coping with the challenge of the oil crises. This coping is similar to the responses described by other scholars. Periods of coping were identified in studies of how NCR laboriously and painfully restructured and reorganized over decades as the industry moved from mechanical to electronic cash registers (Rosenbloom, 2000), how Smith Corona engaged in extensive efforts over 20 years to adjust resources before ultimately failing in 2001 (Danneels, 2010), and how firms experiment before finding appropriate investments (Ahuja and Katila, 2004).

Further, considering how configurations of environmental dynamism influence the origination of dynamic capabilities makes explicit how dynamic environments motivate dynamic capability development. Prior research has argued that environmental dynamism motivates the development of dynamic capabilities (Wang and Ahmed, 2007; Eisenhardt and Martin, 2000) or that dynamic capabilities are more effective in dynamic environments (Drnevich and Kriauciunas, 2011). However scholars have had difficulty articulating why or how. Drawing distinctions among these different configurations of environmental dynamism takes a step towards more explicit attention to the role of environmental dynamism in dynamic capability origination. My results suggest that dynamic capabilities built in anticipation of environmental shifts and ongoing environmental change follow a development pattern akin to path-deepening (Ahuja and Katila, 2004), characterized by inertia and momentum of capability development (Helfat, 1997; Miller and Friesen, 1980). In contrast, dynamic capabilities developed in response to persistent disturbances involve significant new path creation (Ahuja and Katila, 2004), as firms build new capabilities and even expand the family of dynamic capabilities in response to dynamic environments.

6.3.3 Development of Dynamic Capabilities

I argue that how dynamic capabilities are developed, is influenced by the configuration of environmental dynamism in which the firm is operating. In contexts characterized by persistent disturbances, dynamic capabilities are developed as repeated disturbances drive firms to respond in an increasingly efficiently manner to disturbances that remain persistent. For example, in my study firms built increasingly efficient dynamic capabilities in changing the mix of products they produced. The dynamic capability developed as the firms layered on increasingly sophisticated capabilities in platform sharing and facility sharing.

In contrast, dynamic capabilities built in the context of environmental shifts are developed in advance of and in anticipation of future challenges. These capabilities tend to emphasize sensing capabilities that permit firms to identify shifts before or while they are occurring (Teece, 2007). One difficulty is that in these contexts it is difficult to anticipate how effective a dynamic capability will be to an unknown and uncertain future environmental shift. If a firm is developing a dynamic capability to address an unknown environmental shift, it is difficult to know how effective a dynamic capability will be, until that occurs. Finally, dynamic capabilities in the context of ongoing environmental change develop as higher-order dynamic capabilities modify lower-order dynamic capabilities (Winter, 2003; Collis, 1994). This form of change can be considered more routinized, and change can be considered to be occurring continuously across the multiple levels of the dynamic capability hierarchy.

6.3.4 Deployment of Dynamic Capabilities

Firms also deploy dynamic capabilities differently for given configurations of environmental dynamism. In the case of persistent disturbances, firms in my study responded to disturbances by selecting appropriate dynamic capabilities from their dynamic capability architecture; dynamic capabilities which had been built in response to past disturbances. I found that firms continued to deploy dynamic capabilities that were built decades earlier. In contrast, dynamic capabilities built in environments of ongoing environmental change continuously deployed their dynamic capabilities across multiple levels of the capability hierarchy (Collis, 1994; Winter, 2003). Finally, dynamic capabilities built in anticipation of environmental shifts were deployed through a combination of sensing an environmental shift and responding to that shift.

6.3.5 Research Approaches for Dynamic Capabilities

Finally, different configurations of environmental dynamism have a bearing on the methodological approaches and empirical measurements that scholars use to study different dynamic capabilities. When studying persistent disturbances, scholars should focus on archival data incorporating interviews for context and interpretation. Studying persistent disturbances mandates a longitudinal perspective encompassing many years. However, when studying environmental shifts, researchers may wish instead to focus on the managerial cognition processes associated with sensing and interpreting environmental shifts. The use of interviews and ethnographies to build contemporary case studies is highly suitable. While identifying organizations in the middle of an environmental shift would be ideal (see Meyer's 1982 study of jolts as an example of a study taking advantage of a unique opportunity in the environment), practically these studies would be designed as retrospective accounts of organizations that have successfully, and preferably recently, navigated dynamic capabilities in the context of an environmental shift. Finally, in studying dynamic capabilities built in response to ongoing environmental change, scholars could employ detailed surveys, interviews, or even diaries to capture and interpret change processes in real-time.

Chapter 7 – Conclusion

7.0 Conclusion

7.1 Summary of Contributions

My research offers four contributions to the study of strategic management and, in particular, to dynamic capabilities. First, it offers a stronger understanding of the role that configurations of environmental dynamism play in the development of dynamic capabilities. While prior research most commonly conceptualizes environmental dynamism in terms of different dimensions, such as velocity, my research focuses on *configurations* of environmental dynamism. I examine an important but understudied configuration of environmental dynamism that I call persistent disturbances, defined as *repeated temporary events confronting firms*. I argue that persistent disturbances are an important but understudied configuration of environmental dynamism.

My research also highlights how dynamic capabilities develop differently in the presence of different configurations of environmental dynamism. This finding highlights an important recursive relationship between a firm's dynamic capabilities and its environment. In this study I found that, while dynamic capabilities were built in response to dynamic environments, the nature of the dynamic environment in which a firm operated played a significant role by influencing the nature, origination, development, and deployment of the dynamic capabilities that the firm developed.

Second, my research contributes to a more nuanced understanding of the architecture of dynamic capabilities. By examining in detail firm's manufacturing flexibility related dynamic capabilities that developed over 45 years, I discerned that the dynamic capability architecture of these firms manufacturing flexibility comprised a family of dynamic capabilities which in turn comprised layers of capabilities that changed over time. I found that this family of dynamic capabilities, comprising production volume flexibility, production mix flexibility, and partnering flexibility, was built over time in response to specific persistent disturbances from the firm's environment. These dynamic capabilities in turn comprised capabilities which made adapting a firm's underlying ordinary capabilities more effective by increasing speed, reducing costs, and providing a range of alternatives. This highly layered dynamic capability architecture serves a critical function in explaining how dynamic capabilities that seem similar can behave differently.

Third, building on my insights into dynamic capability architecture and the longitudinal nature of my data and analysis, my research sheds light on how dynamic capabilities develop over time. I found that in environments characterized by persistent disturbances, instead of building dynamic capabilities in response to uncertainties and unknowns, firms built dynamic capabilities over time in response to repeated and predictable disturbances. A firm develops its dynamic capabilities by building entirely new dynamic capability layers or by adding or modifying capabilities that support the firm's dynamic capability. Development proceeds from early periods of coping, as firms struggle with dynamic capabilities that have poor technical fitness with respect to the type of change required, to periods in which the dynamic capabilities exhibit high technical fitness and are well adapted to the demands of the persistent disturbances.

Finally, my research offers a methodological contribution as well. Critics of the dynamic capability literature have expressed concern that dynamic capabilities cannot be observed or measured and most work on dynamic capability stops short of showing dynamic capabilities in much detail (Pavlou and El Sawy, 2011). My approach which sought to understand different, albeit related, responses to persistent disturbances facing them firm could be duplicated in other settings and with other dynamic capabilities to delve into the underlying architecture of a dynamic capability and understand that dynamic capability in greater detail.

7.2 Implications for Managers and Policy Makers

My research has implications for managers and policy makers. The first implication is that managers should strive to understand the configuration(s) of environmental dynamism they are facing in their environments. Some industries or environmental contexts are associated with particular configurations of environmental dynamism. For instance, the semi-conductor industry due to its rapidly changing technology is often held up as hypercompetitive and fast paced and resembles ongoing environmental change. Dynamism in other environments may resemble environmental shifts, such as industries that are strongly dependent upon technological or regulatory regimes which are subject to dramatic change as new technologies or governments sweep into use or power. Still other environments are characterized by persistent disturbances, like the North American automotive industry. Since, as I argue above, the dynamic capabilities firms build in response to each configuration of environmental dynamism differ, a strong understanding of these configurations of environmental dynamism can help firms build the dynamic capabilities that are most appropriate for their environments. Further, my study highlights to managers that they may be required to address very different configurations of environmental dynamism concurrently. It is not simply a matter of building faster or more efficient dynamic capabilities, but rather dynamic capabilities of different types.

Second, my research highlights the layered architecture associated with dynamic capabilities. At the core of this discussion on architecture is the insight that even dynamic capabilities that appear very similar, can provide very different abilities to change and adapt. For instance, prior to the 1970s, an automotive firm's dynamic capability in manufacturing flexibility rested in the firm's ability to adjust the production volume—altering sources of production and adjusting how the capacity of plants and facility was utilized. Over time, however, firms layered on additional dynamic capabilities that helped the firm exhibit new forms of manufacturing flexibility that included the ability to flexibly adjust its production mix and to work in new and creative ways with partners to lower costs. For managers this means that dynamic capabilities that appear similar, come in many different shades. Managers must understand what disturbances the firm is prepared to respond to, and be aware of those the firm will have greater difficulty with. A contemporary example is the recent difficulties that the Japanese automotive firms Toyota and Honda have had in adapting to tsunamis in Japan and flooding in Thailand. While these firms are lauded for their manufacturing flexibility that incorporated just-in-time systems and highly flexible manufacturing facilities, they have been forced to shut down plants as a result of parts shortages from their tightly integrated suppliers that have been hit by these natural disasters.

7.3 Limitations and Future Research

This study is not without its limitations. First, my study is inductive theory-building research, and thus my findings are not generalizable in the statistical sense. Instead my findings generalize to theory (Yin, 2009). I situated my study within a single industry—automotive—and in a specific geographical region—North America. Since prior research has stressed that capabilities are often context specific (Laamanen and Wallin, 2009; Ethiraj et al, 2005), my study may not generalize beyond the automotive industry. However, the automotive industry shares similarities with other manufacturing industries and industries possessing homogeneous oligopolies in moderately dynamic and regulated environments. Thus, my insights are most likely to be applicable in manufacturing industries and industries such as telecommunications, energy production, forestry, and mining, which are oligopolistic in structure and which have strong regulations and have had many disturbances over their long histories. Within the automotive context my study is further focused on a particular category of dynamic capabilities in manufacturing flexibility. Thus the theories I propose may be further limited to dynamic capabilities that closely resemble manufacturing flexibility. Further research should study a broader range of industries and dynamic capabilities.

Further, my case study has a historical focus and differs from contemporary case studies in its reliance on archival and historical documentation. The nature of this archival dataset constrained my interpretation and analysis because I was reliant on what experts had chosen to write about and did not have the opportunity to ask pointed questions as one would with interview or focus group data collection methods. This constraint is a reflection of the longitudinal nature of my study, which makes interviews and focus groups unreliable owing to retrospective biases (Golden, 1992). While I took steps to address and mitigate the difficulties of this historical focus, such as employing high-quality data sources and corroborating qualitative opinions and perspectives with quantitative data (Jick, 1979), this limitation remains an inherent challenge of conducting inductive research examining long historical periods.

Third, the strength of my dataset, and thus my analysis, is that it is longitudinal. This has permitted me to analyze patterns over a full 45 years of data. While this is a strength of my study, it carried with it implicit difficulties with respect to the depth of analysis for a given year. Future research may explore specific events in more detail, such as the actions that firms took prior to, during, and following major oil crises and regulatory events, so as to gain greater depth of insight into how dynamic capabilities originate and develop.

One specific limitation of my archival data was that they did not provide information about managers' cognitive processes and how managers perceived their environments before developing dynamic capabilities. Danneels (2011) stresses the importance of cognition with respect to how dynamic capabilities are deployed, arguing that to be effective, managers need a strong understanding of their firm's resources and capabilities. Gavetti (2005) in turn, highlights the importance of cognition in building an accurate interpretation of the challenges the firm is facing. Recent research on dynamic managerial capabilities argues for the reintroduction of the manager as decision maker into studies of dynamic capabilities (Adner and Helfat, 2003; Sirmon and Hitt, 2009). Incorporating information about cognition processes could also shed light onto how persistent disturbances are perceived. An analysis of my data suggests that different firms identified different disturbances as being most salient. For instance, from a study of annual reports it was clear that for Chrysler, the Vietnam War imposed significantly on their business, while managers at Ford and GM made no mention of any difficulties associated with that war. Future research could explore how managers within firms perceived the persistent disturbances in their environments, and attempt to better understand the decision-making processes through which they build dynamic capabilities to respond. Extending this study by interviewing managers about how they perceive disturbances and how they respond would provide a stronger cognitive understanding of managerial action that could be very valuable.

In addition, my study distinguishes among environments possessing different configurations of environmental dynamism. I distinguish environmental shifts from ongoing environmental change and persistent disturbances. However, firms face complex environments that invariably include some combination of different configurations of environmental dynamism. Thus firms likely face two or more of these configurations simultaneously. Future research could consider how firms build dynamic capabilities that permit them to respond and adapt to environments characterized by multiple configurations of environmental dynamism at the same time. How do firms build and maintain these different dynamic capabilities? Research could also examine the interactions between different configurations of environmental dynamism and between dynamic capabilities developed to address each configuration.

My research has demonstrated that delving deeper into a particular dynamic capability, such as manufacturing flexibility, can offer critical insights regarding the inner workings of a dynamic capability. In particular, my study offered an understanding of dynamic capability architecture. I argue that future research should delve deeper into specific dynamic capabilities such as alliance management, dynamic managerial capabilities, and new product development processes. This approach has the potential to empirically ground future understanding of dynamic capability architecture.

Finally, my research highlights how automotive firms dramatically improved the technical fitness of their dynamic capabilities in manufacturing flexibility over the course of my study period, from early incompetence in adapting product mix and partnering to strong, well-tested, and technically fit dynamic capabilities. However, despite these improvements the firms floundered. The firms' financial performance deteriorated to such a point that in 2009 both Chrysler and GM declared bankruptcy, with Ford narrowly avoiding a similar fate. Future research should explore this disconnect between the technical fitness of a given dynamic capability and the performance of the firm as a whole. Some research has begun to address this important question. Shamsie, Martin, and Miller (2009) found that dynamic capabilities do not necessarily lead to performance improvement. Still other research has argued that dynamic capabilities operate across levels of analysis (Rothaermel and Hess, 2007; Drnevich and

Kriauciunas, 2011). Research by Coff (2010) shows how rent appropriation should be considered from very early stages of capability development, arguing that both should coevolve. In short, future research should pursue what firms require, beyond a technically fit dynamic capability, in order to achieve superior (or even average) returns.

7.4 Concluding Remarks

In a recent article on dynamic capabilities, Helfat and Winter (2011) pondered the paradox of the (n)ever-changing world (Birnholtz, Cohen, and Hoch, 2007) asking "[i]f everything is changing all the time, what then is the basis of the impression that some things do not change at all?" Indeed, managers are often left with the impression that the world is changing too fast or too dramatically, but at the same time they are confronted with variations on familiar disturbances. Addressing this paradox requires thinking that advances our understanding of environmental dynamism and the capabilities that firms build in response.

In my research, the (n)ever-changing world is well illustrated by a configuration of environmental dynamism that I call persistent disturbances, defined as repeated temporary events confronting firms. The persistent disturbances I studied in the North American automotive industry were economic cycles, government regulations, labour disruptions, competitive pressures, and energy challenges. Each of these persistent disturbances depicted arenas of ongoing concern for automotive firms, but also ones which the firms had had decades of experience addressing.

My research studied the dynamic capabilities related to manufacturing flexibility that firms built in response to these persistent disturbances—both *what* they were and *how* firms built them. I found that firms built dynamic capabilities in these environments, progressing from technically unfit dynamic capabilities towards increasingly technical fit dynamic capabilities through a nested process of layering. As persistent disturbances remained in place, firms added and elaborated both dynamic capabilities and the capabilities they comprised to improve the effectiveness of their responses to the persistent disturbances. The resulting dynamic capabilities resembled the process by which they were built, possessing a multi-layered capability architecture.

In short, my research emphasizes the importance of better understanding dynamic capabilities through three avenues. First, my research stresses the importance of moving beyond dimensions of environmental dynamism towards a better understanding of configurations of environmental dynamism and the role these play in the development of dynamic capabilities. I take steps in this regard by discussing the influence that different configurations of environmental dynamism have with respect to the nature, origination, development, and deployment of dynamic capabilities. Second, I encourage scholars to identify and study the capability architecture of different types of dynamic capabilities across different contexts. Even subtle variations in capability architecture reveal differences in how and how well a firm can respond to disturbances. Finally, my research highlights how dynamic capabilities can develop in parallel as environmental dynamism unfolds. Through a process of layering on top of existing dynamic capabilities, firms can, over time, improve the technical fitness of their dynamic capabilities for a particular persistent disturbance.

References

Adler, P. S. 1993. The learning bureaucracy: New united motors manufacturing, inc. In B. M. Staw & L. L. Cummings (Ed.), ***Research in organizational behavior***, vol. 15: 111-194. Greenwich, CT: JAI Press.

Adler, P. S., Goldoftas, B., & Levine, D. I. 1999. Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. ***Organization Science***, 10(1): 43-68.

Adner, R., & Helfat, C. E. 2003. Corporate effects and dynamic managerial capabilities. ***Strategic Management Journal***, 24: 1011-1025.

Agarwal, R., & Helfat, C. E. 2009. Strategic renewal of organizations. ***Organization Science***, 20(2): 281-293.

Alcott, B. 2005. Jevons' paradox. ***Ecological Economics***, 54(1): 9-21.

Anand, J., Oriani, R., & Vassolo , R. S. 2010. Alliance activity as a dynamic capability in the face of discontinuous technological change. ***Organization Science***, 21(6): 1213-1232.

Anderson, P. 1999. Complexity theory and organization science. ***Organization Science***, 10(3): 216-232.

Arend, R. J., & Bromiley, P. 2009. Assessing the dynamic capabilities view: Spare change, everyone? ***Strategic Organization***, 7(1): 75-90.

Arikan, A. M., & McGahan, A. M. 2010. The development of capabilities in new firms. ***Strategic Management Journal***, 31: 1-18.

Barney, J. 1991. Firm resources and sustained competitive advantage. ***Journal of Management***, 17(1): 99.

Barr, P. S., Stimpert, J. L., & Huff, A. S. 1992. Cognitive change, strategic action, and organizational renewal. ***Strategic Management Journal***, 13: 15-36.

Barreto, I. 2010. Dynamic capabilities: A review of past research and an agenda for the future. ***Journal of Management***, 36(1): 256-280.

Birnholtz, J. P., Cohen, M., & Hoch, S. V. 2007. Organizational character: On the regeneration of camp poplar grove. ***Organization Science***, 18(2): 315-332.

Brown, S. L., & Eisenhardt, K. M. 1997. The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. ***Administrative Science Quarterly***: 1-34.

Burgelman, R. A. 1991. Intraorganizational ecology of strategy-making and organizational adaptation: Theory and field research. ***Organization Science***, 2(3): 239-262.

Burgelman, R. A. 1994. Fading memories: A process theory of strategic business exit in dynamic environments. ***Administrative Science Quarterly***, 39(1): 24-56.

Capron, L., & Mitchell, W. 2009. Selection capability: How capability gaps and internal social frictions affect internal and external strategic renewal. ***Organization Science***, 20(2): 294-312.

Coen, C. A., & Maritan, C. A. 2011. Investing in capabilities: The dynamics of resource allocation. ***Organization Science***, 22(1): 99-117.

Coff, R. W. 2010. The coevolution of rent appropriation and capability development. ***Strategic Management Journal***, 31: 711-733.

Collis, D. J. 1994. How valuable are organizational capabilities? ***Strategic Management Journal***, 15(S1): 143-152.

Danneels, E. 2008. Organizational antecedents of second-order competences. ***Strategic Management Journal***, 29(5): 519-543.

Danneels, E. 2010. Trying to become a different type of company: Dynamic capability at Smith Corona. ***Strategic Management Journal***, 32: 1-31.

D'Aveni, R. A. 1994. ***Hypercompetition: Managing the dynamics of strategic maneuvering.*** New York: The Free Press.

Davis, J. P., Eisenhardt, K. M., & Bingham, C. B. 2009. Optimal structure, market dynamism, and the strategy of simple rules. ***Administrative Science Quarterly***, 54: 413-452.

Dess, G. G., & Beard, D. W. 1984. Dimensions of organizational task environments. ***Administrative Science Quarterly***, 29(1): 52-73.

Di Stefano, G., Peteraf, M. A., & Verona, G. 2010. Dynamic capabilities deconstructed: A bibliographic investigation into the origins, development, and future directions of the research domain. ***Industrial and Corporate Change***, 19(4): 1187-1204.

Dixon, S. E. A., Meyer, K. E., & Day, M. 2010. Stages of organizational transformation in transition economies: A dynamic capabilities approach. ***Journal of Management Studies***, 47(3): 416-436.

Dosi, G., Nelson, R. R., & Winter, S. G. 2000. ***The nature and dynamics of organizational capabilities***. New York: Oxford University Press.

Doving, E., & Gooderham, P. N. 2008. Dynamic capabilities as antecedents of the scope of related diversification: The case of small firm accountancy practices. ***Strategic Management Journal***, 29: 841-857.

Drnevich, P. L., & Kriauciunas, A. P. 2011. Clarifying the conditions and limits of the contributions of ordinary and dynamic capabilities to relative firm performance. ***Strategic Management Journal***, 32(254): 279.

Duncan, R. B. 1972. Characteristics of organizational environments and perceived environmental uncertainty. ***Administrative Science Quarterly***, 17(3): 313-327.

Dutton, J. E., & Dukerich, J. M. 1991. Keeping an eye on the mirror: Image and identity in organizational adaptation. ***Academy of Management Journal***, 34(3): 517-554.

Easterby-Smith, M., Lyles, M. A., & Peteraf, M. A. 2009. Dynamic capabilities: Current debates and future directions. ***British Journal of Management***, 20: S1-S8.

Eisenhardt, K. M., & Martin, J. A. 2000. Dynamic capabilities: What are they? ***Strategic Management Journal***, 21(10-11): 1105-1121.

Eisenhardt, K. M., & Tabrizi, B. N. 1995. Accelerating adaptive processes: Product innovation in the global computer industry. ***Administrative Science Quarterly***, 40(1): 84-110.

Eisenhardt, K. M. 1989. Building theories from case study research. ***The Academy of Management Review***, 14(4): 532-550.

Eisenhardt, K. M., & Graebner, M. E. 2007. Theory building from cases: Opportunities and challenges. ***The Academy of Management Journal***, 50(1): 25-32.

Ethiraj, S. K., Kale, P., Krishnan, M. S., & Singh, J. V. 2005. Where do capabilities come from and how do they matter? A study in the software services industry. ***Strategic Management Journal***, 26: 25-45.

Farjoun, M., & Levin, M. 2011. A fractal approach to industry dynamism. ***Organization Studies***, 32(6): 825-851.

Fox-Wolfgramm, S. J., Boal, K. B., & Hunt, J. G. 1998. Organizational adaptation to institutional change: A comparative study of first-order change in prospector and defender banks. ***Administrative Science Quarterly***, 43(1): 87-126.

Galunic, D. C., & Rodan, S. 1998. Resource recombinations in the firm: Knowledge structures and the potential for Schumpeterian innovation. ***Strategic Management Journal***, 19: 1193-1201.

Galunic, D. C., & Eisenhardt, K. M. 2001. Architectural innovation and modular corporate forms. ***Academy of Management Journal***, 44(6): 1229-1249.

Gavetti, G. 2005. Cognition and hierarchy: Rethinking the microfoundations of capabilities' development. ***Organization Science***, 16(6): 599-617.

Gersick, C. J. G. 1991. Revolutionary change theories: A multilevel exploration of the punctuated equilibrium paradigm. ***Academy of Management Review***, 16(1): 10-36.

Gerwin, D. 1993. Manufacturing flexibility: A strategic perspective. ***Management Science***, 39(4): 395-410.

Gibbert, M., Ruigrok, W., & Wicki, B. 2008. What passes as a rigorous case study? ***Strategic Management Journal***, 29: 1465-1474.

Gilbert, C. G. 2006. Change in the presence of residual fit: Can competing frames coexist? ***Organization Science***, 17(1): 150-167.

Gioia, D. A. 1992. Pinto fires and personal ethics: A script analysis of missed opportunities. ***Journal of Business Ethics***, 11(5-6): 379-389.

Golden, B. R. 1992. The past is the past--or is it? the use of retrospective accounts as indicators of past strategy. ***Academy of Management Journal***, 35(4): 848-860.

Harbour and Associates. 1989/1992. ***The harbour report***. Rochester, Michigan: Harbour and Associates.

Harbour and Associates. 1999. ***The harbour report***. Rochester, Michigan: Harbour and Associates.

Harbour and Associates. 2003. ***The harbour report***. Rochester, Michigan: Harbour and Associates.

Harbour and Associates. 2007. ***The harbour report***. Rochester, Michigan: Harbour and Associates.

Helfat, C. E. 1997. Know-how and asset complementarity and dynamic capability accumulation: The case of R&D. ***Strategic Management Journal***, 18(5): 339-360.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., & Winter, S. G. 2007. ***Dynamic capabilities understanding strategic change in organizations***. Malden, MA, U.S.: Blackwell Publishing.

Helfat, C. E., & Peteraf, M. A. 2003. The dynamic resource-based view: Capability lifecycles. ***Strategic Management Journal***, 24(10): 997-1010.

Helfat, C. E., & Peteraf, M. A. 2009. Understanding dynamic capabilities: Process along a developmental path. ***Strategic Organization***, 7(1): 91-102.

Helfat, C. E., & Raubitschek, R. S. 2000. Product sequencing: Co-evolution of knowledge, capabilities and products. ***Strategic Management Journal***, 21: 961-979.

Helfat, C. E., & Winter, S. G. 2011. Untangling dynamic and operational capabilities: Strategy for the (N)ever-changing world. ***Strategic Management Journal***, 32: 1243-1250.

Henderson, R., & Cockburn, I. 1994. Measuring competence? exploring firm effects in pharmaceutical research. ***Strategic Management Journal***, 15: 63-84.

Henderson, R. M., & Clark, K. B. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. ***Administrative Science Quarterly***, 35(1): 9-30.

Jacobides, M. G. 2006. The architecture and design of organizational capabilities. ***Industrial and Corporate Change***, 15(1): 151-171.

Jick, T. D. 1979. Mixing qualitative and quantitative methods: Triangulation in action. ***Administrative Science Quarterly***, 24(4): 602-611.

Kale, P., & Singh, H. 2007. Building firm capabilities through learning: The role of the alliance learning process in alliance capability and firm-level alliance success. ***Strategic Management Journal***, 28: 981-1000.

Keil, T., McGrath, R. G., & Tukiainen, T. 2009. Gems from the ashes: Capability creation and transformation in internal corporate venturing. ***Organization Science***, 20(3): 601-620.

King, A. A., & Tucci, C. L. 2002. Incumbent entry into new market niches: The role of experience and managerial choice in the creation of dynamic capabilities. ***Management Science***, 48(2): 171-186.

Laamanen, T., & Wallin, J. 2009. Cognitive dynamics of capability development paths. ***Journal of Management Studies***, 46(6): 950-981.

Lampel, J., & Shamsie, J. 2003. Capabilities in motion: New organizational forms and the reshaping of the Hollywood movie industry. ***Journal of Management Studies***, 40(8): 2189-2210.

Lampel, J., Shamsie, J., & Shapira, Z. 2009. Experiencing the improbable: Rare events and organizational learning. ***Organization Science***, 20(5): 835-845.

Langley, A. 1999. Strategies for theorizing from process data. ***The Academy of Management Review***, 24(4): 691-710.

Lavie, D. 2006. Capability reconfiguration: An analysis of incumbent responses to technological change. ***Academy of Management Review***, 31(1): 153-174.

Lawrence, P. R., & Lorsch, J. W. 1967. ***Organization and environments: Managing differentiation and integration***. Irwin: Homewood.

Lee, C., Venkatraman, N., Tanriverdi, H., & Iyer, B. 2010. Complementarity-based hypercompetition in the software industry: Theory and empirical test, 1990-2002. ***Strategic Management Journal***, 31: 1431-1456.

Lee, T., Mitchell, T., & Sablynski, C. 1999. Qualitative research in organizational and vocational behavior. ***Journal of Vocational Behavior***, 55: 161-187.

Leiblein, M. J. 2011. What do resource- and capability-based theories propose? ***Journal of Management***, 37(4): 909-932.

Lengnick-Hall, C. A., & Beck, T. E. 2005. Adaptive fit versus robust transformation: How organizations respond to environmental change. ***Journal of Management***, 31(5): 738-757.

Leonard-Barton, D. 1992. Core capabilities and core rigidities: A paradox in managing new product development. ***Strategic Management Journal***: 111-125.

Lichenthaler, U., Ernst, H., & Hoegl, M. 2010. Not-sold-here: How attitudes influence external knowledge exploitation. ***Organization Science***, 21(5): 1054-1071.

Luo, Y. 2002. Capability exploitation and building in a foreign market: Implications for multinational enterprises. ***Organization Science***, 13(1): 48-63.

Makadok, R. 2001. Toward a synthesis of the resource-based and dynamic- capability views of rent creation. ***Strategic Management Journal***, 22: 387-401.

Malik, O. R., & Kotabe, M. 2009. Dynamic capabilities, government policies, and performance in firms from emerging economies: Evidence from India and Pakistan. ***Journal of Management Studies***, 46(3): 421-450.

March, J.G. 1991. Exploration and Exploitation in Organizational Learning. ***Strategic Management Journal***, 2(1): 71-87.

Marcus, A. A., & Anderson, M. H. 2006. A general dynamic capability: Does it propagate business and social competencies in the retail food industry? ***Journal of Management Studies***, 43(1): 19-46.

Martin, J. A. 2011. Dynamic managerial capabilities and the multibusiness team: The role of episodic teams in executive leadership groups. ***Organization Science***, 22(1): 118-140.

McKelvie, A. & Davidsson, P. 2009. From resource base to dynamic capabilities: An investigation of new firms. ***British Journal of Management***, 20: S63-S80.

Meyer, A. D. 1982. Adapting to environmental jolts. ***Administrative Science Quarterly***, 27(4): 515-537.

Mie, A., & Teece, D. J. 2009. Dynamic capabilities and the role of managers in business strategy and economic performance. ***Organization Science***, 20(2): 410-421.

Miles, M. B., & Huberman, A. M. 1984. Analysing qualitative data: A source book for new methods. ***Sage, Beverly Hills, CA***.

Milliken, F. J. 1987. Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. ***The Academy of Management Review***, 12(1): 133-143.

Moliterno, T. P., & Wiersema, M. F. 2007. Firm performance, rent appropriation, and the strategic resource divestment capability. ***Strategic Management Journal***, 28: 1065-1087.

Morgan, N. A., Vorhies, D. W., & Mason, C. H. 2009. Market orientation, marketing capabilities, and firm performance. ***Strategic Management Journal***, 30: 909-920.

Nader, R. 1965. ***Unsafe at any speed: The designed-in dangers of the american automobile***. New York, NY: Grossman Publishers.

Narayanan, V. K., Colwell, K., & Douglas, F. L. 2009. Building organizational and scientific platforms in the pharmaceutical industry: A process perspective on the development of dynamic capabilities. ***British Journal of Management***, 20: S25-S40.

Nelson, R. R., & Winter, S. G. 1982. ***An evolutionary theory of economic change***. Cambridge, MA: Harvard University Press.

Newbert, S. L. 2007. Empirical research on the resource-based view of the firm: An assessment and suggestions for future research. ***Strategic Management Journal***, 28(121): 146.

Nunnally, J. 1978. ***Psychometric theory*** (2nd ed.). New York: McGraw-Hill.

Oliver, C., & Holzinger, I. 2008. The effectiveness of strategic political management: A dynamic capabilities framework. ***Academy of Management Review***, 33(2): 496-520.

Pablo, A. L., Reay, T., Dewald, J. R., & Casebeer, A. L. 2007. Identifying, enabling and managing dynamic capabilities in the public sector. ***Journal of Management Studies***, 44(5): 687-708.

Pacheco-De-Almeida, G. 2010. Erosion, time compression, and self-displacement of leaders in hypercompetitive environments. ***Strategic Management Journal***, 31: 1498-1526.

Pavlou, P. A., & El Sawy, O. A. 2011. Understanding the elusive black box of dynamic capabilities. ***Decision Sciences***, 42(1): 239-273.

Peter, J. P. 1979. Reliability: A review of psychometric basics and recent marketing practices. ***Journal of Marketing Research***, 16: 6-17.

Pettigrew, A. M. 1990. Longitudinal field research on change: Theory and practice. ***Organization Science***, 1(3): 267-292.

Pettus, M. L. 2001. The resource-based view as a developmental growth process: Evidence from the deregulated trucking industry. ***Academy of Management Journal***, 44(4): 878-896.

Pfeffer, J. 1982. ***Organizations and organization theory***. Boston: Pitman.

Pfeffer, J., & Salancik, G. R. 1978. ***The external control of organizations***. New York: Harper & Row.

Pierce, L. 2009. Big losses in ecosystem niches: How core firms decisions drive complementary product shakeouts. ***Strategic Management Journal***, 30: 323-347.

Pratt, M.G. 2009. For the lack of a boilerplate: Tips on writing up (and reviewing) qualitative research. ***Academy of Management Journal***, 52(5): 856-862.

Priem, R. L., & Butler, J. E. 2001. Is the resource-based "view" a useful perspective for strategic management research? ***Academy of Management Review***, 26(1): 22-40.

Rerup, C. 2009. Attentional triangulation: Learning from unexpected rare crises. ***Organization Science***, 20(5): 876-893.

Rindova, V. P., & Kotha, S. 2001. Continuous "morphing": Competing through dynamic capabilities, form and function. ***Academy of Management Journal***, 44(6): 1263-1280.

Romme, A.G., Zollo, M., & Berends, P. 2010 Dynamic capabilities, deliberate learning and environmental dynamism: a simulation model. ***Industrial and Corporate Change***, 19(4): 1271-1299.

Rosenbloom, R. S. 2000. Leadership, capabilities, and technological change: The transformation of NCR in the electronic era. ***Strategic Management Journal***, 21: 1083-1103.

Rothaermel, F. T., & Hess, A. M. 2007. Building dynamic capabilities: Innovation driven by individual-, firm-, and network-level effects. ***Organization Science***, 18(6): 898-921.

Salvato, C. 2009. Capabilities unveiled: The role of ordinary activities in the evolution of product development processes. ***Organization Science***, 20(2): 384-409.

Salvato, C., & Rerup, C. 2011. Beyond collective entities: Multilevel research on organizational routines and capabilities. ***Journal of Management***, 37(2): 468-490.

Sastry, M. A. 1997. Problems and paradoxes in a model of punctuated organizational change. ***Administrative Science Quarterly***, 42(2): 237-275.

Schilke, O., & Goerzen, A. 2010. Alliance management capability: An investigation of the construct and measurement. ***Journal of Management***, 36(5): 1192-1219.

Schreyogg, G., & Kliesch-Eberl, M. 2007. How dynamic can organizational capabilities be? towards a dual-process model of capability dynamization. ***Strategic Management Journal***, 28: 913-933.

Sethi, A. K., & Sethi, S. P. 1990. Flexibility in manufacturing:A survey. ***The International Journal of Flexible Manufacturing Systems***, 2: 289-328.

Shamsie, J., Martin, X., & Miller, D. 2009. In with the old, in with the new: Capabilities, strategies and performance among the Hollywood studios. ***Strategic Management Journal***, 30: 1440-1452.

Sirmon, D. G., & Hitt, M. A. 2009. Contingencies within dynamic managerial capabilities: Interdependent effects of resource investment and deployment on firm performance. ***Strategic Management Journal***, 30: 1375-1394.

Sirmon, D. G., Hitt, M. A., & Ireland, R. D. 2007. Managing firm resources in dynamic environments to create value: Looking inside the black box. ***Academy of Management Review***, 32(1): 273-292.

Slack, N. 2005. The flexibility of manufacturing systems. ***International Journal of Operations and Production Management***, 25(12): 1190-1200.

Song, M., Droge, C., Hanvanich, S., & Calantone, R. 2005. Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. ***Strategic Management Journal***, 26: 259-276.

Staw, B., McKechnie, P. I., & Puffer, S. M. 1983. The justification of organizational performance. ***Administrative Science Quarterly***, 28(4): 582-600.

Sull, D. 1999. The dynamics of standing still: Firestone tire & rubber and the radial revolution. ***Business History Review***, 73(3): 430-464.

Sutcliffe, K. M., & Vogus, T. J. 2003. Organizing for resilience. In K. S. Cameron, J. E. Dutton, & R. E. Quinn (Ed.), ***Positive organizational scholarship: Foundations of a new discipline***: 94-110. San Francisco: Berrett-Koehler.

Teece, D. J. 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. ***Strategic Management Journal***, 28: 1319-1350.

Teece, D. J., Pisano, G., & Shuen, A. 1997. Dynamic capabilities and strategic management. ***Strategic Management Journal***, 18(7): 509-533.

Tripsas, M., & Gavetti, G. 2000. Capabilities, cognition and inertia: Evidence from digital imaging. ***Strategic Management Journal***, 21(10/11): 1147-1161.

Tushman, M. L., & Anderson, P. 1986. Technological discontinuities and organizational environments. ***Administrative Science Quarterly***, 31(3): 439-465.

Tushman, M. L., & Romanelli, E. 1985. Organizational evolution: A metamorphosis model of convergence and reorientation. In L. L. Cummings & B. M. Staw (Ed.), ***Research in organizational behavior***, vol. 7: 171-222. Greenwich, CT: JAI Press.

Upton, D. 1994. The management of manufacturing flexibility. ***California management review***, Winter: 72-89.

Van Maanen, J. 1979. The fact of fiction in organizational ethnography. ***Administrative Science Quarterly***, 24(4): 539-550.

Vergne, J., & Durand, R. 2011. The path of most persistence: An evolutionary perspective on path dependencies and dynamic capabilities. ***Organization Studies***, 32(3): 365-382.

Wang, C. L., & Ahmed, P. K. 2007. Dynamic capabilities: A review and research agenda. ***International Journal of Management Reviews***, 9(1): 31-51.

Ward's Automotive Yearbook. 1965-2010. Detroit, MI.

Wernerfelt, B. 1984. A resource-based view of the firm. ***Strategic Management Journal***: 171-180.

Wiggins, R. W., & Ruefli, T. W. 2005. Schumpeter's ghost: Is hypercompetition making the best of times shorter? ***Strategic Management Journal***, 26(10): 887–911.

Winter, S. G. 2000. The satisficing principle in capability learning. ***Strategic Management Journal***, 21(10/11): 981-996.

Winter, S. G. 2003. Understanding dynamic capabilities. ***Strategic Management Journal***, 24: 991-995.

Yin, R. 2009. ***Case study research: Design and methods***. Thousand Oaks, CA: Sage Publications.

Zahra, S. A., & George, G. 2002. Absorptive capacity: A review, reconceptualization, and extension. ***Academy of Management Review***, 27(2): 185-203.

Zander, U., & Kogut, B. 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test. ***Organization Science***, 6(1): 76-92.

Zollo, M. & Reuer, J. J. 2010. Experience Spillover Across Corporate Development Activities. ***Organization Science***, 21(6):1195-1212.

Zollo, M., & Winter, S. G. 2002. Deliberate learning and the evolution of dynamic capabilities. ***Organization Science***, 13(3): 339-351.

Appendices

Table A1 Definitions of Key Terms

Term	Definition
Dynamic Capabilities	A firm's ability to integrate, build, and reconfigure internal and external competencies to address changing environments
Disturbance	Adversity, either internally generated or externally imposed, that disrupts the normal functioning of the firm
Persistent Disturbance	Repeated temporary events confronting firms
Persistent Manufacturing Implication	The manufacturing related implications of repeated temporary events confronting firms
Manufacturing Flexibility	A firm's ability to adapt to environmental changes by varying products, product mix and production volumes.
Capability Architecture	How different capabilities fit together or relate to one another
Evolutionary Fitness (of Dynamic Capabilities)	Evolutionary fitness refers to how well a dynamic capability enables a firm to survive and even grow in changing environment
Technical Fitness (of Dynamic Capabilities)	Technical fitness pertains to how effective a dynamic capability is at performing its intended function
Environmental Dynamism	Change in a firm's external environment
Configuration (of Environmental Dynamism)	Recognizable patterns of environmental dynamism

Table A2 Dynamic Capabilities Literature Review – Empirical Review

Author	Dynamic Capability	Dynamic Capability Development	Environmental Dynamism Characteristics	Method	Research Context
Adner and Helfat, 2003	Dynamic Managerial Capabilities Managerial human capital, managerial social capital and managerial cognition; these factors can influence how strategic decisions are made; in strategic reorientation in response to changing conditions in environment	NA	Fluctuating Oil Prices; Changing environments	ANOVA	U.S. Petroleum Industry from 1977 through 1997
Agarwal and Helfat, 2009	Strategic Renewal IBMs transformations from electromechanical accounting equipment to an electronic computing company and then to a business computing services company; also incremental strategic renewal	NA	Dramatic shifts in its external environment; specifically new technology or changing competition	Case	IBM from 1940
Anand, Oriani, and Vassolo, 2010	Firm Entry "Ability to create and manage new alliances in order to enter emerging technological fields in the presence of discontinuous technological change." P1214	NA	Discontinuous Technological Change	Heckman probit model	U.S. and European Phramaceutical firms from 1980s through 2000.
Capron and Mitchell, 2009	Capability Sourcing Ability to select appropriate modes of capability sourcing - internal development or	NA	Rapid industry changes, including deregulation, price competition,	Survey and survival survey	International telecommunications industry (2000 to 2005)

	external sourcing – so as to renew capabilities moderator role		technological convergence and entry of foreign competitors		
Coen and Maritan, 2011	Resource Allocation Process The capacity to manage investments in operational capabilities. Operationalized as the ability to recognize opportunities (search) to invest in new operational capabilities	NA		Simulation	NA
Danneels, 2008	Exploration and Learning Ability to explore new markets (marketing) and ability to explore new technologies (R&D) Ability to build new competences.	5 organizational antecedents (4 of which gained empirical support): slack resources, environmental scanning, willingness to cannibalize and constructive conflict. Tolerance for failure not	Environmental change making previously acquired competences obsolete or create opportunities for new competences	Regression	Public manufacturing
Danneels, 2010	Renewal of Resources and Competences How Smith Corona attempted to modify its resources (leverage, create, access and release)	Resource cognition plays an important role because managers understand the resources they have, and their fungibility.	Environmental shift from mechanical typewriters to electronics. Environmental change that threatens long-run viability of the firm. Market and technological change	Case	Smith Corona – typewriters 1980-2001
Doving and Gooderham, 2008	Altering service portfolio offering of a firm (related diversification)	NA	Changing environments	Regression	Small accountancies in Norway
Drnevich and Kriauciunas, 2011	IT ordinary and dynamic capabilities	NA	Degree of environmental dynamism	Regression	Chilean firms – IT based capabilities
Galunic and	Architectural Innovation	Social and economic	Changing markets;	Case	Multi-business firm

Eisenhardt, 2001	Corporate level processes by which multi-business firms reconfigure or realign their resources.	logics Simple rules that guide charter redeployment Executives are key	evolving product markets		
Ethiraj, Kale, Krishnan, and Singh, 2005	Role of client specific and project management capabilities	Capabilities develop through repeated interactions and through deliberate and persistent investments.	NA	Interviews and Regressions	Software services Industry; single firm multiple projects
Gilbert, 2006	General – The ability to move from one competency configuration to another	Argue that structural differentiation permits simultaneous holding of two competency configurations	Discontinuous environmental change	Case	Newspaper organization
Helfat, 1997	Creating new products and processes Decisions to engage in coal gasification /liquefaction R&D	DC accumulation based on past complementary assets (refining assets) and know-how (refining R&D; other synthetic fuels); or strong capabilities in new space (ie coal assets)	Oil price increases – 1973 and 1979	Regression	U.S. Petroleum industry during 1970s and early 1980s
Kale and Singh, 2007	Alliance learning process Articulation, codification, sharing and internalization of alliance management know-how. A higher order DC, helps firms learn, accumulate, and leverage alliance know-how so as to modify or improve its operational alliance management skills.	Learning and knowledge accumulation processes are how firms build and sustain a dynamic capability that permits the firm to modify its alliance capabilities	NA	Survey;	Large firms
King and Tucci, 2002	Market entry A general DC surrounding the role of experience on market entry patterns	Prior experience important for dynamic change	Technological change; development of new markets; explicitly recognizes different types of environmental	Regression from archival	Disk drive industry

			dynamism		
Laamanen and Wallin, 2009	Cognitive microfoundations of capability development	Role of cognition at operational capability, capability portfolio, and enterprise level in dynamic capability development	NA	Case	Network software security firms
Lampel and Shamsie, 2003	Industry transitions Identified mobilizing (bringing together bundles of resources) and transforming (putting together a finished product) capabilities	Environment transitions can emphasize and direct attention to changing and innovating one or more sets of capabilities at the expense of others.	Industry transition from studio to hub and spoke organizations (a PE model)	Regression	Hollywood film industry
Lee, Venkatraman, Tanriverdi, and Lyer, 2010	Managing complementarity relationships among firm's product markets to match industry changes. Two approaches – reconfigure resource base of product portfolio or reposition product portfolio	NA	Hypercompetition	Regression	Software industry
Malik and Kotabe, 2009	Three dynamic capabilities including manufacturing flexibility, organizational learning and reverse engineering	Underpinning DC – learning (repetition and experimentation), reconfiguration (identify opportunities and changing resources - external) and coordination (how managers coordinate and integrate internally) processes	Shift from emerging economy through market liberalization	Survey and regression	Indian and Pakistani firms
Marcus and Anderson, 2006	General DC Ability to renew, augment and adapt competencies over time	NA	NA	Survey/ regression	US Retail food
Martin, 2011	Dynamic managerial	Antecedents of dynamic	Dynamic environment;	Multiple-case study	Multibusiness

	capabilities	managerial capabilities include recombinative structures, recombinative processes and social equivalence	uncertain and rapidly changing		organizations in software industry
Moliterno and Wiersema, 2007	Resource divestment capability How divestment can generate competitive advantage	NA	NA	Regression	Major League Baseball
Morgan, Vorhies, and Mason, 2009	Acquiring and deploying resources in such a way as to reflect changing environment	NA	NA	Mail Survey; SEM	Broad sampling of US firms
Narayanan, Colwell, and Douglas, 2009	Fast drug development and chemical biology R&D platforms	Development of DC a combination of path dependent behaviours and firm idiosyncratic behaviours; early dynamic capability fragility	Fast paced environment	Case based	Single US Pharmaceutical
Pablo, Reay, Dewald, and Casebeer, 2007	Learning through experimenting; Bringing together existing resources in new ways	Phases of developing DC: Identify latent DC, enabling the DC and managing ongoing tensions	Continuous reduction in financial resources (squeeze); Continual need for improvement;	Interviews	Public healthcare in Calgary
Pierce, 2009	Ability of firms to survive in face of strategic change by core firms in their industry.	Forecasting capabilities; Related experience in niche market;	Core firms create shakeouts that challenge niche markets.	Regression	Automotive leases
Rindova and Kotha, 2001	Continuous Morphing Ability to change organizational form (structures, organizational arrangements), function (product strategy) dynamically. Can be used to support rapid changes in	Dynamic capabilities are open-ended; emergent and evolving over time; process of layering resources to convert strengths to assets	Hypercompetitive; high velocity; regimes of rapid change; It is about maintaining dynamic fit with this changing environment.	Cases	Search Engines

	strategy required in dynamic environments				
Rosenbloom, 2000	Achieving new forms of competitive advantage.	Actualize latent dynamic capabilities; painful crisis during adaptation	Radical technological change in business equipment	Case	Business Equipment (NCR)
Rothaermal and Hess, 2007	Seeking the locus of dynamic capabilities – individuals, firm or network	Finds that antecedents for dynamic capabilities at the individual, firm and network levels of analysis.	Exogenous paradigm shifts	Regression	Biotechnology
Salvato, 2009	Dynamic managerial capabilities	Encoding successful experiments into higher level capabilities; ordinary and mindful acts can play a strong role in DC development; initial temporary under performance	Ever changing competitive environment	Sequential analysis	Alessi Italian designer
Schilke and Goerzen, 2010	Alliance management capability Degree to which organizations possess relevant management routines that enable them to effectively manage their portfolio of strategic alliances	NA	NA	SEM	R&D Alliances
Shamsie, Martin, and Miller, 2009	Investment decisions – Choosing between improving strengths or developing weaknesses	Resource allocation between exploiting and exploring	Constant and unpredictable change	Regression	Hollywood film industry
Sirmon and Hitt, 2009	Dynamic Managerial Capabilities/Asset Orchestration Focusing on manager's resource-related decisions such as resource investment	NA	NA	Two-stage least squares regression	Banks

	and deployment (asset orchestration)				
Song, Droge, Hanvanich, and Calantone, 2005	Resource configuration, complementarity and integration.	NA	Moderated by low or high technological turbulence	SEM	Joint Ventures

Table A3 Persistent Disturbance Codes and Persistent Manufacturing Implications

Persistent Disturbance Codes	Description	Representative Passage	Persistent Manufacturing Implications
Economic Cycles	Economic cycles refer to the booms and busts of recessionary cycles as well as other economic factors such as high inflation.	*Deepening recession, double-digit inflation and public uncertainty over the availability and price of gasoline took their toll of vehicle sales and industry profits in most major markets last year.* [Ford 1974 Annual Report] *The year 1982 was another year of mixed economic results. While both inflation and interest rates declined significantly, the long sought upturn in economic activity did not occur. As a result. Industry deliveries of passenger cars and trucks declined for the third straight year.* [GM 1982 Annual Report] *We had a good first half in 1995, second half automotive profits were reduced by lower U.S. production volume caused by a soft car market* [Ford 1995 Annual Report]	Fluctuating Consumer Demand Profit Margin Pressure
Labour Disruptions	Labour disruptions included strikes and labour negotiations	*The strike by the UAW, extended from September 7 to November 11 caused the Company to lose more than 600,000 cars and trucks from scheduled production in North America. This lost production was particularly damaging because it came at the start of a new model year, when customer demand is high.* [Ford 1967 Annual Report] *The new three-year agreement concluded last December between the Company and the United Automobile Workers is by far the most costly in our history. It has increased the downward pressure on profits, the upward pressure on prices, the gap between U. S. and foreign labor costs and the difficulty of competing with foreign cars imported into the U.S* [Ford 1970 Annual Report] *A more important factor was the UAW strike in the fall, which shut down most GM facilities in the United States for a minimum of ten weeks, and some for a longer period. … We estimate that the strike caused production losses of more than 1.5 million cars and trucks.* [GM 1970 Annual Report] *Strike-related production losses in the United States and Canada during the first and fourth quarters of the year reduced our earnings by approximately 1.2 billion.* [GM 1996 Annual Report]	Profit Margin Pressure
Energy Challenges	Energy challenges included energy crises as well as fluctuating fuel prices	*Late in the year, the Mid-East war and the Arab oil embargo transformed what had been a worsening petroleum shortage into an immediate energy crisis. The energy crisis, in turn, transformed what had been a steady trend toward small cars into a sudden rush.* [Ford 1973 Annual Report] *… rising fuel prices caused demand for SUVs to drop sooner and faster than we had anticipated.* [Ford 2005 Annual Report]	Fluctuating Consumer Model Preferences Fluctuating Consumer Demand

		For the automobile industry, 1974 was the year the patterns of the marketplace went awry. In the gasoline-short early months, demand for small cars soared to unprecedented levels while sales of fullsize cars dropped sharply. For a time, used Vegas were bringing higher prices than used Impalas. No one knew when the oil embargo and gasoline allocations would end; no one knew where the new trends would lead. America's love affair with the automobile was said to be over. [GM 1974 Annual Report] *The impact of 1979's fuel shortages and high prices is likely to last longer than it did after the 1973-74 crisis. By ignoring gas guzzlers and turning to smaller, fuel efficient cars, consumers seem to be reasserting themselves as our No.1 taskmaster.* [WARDS 1980] *"Ford's main U.S. problem, abetted by the economy and the energy situation, was Ford's small-car lineup. It was no longer new and exciting. Its new-for-'79 downsized LTD was being passed up by some buyers who became more interested in small cars as gasoline prices rose to $1.25 a gallon and were expected to go nowhere but up in 1980 and beyond"* (WARD, 1980:211)	
Competitive Pressures	Competitive pressures included those from domestic competitors as well as international entrants from Japan, Europe and Asia.	*With the reduction of trade barriers, the rapid growth of the Japanese automotive industry and the merging of many European manufacturers to form larger and more efficient firms, worldwide competition in our industry is becoming steadily more vigorous. The ability to sell at competitive prices and still earn, a satisfactory return depends more than ever on efficiency gains made possible through technological advances, as well as on continued innovation in product design.* [Ford 1970 Annual Report] *One of the reasons for the strength of Japanese cars sales in the U.S. market is the price advantage resulting primarily from the substantial disparity between Japanese and U.S. wage rates. In 1977 Japanese labor costs were about $7 an hour below US costs.* [Ford 1977 Annual Report] *The current labor cost differential in excess of $8 per hour, comparing GM wages and benefits with those of Japanese auto workers and with the average for all U.S. manufacturing workers, represents a disadvantage to General Motors of approximately $8 billion in a typical year. No company can compete for long, and no jobs are safe for long, with that kind of disadvantage.* [GM 1981 Annual Report] *The competitive playing field is larger and more open than it's ever been before. That means Ford is going to have to compete increasingly with the best companies in the world, wherever they are located and wherever they operate.* [Ford 1994 Annual Report] *Competition in the automotive industry is intensifying, with more market segments and more new products than ever before* [Ford 2003 Annual Report] *The second was the consistent pressure that rising costs and intensified competition exerted on profits throughout the year.* [GM 1971 Annual Report]	Fluctuating Consumer Demand Profit Margin Pressure

		While domestic-make car sales slumped 10% to 8.3 million in 1979 from 9.3 million in 1978, cars from Europe and Japan soared 16% over 1978 to a record 2.3 million from 2.0 million units. [WARDS 1980]	
Government Regulations	Government regulations covered a range of regulatory issues including fuel economy, safety and emissions.	*In the past, our success has depended primarily on our response to the test of the marketplace. In the future, we shall be severely tested by the need to respond at the same time to the requirements of the market and the requirements imposed by the Federal governments' safety and air pollution regulations*. [Ford 1966 Annual Report] *Fuel economy legislation passed during the last session of Congress requires progressive improvement in the average fuel economy of the cars sold by each manufacturer. By the 1985 model year our cars will have to average 27.5 miles per gallon- a requirement that based on existing technology, can be met only if the majority of the cars we sell are Pinto-size or smaller . Today however cars in that class account for less than one-fourth of our sales.* [Ford 1975 Annual Report] *Our efforts to comply with Federal regulations covering vehicle safety, damageability, emissions and fuel economy continue to require large and growing expenditures.* [Ford 1976 Annual Report] *Meeting additional [regulatory] requirements will call for further redesign of much of the Company's product line by 1985. From 1978 through 1985, the Company will launch 22 major new North American product development programs, compared with six in the prior eight years. For example from 1980 to 1984 Ford will introduce an average of one new engine a year compared with one every 2.4 years between 1968 and 1980, and one new transmission a year, compared with one every four years for the prior 15 years.* [Ford 1978 Annual Report] *Government regulation of the auto industry had become a permanent fixture. The cost of compliance with federal regulation by some industry estimates was over $100 billion a year.* [WARDS 1980] *"The Federal Government's programs of conservation of energy, increased highway safety, and protection of health are fully consistent with the goals of Chrysler Corporation. However, in the past year alone, the Federal Government has put into final or proposed form four major standards covering motor vehicles which go beyond reasonable limits, substantially increase our capital needs, and raise the cost to the consumer."* (Chrysler Annual Report, 1977)	Profit Margin Pressure Fluctuating Consumer Model Preferences

Table A4 Ford Production Volume Flexibility

Year	Ford - Production Volume Flexibility
1964	• New sources for Mustang added due to demand at Dearborn Michigan, San Jose California, and Metuchen New Jersey
1967	• Heavy overtime used to make up for losses due to strikes
1968	• Common for vehicles to be built in a small number of plants – ie Falcon just in St. Thomas Ontario
1970	• High production cars launched at a number of plants – so Pinto at San Jose, St. Thomas, and Metuchen plants
1971	• Realignments and inventory adjustments cause production fluctuations – as much as 16,000 units from week to week. • Weak demand for some cars can mean facilities falter – Cougar facility in Dearborn faltered due to weak sports car market • Use of overtime to match demand for Mark IV
1977	• Changed over two small car plants early due to diminished demand • Full-size cars didn't change over models until August
1978	• Louisville and Atlanta plants closed a week early to adjust inventories
1980	• Closed two assembly plants and two component factories • Reduced active hourly workforce by 25%; cut salaried by 20,000 • Ability to ramp up production of Ford's Escort is hampered by limited engine capacity; plans in place to double capacity at Dearborn engine plant and start production at Lima Ohio as well as a new plant in Mexico
1981	• Two new sources for subcompacts – San Jose and St. Thomas
1982	• In exchange for wage freezing, Ford agreed to a moratorium on plant closings; this reduces ability to adjust demand
1982	• Escort built at four plants – Edison, Wayne, San Jose and St. Thomas • Reduced production volumes – UAW agrees to alternating shift routine – 10 days on and then 10 days off. Saved jobs and kept skilled workers available for when sales picked up • Cuts in plant scheduling • Lincoln Mercury – a second shift added and 1100 workers recalled at St. Louis to increase output
1983	• 18% of cars built on overtime between July and December • Production increases of Marquis and Grand Marquis at St. Louis and Chicago • Second shift added for Mark and Lincoln and an increase in line speed for Wixom MI
1985	• Tooling up to build 500,000 Taurus and Sable (sister cars)
1986	• Delayed plans to drop Grand Marquis due to strong market demand
1987	• UAW agreement stipulates no UAW employee could be laid off due to domestically made component or car being replaced by an imported vehicle. And a moratorium on plant closings granted to UAW
1989	• Able to manage inventory adjustments by reducing daily overtime – not until January 1990 did they need to close plants. This is because Ford had kept capacity low, revamping existing facilities instead of building new ones

1990	• Ford closes plants for 85 plant weeks and plans cuts to salaried staff
1992	• Increasing capacity of medium/heavy truck facilities
1993	• Plans to sell 800,000 of Mondeo world car yearly
1994	• Increased capacity at St. Louis plant by 135,000 units (to 445,000 units) • Halved production of Aerostar van • Michigan truck plant going to three crew for an increase of 32,000 units
1997	• Shuttering Lorain plant for up to two years
2002	• Large downsizing activity – 35,000 jobs and five NA plants (Edison, Ontario Truck Oakville, St. Louis, Cleveland casting and Michigan-based Vulcan forge) – Shrinking capacity by 1 million units by mid decade • Discontinued low margin plates – Cougar, Villager, Continental, and Escort
2004	• Ford to cut a shift at Oakville • Closures of Ontario Truck, Edison, and Rouge plants • Wayne experiencing multiple down weeks to trim inventory
2005	• Major reshuffling calling for 14 plants closing (including St. Louis, Atlanta, Wiixom, Twin Cities, Norfolk, and Batavia transmission) and reduction of hourly workforce by 25,000 to 30,000 jobs by 2012
2007	• 38,000 UAW members accepted buyout packages

Table A5 GM Production Volume Flexibility

Year	GM - Production Volume Flexibility
1971	• Plants working 6 days a week
1973	• Closed down full-size model assembly plants for a week prior to Christmas break
1974	• Cutback of full size production in anticipation of more small car demand. • Closed assembly plants at various points throughout the year to manage inventory
1980	• Ceased production of full-size models at South Gate and St. Louis • South Gate idled from March 1980 to March 1981 • Reduced line speeds at many Olds factories towards end of model years
1982	• Closed indefinitely South Gate, Fremont and Lakewood plants
1982	• Consolidating two rear-drive assembly plants into one to produce front-drive cars for '86 – layoff of 3600 workers • Second shift added to Livonia engine plant
1983	• Second shifts added at Janesville and Lordstown for Cavaliers; • Second shift added at Oklahoma for Celebrity • Use of significant overtime at Lansing • Layoffs, line speed reductions and idle weeks for inventory control at Willow Run
1984	• Fiero and 2000 Sunbird run extended into November - Fiero car always in short supply • 6000 production extended to North Tarrytown • Daily and Saturday overtime common for Cadillac
1985	• Second shift added at Fremont for Nova's • Daily and Saturday overtime common

1986	• A wave of plant closings – mostly inefficient and redundant older ones • Portion of Fremont (NUMMI) turned over to Toyota for production of Corolla
1987	• Three cutbacks in production • Reduced demand at Fiero dropped output to one shift at Pontiac • Norwood closed permanently • GM eliminated second shift indefinitely at Buick City
1989	• Framingham added to indefinitely idled list • Lakewood closing in mid 1990 • Sales slow down led to sporadic one and two week plant shutdowns
1990	• New plant – Saturn at Sprint Hill
1991	• Major losses leading to closing 21 plants, idling 74,000 employees over 4 years
1992	• Saturn moving to three shift production in June of 1993
1994	• Grand Prix adds second shift, recalling 750 laid off workers • Capacity hikes at several plants for pickups, vans and SUVs • Saturn cut production 25% in March through May due to slow sales and rail car shortages • Delayed planned closure of St. Catharine's engine plant
2000	• Built first U.S. Greenfield plant since 1986
2001	• Sporadically idled Orion (as opposed to reduce line speed – this saved 850 workers) • Closed Ste. Therese
2004	• Closed Saginaw Iron plant • Closed Baltimore assembly plant • Expanded Flint South engine plant by 500,000 square feet • Idling of Linden plant – could not be closed due to union contract
2005	• Restructuring plan to close 9 facilities, change operations at four plants and cut 30,000 jobs in 3 years • Close a line at Oshawa, idle No 1 line at Spring Hill and cut third shift at Moraine and Oshawa • In total, expected output reduction from 6.2 million to 4.3 million by 2008

Table A6 Chrysler Production Volume Flexibility

Year	Chrysler - Production Volume Flexibility
1971	• Minimum plant shutdowns for inventory adjustments
1972	• Relatively constant production pattern – few peaks and valleys in schedules • Valiant used same basic body for 6 years – very rare in the industry
1973	• Layoffs and production cutbacks to manage big car inventories that skyrocketed due to energy shortages
1974	• Plant downtime used in early and latter parts of calendar year (energy crisis and recession respectively)
1975	• Intermittent assembly plant shutdowns and layoffs to keep pace with slow

		sales
1978	•	Chrysler's most modern plants operating at capacity early in 1979
1980	•	Closed 8 plants and cut workforce by 31%
1981	•	Lynch Road assembly mothballed
1983	•	Employees working 10 hour shifts seven days a week to facilitate stamping needs (led to wildcat strike)
	•	Dodge production rose 46.5% straining capacity
	•	Most U.S. facilities double shifted
	•	Expected to add five shifts between 1983 and 1984 at each of St. Louis plant 1, St. Louis Plant 2, Sterling Heights, Warren and Windsor
1984	•	Opened 6th US assembly plant in Sterling Heights to assemble two products – Chrysler LeBaron and Dodge Lancer
	•	Added additional source for vans at St. Louis (in addition to Windsor)
	•	Corporate goals to increase production capacity by 25%
1987	•	Plant acquisitions from AMC
	•	Closing of a number of plants
	•	Belvedere added a second shift to new full-size front drive cars
1989	•	Slow sales led to sporadic one and two week plant shutdowns
	•	Closing assembly plants at Detroit Jefferson Ave and St. Louis No. 1
	•	Cancellation of second shift at Jefferson Avenue
1990	•	Slow sales led to sporadic one and two week plant shutdowns
	•	Third shift added at Windsor for small vans
1993	•	Increasing outputs of minivans with a three-shift operation at Windsor
	•	Sterling Heights can produce 190,000 units on 1 shift; 290,000 on two shifts with overtime and 330,000 on a three crew system
	•	Increasing capacity of vehicle assembly and powertrain over 3 years – up 6000 jobs and 500,000 units
1994	•	Second shift added at Sterling Heights following start up of new JA cars
1995	•	Unshuttering St. Louis South plant to increase production of Dodge Ram
1996	•	New Brazil plant to assemble Dakota pickups
2000	•	PT cruiser production hiked at Mexico plant
	•	Week of shut down to control inventory prior to start up of new small vans
2001	•	Downsizing – 19,300 workers by 2001; another 4200 by 2002 and then another 2500 by 2003
	•	Closing Mound Rd at Warren and Toluca Transmission plant; Campo Largo operation in Brazil and Pillette road in Windsor
2002	•	Closed Pillette plant
	•	Mercedes reducing output in Germany of short term contract employees
	•	Planned 12,000 workers to retire
2004	•	35,000 employees reduced
	•	Third shift added at Warren for new midsize
2006	•	Belvidere plant added third shift and overtime shifts
	•	Production cut of 135,000 for second half of the year
2007	•	Calls for 11,000 hourly job cuts and a capacity decrease of 400,000; achieved through shift reductions at three truck plants and a minivan plant

Table A7 Ford Production Mix Flexibility

Year	Ford – Production Mix Flexibility
1964	• Having plants dedicated to a single car is unusual – but Mercury was out of St. Louis
1971	• Developed “back to back” launch between model years – close on Friday and open on Monday/Tuesday with new model. Changeover week output closer to 50% rather than 10% during changeovers
1972	• Increased use of “running changes” which means improving a model in between model years
1973	• Major model switch to production favouring small cars in 60 to 40 ratio including: Pinto production rate increase at Metuchen; redesigning Dearborn to produce Mustang II; Pinto production rate increase at San Jose; Mustang II added to San Jose; second shift added at San Jose; Chicago conversion to intermediate Torino; Wayne conversion to Maverick output. In total, adding 1 million small car units within 12 months. Called “fastest and most expensive production model-mix shift in history”
1974	• Employing imports from European operations
1975	• More running changes than ever before
1977	• Satisfying full-size and intermediate demand – changed over two small car plants early while full-size cars didn’t change over models until August
1979	• Mustang and Thunderbird built from the Fairmont platform. Body frame platform for LTD II and old Thunderbird eliminated. A reduction in platforms
1983	• Big cars and small cars built on the same platform in St. Thomas (Grand Marquis with Ford Escort and Lynx) • Dual front and rear drive production permitted swings based on market demand
1989	• Retooling Edison from Escort to Ranger compact pick up trucks mid-year
1991	• Converting St. Louis from Aerostar to Explorer SUV
1994	• Ford announcing desire to reduce platforms from 24 to 16
1996	• UAW agreement where Ford must replace hourly workers that retire, die or quit on a one to one basis (with some caveats) • Trims platforms from 24 to 16, and engines from 30 to 14 • Ford absorbing workers from Flat Rock into UAW agreement providing flexibility to shift Ford workers and Ford products into and out of the plant
1997	• Low investment vehicle (aimed at China, India, Brazil, other emerging places) would be very flexible – same platform for a pickup, car, van, four-wheel drive
1998	• Philippines plant capable of three body styles – Ranger pickup, Laser Liata and Econovan
2002	• Flexible manufacturing taking hold in Europe (later in North America) involving investments in supplier parks close to assembly plants. Chicago an example, and other plants including Kansas City, Norfolk, and Dearborn (Rouge) • Rouge redone to accommodate three distinct platforms instead of two
2004	• Ford Focus is third vehicle built on global C-segment C1 architecture • Overabundance of body on frame capacity for truck and SUV; not as much capacity cross/utility vehiclesChicago plant involves multi-supplier park and flexible assembly line capable of building eight models from two platforms

	• Dearborn plant capable of building nine models from three platforms
2007	• Preparation for cross utility vehicles (Ford Edge and Lincoln MKX) combined Oakville Ontario and Ontario Truck into a single flexible campus • Plan in place called Global Product Development System (GDPS) in order to bring vehicles out of Mazda quicker

Table A8 GM Production Mix Flexibility

Year	GM Production Mix Flexibility
1968	• Central General Motors Assembly Division took over responsibility of 6 of 11 assembly plants for Chevrolet and Fisher Body Division. This move was made to achieve greater flexibility in processing chassis and body operations
1971	• Shifted plants around – put Nova in Van Nyus and Norwood plants; Moved Camaro from Van Nuys to Norwood
1973	• Laid off workers while resourcing from big to small cars was carried out
1977	• Sourcing changes – LeMans added at Baltimore and dropped at Lakewood; Sunbird added at Lordstown; Phoenix added at Willow Run and North Tarrytown; and Ventura dropped at Van Nuys
1978	• Looking to centralize engine manufacturing more; Chevrolet shared its V-8 with other divisions for first time; Chevrolet typically went alone • Linden ended production of C-body cars several months earlier than other plants to convert to front-drive E body
1979	• Multi-divisional sourcing of supplies –such as engines from Chevrolet to Buick, Oldsmobile and Pontiac • Oldsmobile providing diesels for other divisions – Chevrolet, Pontiac, Buick and Cadillac • Pontiac's fuel efficient engines sold to others within GM family • Olds exchanged some production capacity dedicated to H-body Starfire cars for additional X-car allocation
1980	• Pontiac producing 4-cylinders for other divisions – phasing out V-8s to make more four cylinders • Oldsmobile produced diesel and gasoline V-8's for all divisions – more diesels given gasoline crunch • Cadillac using Buick's V-6 until it could produce its own
1981	• Corvette production moved to Bowling Green from St. Louis • Importing 4 cylinder engines from GM do Brazil
1982	• In exchange for pay concessions, GM agreed not to close four component plants • Converting Pontiac plant to other use
1983	• '88s and 98's started at Cadillac's Detroit plant – first time Cadillac shared its home plant • GM-20 (N-cars) being build by Oldsmobile for Olds, Pontiac and Buick on a single line • Buick City is born by converting 60 year old unrelated component manufacturing and assembly plants into a 500 acre state of the art facility
1984	• Buick City to build 314,000 cars annually – uses maximum JIT parts delivery –

	just one day of components on hand
1985	• LeSabre and Olds 88 designed on new platform • Hamtramck plant included robot painters
1986	• N-car trio – So three cars based on N-Body • E/K trio – three cars based on this (Buick, Olds and Cadillac) • Some difficulties from synergies with vehicles looking very similar
1987	• Mix of 4 door sedans and 5 door hatchbacks for NUMMI's Nova • Specialized plant in Lansing for luxury 2 seater Reatta • Cadillac employing "simultaneous engineering" for quick design changes to things like grill panels and tail-lights
1988	• Cadillac only fully integrated and self-contained GM North American car division – they considered moving all output to a single plant in Hamtramck
1989	• Some switching around – Lordstown van output move to Flint and then Flint moves to Janesville and then Janesville to Lordstown • Lumina trio – coupe, sedan and minivan on same platform • Chevrolet, Pontiac and Olds splitting APV output from North Tarrytown
1991	• Consolidation of engine and transmissions operations into the GM Powertrain Division
1997	• Additional concerns that distinctive brand equity difficult when building Chevrolets, Opels and Saturns from the same architecture • Shifted work from UAW plants in Pontiac to Oshawa where CAW agreed to different work rule changes
1998	• GMT800 program was future of GM's SUV and pickups. Eventually would form basis of 40 models. Used a hydroformed frame with three box-shaped modules that could be mixed and matched to produce maximum model variation with minimum parts. Four front models, four mid sections and two rear sections created 14 models. Result was reduced build time, less changeover downtime and improved differentiation • Bulldozing inefficient plants to build state of the art facilities with modular assembly that operated 24 hours a day (Yellowstone)
1999	• Project Yellowstone called for two new assembly plants (Lansing and Lordstown) with suppliers bringing up to 15 built-up modules including interior cockpits and doors. (Heavily challenged by UAW)
2003	• Equinox based on same Theta platform as Saturn • Saab building first SUV based on GM's GMT360 midsize truck platform • Cobalt marked North American arrival of GM's global Delta platform (also used by Opel's Astra)
2005	• New flexible manufacturing at Oshawa
2006	• Increased use of shared global platforms

Table A9 Chrysler Production Mix Flexibility

Year	Chrysler Production Mix Flexibility
1973	• Reliant on Colt for its subcompact vehicle – lack of domestic subcompact left Dodge and Chrysler in the lurch
1978	• Lynch Road plant only '79 model year plant to build a single body style exclusively
1979	• Shutdown Hamtramck assembly plant which was 6 stories high • Eliminated the production sales bank system
1981	• Continued use of sister K-cars – Reliant and Aries
1983	• Windsor gutted and replaced with minivan – 123 robots helped with assembly • Chrysler Laser built on same line as Reliant and LeBaron at St. Louis
1986	• Chrysler and Plymouth separated – as part of the trend to distinguish cars from one another despite shared platforms • Building upscale subcompact alongside H-cars at Sterling Heights
1987	• Switching production from Belvedere to former AMC plant in Kenosha lost 6 months of production of subcompact L cars • Another transfer from St. Louis to Kenosha – m-cars Gran Fury, Fifth Avenue and Dodge Diplomat
1988	• Modern UAW agreement brought influx of robots (from 70 to 220)
1992	• New Yorker and LHS sharing a body and output • Ram and Dakota trucks sharing a line at Warren
1996	• CAW negotiation yielded job security improvements. All jobs lost to outsourcing would be replaced one to one • Chrysler simplified minivan to have a fourth sliding door after 90% of orders had that option
1997	• China concept vehicle – idea of a really inexpensive and easy to manufacture vehicle for China • Adapting continuous improvement system from Toyota • Talk of integrating passenger car platforms to reduce investment and focus on light truck/SUV capacity – but stopped short of abandoning cars due to cyclical nature of the industry
2002	• Built new Pacifica platform for station wagon, but will be the basis for next generation of minivans • Sharing underpinnings of Neon with Mitsubishi- produced at Belvedere • Joint platform with Mitsubishi for C-segment cars with possible expansion to D-segment
2005	• Announcement by CEO that by end of 2008 more than 60% of his groups assembly plants would be feature advanced flexible manufacturing technology capable of building multiple models off varied platforms on the same assembly line

Table A10 Ford Partnering Flexibility

Year	Ford – Partnering Flexibility
1983	• Constructing assembly and stamping plants in Mexico to build 130,000 cars annually for U.S.
1984	• New engine from Mazda for the Escort and Tempo • Merkur vehicles received from Germany
1985	• Ford division getting version of Mazda 626 from Mazda's first US assembly plant in Flat Rock
1986	• Front drive version of Mustang being produced at U.S. Flat Rock assembly plant • Festiva coming from Kia – a mini-compact • Lynx being imported from Mazda based on the 323 frame • Opened first Mexican assembly plant
1987	• Probe being produced at Mazda's Flat Rock based on 626; included engineers from both companies but no JV • JV with Volkswagen to build and market cars in Brazil and Argentina • Finalizing plans to build a minivan in North America with Nissan • Tracer from Mexico plant replaced Lynx • Additional model in Merkur line from Germany
1989	• Escort coming from Wayne MI and Hermosillo Mexico • Merkur from Germany dropped
1991	• Ford partnering with Nissan to build small vans (Mercury Villager and Nissan Quest) at Avon Lake plant. Ford's role assembler; Nissan design and engineering
1992	• Ford purchased 50% of Mazda Flat Rock facility • New world car: built in Kansas, engines from Mexico and Belgium, transmission from Batvia, U.S. built transmission
1994	• Ford of Europe to supply Mazda with rebadged version of Fiesta
1995	• Galaxy mini-van launched jointly with Volkswagen in Portugal • Raised stake in Mazda to 35%
1997	• Combined Mazda cycle plan for first time – so a larger optimization of facilities and skills over next 10 years • Trotman expresses continued support for global vehicles
1998	• Last year for Nissan mini-van JV • Could not get sliding door in time for launch of mini-van from Ford's Visteon parts, so went with GM's parts department • Mazda 626 designed in Ford's Small Vehicle Center in Cologne – so may share same platform as next world car
1999	• Sold rights to produce vehicles at their AutoEuropa plants – a Volkswagen JV in Portugal
2000	• JV with Alfa Romeo to build aluminum engine components in Windsor; had a Nemak partnership with Alfa Romeo since 1979
2005	• JV with Peugeot for two new power plants • JV with Changan and Mazda in China engine plant
2008	• New B-segment car based on Mazda2 underpinnings

Table A11 GM Partnering Flexibility

Year	GM – Partnering Flexibility
1972	• Purchased interest in Isuzu – Importing light truck
1973	• Reliance on Opel for subcompact
1975	• Buick shifted from Opels to a T-car from Japan
1979	• New diesel engine coming from Isuzu
1983	• JV announced with Toyota to produce small cars at an idle GM plant in Fremont • Deals with Isuzu and Suzuki Motors to import up to 300,000 compacts starting in 1985
1984	• Nova built with Toyota at Fremont as part of NUMMI pilot • Cars from Isuzu and Suzuki started to come in
1985	• Plans for Pontiac branded South Korean subcompact imported from Daewoo Heavy Industries
1986	• GM getting bodies for Allante from Italy's Pininfarina S.p.A
1987	• Sprint and Spectrum captive imports helped a lot • NUMMI built Nova not measuring up to Chevette or Ford Escort
1988	• Establishing Geo franchise including Suzuki and Isuzu vehicles as well as Prizm (Nova replacement at NUMMI) and Geo Storm (NUMMI)
1989	• JV with Saab Scania to jointly produce cars for sale in West Europe • Formed JVs with governments in East Germany and Hungary to begin production in 1990s • Canada based GM Suzuki plant at CAMI to produce Tracker replacing Japanese imports with Canadian imports • Daewoo's LeMans vehicle strong – it was based on the West German Opel Kadett
1997	• Long 2 month strike in order to take greater advantage of global outsourcing • Possible exchange of car production with Daewoo
2000	• GM investing 20% in Fiat – resulting in a JV for purchasing and powertrain operations in Europe and South America
2001	• Planning on naming suppliers "lead interior integrators" to manage development of passenger compartment of every NA vehicle. GM would assume the overseeing and benchmarking roles • Signed non-binding agreement to acquire large chunk of Daewoo
2002	• Cut share of Isuzu from 49% to 12% • GM exporting Meriva to Canada from Brazil – first global car GM launched in Brazil before Europe
2003	• Equinox featuring Chinese built engine
2005	• Fiat deal exited – but 50/50 JV for engines remains • GM dumps 20% in Fuji (Interesting note – Toyota jumped in with an 8.7% stake in order to tap capacity of Subaru plant in Indiana and build Toyotas
2006	• Unloaded 20.4% stake in Suzuki and its stake in Isuzu

Table A12 Chrysler Partnering Flexibility

Year	Chrysler – Partnering Flexibility
1970	• JV with Mitsubishi for production of vehicles for Japanese and other world markets
1971	• Purchased 15% equity in Mitsubishi
1972	• Shifted Cricket from Great Britain to Japan to be built by Mitsubishi
1974	• Sourcing small engines and manual transaxles from Volkswagen for domestically built subcompact car
1977	• Increased number of cars coming from Mitsubishi - 4
1980	• Was going outside Chrysler for parts
1981	• Jointly producing subcompact with Peugeot SA and getting 450,000 diesel engines (but then Peugeot pulled out in 1982) • Increased breadth of vehicles from Mitsubishi
1984	• JV with Mitsubishi to build cars at new plant in Illinois under name Diamond Star Motors
1986	• AMC to begin production of Chrysler's full-size rear-drive cars in Kenosha in 1987 • Mitsubishi venture underway at Bloomington Illinois
1987	• Mitsubishi engine powers New Yorker vehicles
1988	• Cancelled share of output of Summit from Mitsubishi's Diamond Star plant • Up to 55,000 four door K-cars imported from Mexico (despite UAW objections)
1989	• JV with Renault to produce Junior jeep SUV in Spain • Continued use of Mitsubishi imported vehicles – and from Diamond Star
1990	• Dropping plans with partners – out of the '92 Hyundai Sonata deal with Korea's Hyundai's new plant in Quebec • Out of JV with Renault over jeep • Halved equity with Mitsubishi
1993	• Eagle Talon, Dodge Avenger and Chrysler Seabring built at Diamond Star plant
1994	• Multi-year deal reached to purchase from Italy's VM Motori SpA 200,000 2.5 L diesel engines for Voyager and Cherokee models in EUrope
1995	• Moving all engines in house by end of century • Negotiated end of MMC's manufacture of Dodge Stealths
1996	• Partnership between BMW and Chrysler to produce engines in Latin America for sale outside of North America
1997	• JV with GM to build 4-wheel drive transfer cases, manual transmissions and other driveline products
2000	• A deal between Daimler Chrysler, Mitsubishi and Kia to build high quality low cost cars for all world markets – like Neon
2001	• JV with Mitsubishi to build engines in Germany for use in Smart and Mitsubishi cars
2002	• Underpinnings of Neon shared with Mitsubishi • Partnership with Hyundai and Mitsubishi to build 4 cylinder engines • Sold off an assembly plant to Magna International; Production of Voyager moved to Magna Steyr joining Jeep Grand Cherokee and M-Class
2004	• Engine manufacturing with Mitsubishi and Hyundai increase size • Dropped relationship with Mitsubishi to 25%

	• Sold stake in Hyundai
2005	• Deal with Volkswagen to build minivans at Chrysler's St. Louis plant

A13 Reflexivity Statement

An important practice in qualitative research is to practice reflexivity so as to understand the origins of a researcher's own perspective and in the process enhance the objectivity of a scholars research outputs. A reflexivity statement captures a researcher's perspective and recounts some of the scholar's experience in conducting the research.

First I will comment on my relationship to the automotive industry. I have never been an employee of any organization within the automotive industry. This means that I read detailed firm and industry analysis from the perspective of an industry outsider. Any biases regarding the automotive industry that I held were those of a casual observer of popular news outlets. To sensitize me to the industry, I read two to three books detailing the very early years of the automotive industry including a book on Henry Ford and an economic survey of the automotive industry prior to 1945. Both of these books provided me with a historically grounded understanding of the automotive industry.

This research was conducted as part of my pursuing a doctorate degree in management. In earlier versions of my thesis proposal, this research appeared as an effort to connect how firms respond to disturbances to a multi-level theoretical framework called Panarchy which builds on complex adaptive systems and resilience. While this theoretical framework was not explicitly referenced, I believe that some of these ideas permeated my work (confirmed by Robert Lannigan, a complex systems expert and thesis reviewer, who noted the strong undertones of complex systems theory that were present in this thesis). Further, I have an enduring interest in connecting ideas of sustainability and strategy together which may have further influenced my focus and data analysis such as by sensitizing me to perceive ideas critical to my research such as persistent disturbances.

There was no direct funding for this research, however I was supported throughout my PhD by funds originating from Western University, my thesis advisor, an OGS scholarship and a personal SSHRC grant. None of these funding sources exhibit direct influence on the content or direction of my research.

8.0 Curriculum Vitae

Name:	Brent McKnight
Post-Secondary Education and Degrees:	The University of Western Ontario Richard Ivey School of Business London, Ontario, Canada 2006-2012, Ph.D Business Administration
	McMaster University Hamilton, Ontario, Canada 2001-2002, M.B.A.
	McMaster University Hamilton, Ontario, Canada 1995-2001, B.Eng. & Mgmt
Honours and Awards:	Academy of Management – BPS Division – Outstanding Reviewer Award (2011)
	Ontario Graduate Scholarship – The University of Western Ontario (2007, 2010)
	C.B. (Bud) Johnston Ontario Graduate Scholarship (2010)
	Social Sciences and Humanities Research Council Grant (2009)
	Honourable Mention in ASAC Best Paper Competition (2009) Strategy Division
	Honourable Mention in ASAC Best Paper Competition (2009) Social Responsibility Division
	Brock Scholarship – The University of Western Ontario (2006, 2007, 2008, 2009)
	Plan of Excellence – The University of Western Ontario (2006, 2008)
	University Prize for Special Achievement – McMaster University (2001)
	McMaster Merit Entrance Scholarship for Academic Achievement – McMaster University (1995)

Related Work Experience: 2012: Lecturer, Richard Ivey School of Business at The University of Western Ontario

2011: Adjunct Professor, DeGroote School of Business at McMaster University

2006-2011: Research Assistant, Richard Ivey School of Business at The University of Western Ontario

2009-2010: Lecturer, Richard Ivey School of Business at The University of Western Ontario

2001-2002: Teaching Assistant, DeGroote School of Business at McMaster University

Publications:

Peer Reviewed Articles

- Bansal, P. and McKnight. B. (2009), Looking Forward, Pushing Back, and Peering Sideways: Analyzing the Sustainability of Industrial Symbiosis. ***Journal of Supply Chain Management***, 45(4), 26-37
- McKnight, B. (2009) Give it Some Time: Corporate Diversification and Time, ***Administrative Science Association of Canada Proceedings***, 37th Annual Meeting, Niagara Falls, Ontario.
- Frooman, J., Branzei, O, McKnight, B. and Zietsma, C. (2009) Social (Ir)responsibility Effects on Long-Term Capital Costs, ***Administrative Science Association of Canada Proceedings***, 37th Annual Meeting, Niagara Falls, Ontario.
- Frooman, J., Zietsma, C. and McKnight, B. (2008). There is no good reason not to be good, ***Best Paper Proceedings for the Administrative Science Association of Canada*** (paper 29-9), 36th Annual meeting, Halifax, Nova Scotia, May 24-27.
- Frooman, J., Zietsma, C., McKnight, B., and Murrel, A. (2008). How Risk Mediates the CSP-CFP Link, ***Best Paper Proceedings of the Academy of Management Conference***, 68th Annual Meeting. Anaheim, CA. August 10-13.
- McKnight, B and Bontis, N. (2002), E-Improvisation: Collaborative groupware technology expands the reach and effectiveness of organizational improvisation. ***Knowledge and Process Management***, 9(4), 219-227

Book Chapters

- Zietsma, C. and McKnight, B. (2009). Building the Iron Cage: Co-creation work in the context of competing proto-institutions. Invited contribution to Lawrence, T.B., Suddaby, R. & Leca, B. (Eds.). Handbook of Institutional Work, Cambridge University Press.

Cases

- Zietsma, C. and McKnight, B. (2007). Sensible Life Products (A) & (B), Registered with Ivey, 9B07M057 and 9B07M058.

Conference Presentations

- McKnight, B. (2011) The Role of System Diversity in Sustainable Development: A resilience based conceptualization, ***Administrative Science Association of Canada***, 39th Annual Meeting, Montreal, Quebec, July 2-5.
- Frooman, J., Branzei, O, McKnight, B. and Zietsma, C. (2010) The Shadow of the Future: Social Assessments of Forward-Looking Risk and CSP-CFP, ***Academy of Management Conference***, 70th Annual Meeting. Montreal, Quebec, August 6-10.
- McKnight, B. and Bansal, P. (2009). The Sustainability of Industrial Symbiosis, ***Academy of Management Conference***, 69th Annual Meeting. Chicago, IL, August 7-11.
- Frooman, J. Zietsma, C. and McKnight, B. (2009) When it's Good to be good and when it's good to be bad: CSP and the cost of debt vs equity capital, ***Academy of Management Conference***, 69th Annual Meeting. Chicago, IL, August 7-11.
- McKnight, B. (2009) Give it Some Time: Corporate Diversification and Time, ***Administrative Science Association of Canada***, 37th Annual Meeting, Niagara Falls, Ontario.
- Frooman, J., Branzei, O, McKnight, B. and Zietsma, C. (2009) Social (Ir)responsibility Effects on Long-Term Capital Costs, ***Administrative Science Association of Canada Proceedings***, 37th Annual Meeting, Niagara Falls, Ontario.
- Frooman, J., Zietsma, C., McKnight, B., and Murrel, A. (2008). How Risk Mediates the CSP-CFP Link, ***Academy of Management Conference***, 68th Annual Meeting. Anaheim, CA. August 10-13.
- Frooman, J., Zietsma, C. and McKnight, B. (2008). There is no good reason not to be good, ***Administrative Science Association of Canada*** (paper 29-9), 36th Annual meeting, Halifax, Nova Scotia, May 24-27.
- McKnight, B. and Zietsma, C. (2007). Local Understandings: Boundary Objects in High Conflict Settings, ***International Conference on Organizational Learning, Knowledge and Capabilities***, June, London, Canada.
- McKnight, M. (2007). Recognize Me? Reputation and the Liability of Newness, ***ASAC Conference***, June, Ottawa, Canada.
- McKnight, B. and Zietsma, C. (2007). The Little Council that Could: How the Forest Stewardship Council Changed Established Institutions, ***McMaster World Congress***, January, Hamilton, Ontario.
- McKnight, B. and Bontis, N. (2001). E-Improvisation: Collaborative groupware technology expands the reach and effectiveness of organizational improvisation, ***International Symposium on Organizational Improvisation***, June, Lisbon, Portugal.