Distribution Strategy and Retail Performance in the U.S. Market for Plug-in Electric Vehicles: Implications for Product Innovation and Policy

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Abstract

From a marketing and sales perspective, plug-in electric vehicles (PEVs) are very different from conventional gasoline and diesel cars. They are also very different from prior advancements in automotive technology. PEVs hold distinctly different value for customers, entail material changes in consumer behavior and require new support infrastructure on which customers must rely. New car dealers may be ill-equipped to sell these radically innovative new products, with potentially adverse consequences for PEV adoption.

In this dissertation, I address the behavior of new car dealers as they face these new PEV products through the lens of product innovation, marketing strategy and retail performance. Marketing theory suggests that success in bringing radically different technologies to market depends on whether manufacturers can match an appropriate distribution strategy to the type of innovation being introduced. I examine the relationship between innovation form and distribution strategy by analyzing national new car buyer survey data from automotive research firm J.D. Power and by conducting a total of 43 interviews with automakers and new car dealers in California's core PEV markets.

The analysis revealed a sizeable gap in the reported quality of the retail experience between buyers of new conventional cars and new PEVs. PEV buyers rated new car dealers much lower than buyers of conventional cars, and reported much lower intended loyalty to those manufacturers as a result. The big exception came from buyers of electric cars from industry newcomer Tesla Motors, a company noted for pioneering new approaches to selling electric vehicles. Tesla employs an innovation-specific distribution strategy featuring company-owned

retail stores, service centers and charging infrastructure. In contrast to dealer-based sales, Tesla buyers reported much higher retail satisfaction and higher intended buyer loyalty.

The research uncovered several factors that could explain observed disparities in retail satisfaction, including a steeper learning curve for dealer salespeople, low initial demand, questionable profitability and other substantive burdens on dealers. Consequently, many dealers may choose to forego opportunities to sell PEVs or to make PEV-specific investments in facilities, equipment or training that could lift buyer satisfaction with the retail experience. Pervasive state franchise laws further ban manufacturers from selling PEVs directly to customers and restrict options by which manufacturers might bolster the PEV retail experience through existing dealer channels.

In light of these findings, I suggest a dual-path approach for policy aimed at mitigating distribution-related barriers by: (1) Aligning government-funded incentive programs with industry practices through more "retail friendly" policies that reduce uncertainty for dealers and end customers, and (2) Empowering manufacturers to pursue alternative market introduction approaches for distributing PEVs.

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List of Abbreviations

ACES	American Clean Energy and Security Act (2009)
ADDICA	Automobile Dealers Day in Court Act (1956)
AFV	Alternative Fuel Vehicle
AIC*c*	Akaike's Information Criterion (corrected for small sample size)
ARB	Air Resources Board
ARRA	American Recovery and Reinvestment Act (2009)
AVTM	Advanced Vehicle Technology Manufacturer
BEV	Battery Electric Vehicle
BEVx	Battery Electric Vehicle equipped with a small ICE range-extender
BI	Buyer Index
CAFE	Corporate Average Fuel Economy
CAR	Center for Automotive Research
CI	Confidence Interval
CVB	Conventional Vehicle Buyer
DOE	Department of Energy
DOI	Diffusion of Innovations
EAA	Electric Automobile Association
EREV	Extended-Range Electric Vehicle (equipped with large ICE)
EISA	Energy Independence and Security Act (2007)
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GLMM	Generalized Linear Mixed Effect Model
HEV	Hybrid Electric Vehicle
HOV	High-Occupancy Vehicle
IC	Information Theoretic
ICEV	Internal Combustion Engine Vehicle
LCL	Lower Control Limit
LCV	Low Carbon Vehicle

LEV	Low Emission Vehicle
LME	Linear Mixed Effect
LRT	Likelihood Ratio Test
ML or MLE	Maximum Likelihood; Maximum Likelihood Estimation
MSRP	Manufacturer's Suggest Retail Price
MY	Model Year
OEM	Original Equipment Manufacturer (e.g., automakers)
OTA	Over-the-Air
PEV	Plug-in Electric Vehicle
PEVC	Plug-in Electric Vehicle Collaborative
PHEV	Plug-in Hybrid Electric Vehicle
PVB	Plug-in Vehicle Buyer
TARP	Troubled Asset Relief Program (2008)
SNM	Strategic Niche Management
SSI	Sales Satisfaction Index
TIS	Technology Innovation System
UCL	Upper Control Limit
WOM	Word-of-Mouth
WTP	Willingness to Pay
ZEV	Zero Emission Vehicle

1 Introduction

Cars, and the car business, are evolving faster now than ever before. Widening internet use, entry of industry newcomer and electric vehicle pioneer Tesla Motors, and growing consumer interest in high-tech vehicle content (such as tech giant Google's experiments with self-driving cars) is spurring a race to bring increasingly feature-packed high-technology vehicles to customer driveways. It remains to be seen whether increased electrification and the "Internet of things" marks the next great wave of innovation in an industry that has witnessed few such sea changes in well over half a century.

Even now, spurred by stricter fuel efficiency standards and government mandates for increasing numbers of Zero Emission Vehicles (ZEVs), alternatives such as plug-in electric vehicles (PEVs) that run on grid electricity have made their way to market. Conditioned by experiences with the likes of Dell, Apple and Uber, these technologies are attracting a new crop of buyers with different expectations of not only what the role of the car is in their lives, but different ideas about how they should shop for and purchase their next car. Increased technology content in vehicles, growing consumer preference for Internet-based shopping and the increasing pace of technological change appears to be fostering a widening divide between the way cars have always been sold and the way a growing number of customers expect to buy their next vehicle. Nowhere may this be more evident than with the recent introduction of plug-in electric vehicles (PEVs) to customers in a number of U.S. markets.

1.1 Problem Statement

Although automakers have made PEVs available for purchase by private consumers since late 2010, only a minority of dealers in core PEV markets currently offers them. A 2014 study in which non-profit consumer advocacy firm *Consumer Reports* dispatched nine mystery shoppers to visit 85 dealers across four states found most dealers knew little about the PEVs they sold. In some cases, dealers outright discouraged buyers from considering a PEV (Evarts 2014). Moreover, through court battles, regulatory hearings and legislative maneuvers, dealer groups have moved to block automaker Tesla Motors, a Silicon Valley start-up dedicated to selling battery electric vehicles (BEV), from selling its flagship Model S direct to customers. Limited engagement by dealers, sub-par retail quality and efforts that block distribution-related innovations could adversely impact growth of the nascent PEV market.

In the wake of these challenges, the California Governor's Office has called on state agencies to "encourage and support auto dealers to increase sales and leases of ZEVs" (2013e). Policymakers, however, have little understanding of dealer practices or how they might support increased ZEV sales vis-à-vis dealerships. Policies do not account for these potentially key players and little available data exists that describes the extent to which new car dealers are embracing PEVs or that examines the quality of retail delivery witnessed by PEV buyers.

1.2 Focus of the Study

The study examines the following question: *What role does distribution strategy play in the adoption of PEVs?* This study investigates initial evidence using a grounded theory approach (Eisenhardt 1989) as a starting point. It relies on an extensive literature review and stakeholder interviews to determine the structure of relations among actors responsible for distributing new vehicles to end customers and to capture retailer perceptions of the PEVs they sell. It then examines national new car buyer survey data to determine whether differences exist in retail quality between PEV and conventional vehicle buyers. It leverages insights from these sources, in combination with theory from literature, to develop and test a number of hypotheses that might explain sources of variation in the quality of the retail experience and to determine the impacts of these differences on customer loyalty. The study further examines market dynamics that may drive or impede uptake of PEVs by dealers and the quality of retail delivery to PEV customers. It concludes by offering potential avenues for policy intervention. It also documents challenges, opportunities and emerging practices that appear to aid retailers in marketing and selling plug-in electric vehicles.

While the study approaches the research from a systems perspective (i.e., it encompasses both market and non-market actors, institutional setting and information networks), it focuses squarely on the retail level of analysis. The study is informed by primary interview data collected from industry stakeholders, as well as from analysis of buyer survey data collected by market research firm J.D. Power & Associates. Information is captured at the individual level of analysis, namely individuals who either buy or sell plug-in vehicles.

1.3 Key Research Questions

This dissertation addresses three primary research questions:

1. Are there differences in retail quality reported by PEV and conventional vehicle buyers?
2. What factors potentially contribute to these differences?
3. What are the implications of gaps in retail quality and PEV uptake by dealers for PEV market growth and how might policy address these?

As a first step and to better understand the implications of gaps in performance, the researcher analyzed retail satisfaction data from new vehicle buyers. This step aims to establish whether PEV buyers reported disparities in retail satisfaction and to consider potential consequences for PEV sales and market development.

1.4 Significance of the Study

The purpose of this study was to consider how the automotive retail landscape affects adoption of plug-in electric vehicles. The research is significant in that it undertakes an investigation of a topic area largely overlooked by prior policy research on advanced clean vehicle adoption: The capacity of intermediary actors to introduce substantially innovative new technologies to market. In particular, the study examines the influence of power and dependency relations and the role of incentives in the successful introduction of PEVs.

The point of departure for the research comes in applying the theoretical framework of Slater and Mohr (2006), which relates new product success to the ability of firms to match an appropriate introduction strategy with a particular innovation type, to the challenge of introdcing PEVs to the US market.

1.5 Overview of Research Methods

Exploration of the retail automotive landscape began with informal conversations with new car dealers selling PEVs and customers buying them. These conversations informed analysis of customer retail satisfaction data from market research firm J.D. Power and the development of interview protocols, which quickly centered on investigating reported differences in customer evaluation of the retail experience.

The researcher then examined national retail satisfaction data to consider whether reported disparities may be emblematic of the larger experience of PEV buyers. Based on these findings, the researcher conducted an extensive set of interviews with automakers and new car dealers to investigate potential factors contributing to reported differences in retail quality. The interviews also afforded a deeper exploration of the opportunities and challenges faced by firms selling PEVs, the perceptions and attitudes shaping their efforts and the role of incentives in actor behavior. These insights, in turn, informed additional analysis of the buyer retail satisfaction data. In particular, additional analyses addressed the following:

1. Does powertrain choice explain variation in the percent of buyers who switch from competing makes (a.k.a. "conquest" buyers)?
2. Does powertrain choice explain differences in the time it takes to transact a vehicle purchase?
3. Does powertrain choice explain differences in the reported incidence of dealers that attempt to sell buyers a vehicle they did not want (a.k.a. "cross-selling")?
4. Does powertrain choice explain variation in the percent of buyers intending to return to the dealer for paid services?
5. Does powertrain choice explain variation in intended make loyalty?
6. Do certain elements of the purchase experience matter more to plug-in buyers?

Insights gleaned from interviews informed development of potential hypotheses for testing within the scope of this study. It also identified hypotheses for examination in follow-on research. Based on findings from the combined interview and survey analysis, the study offers guidance for policy intended to advance ZEV market development.

Why Retail Satisfaction?

The researcher favored the use of retail satisfaction by new vehicle buyers as the discriminating performance metric for the retail-level analysis for several key reasons. First, other standard industry measures such as sales data or return on assets were not available to the researcher. This was due to the absence of sales data that distinguished between sales of conventional and plug-in vehicle models, or to the proprietary and closely held nature of the data. Moreover, retail satisfaction is a widely accepted industry performance metric used to gauge a firm's overall standing relative to competitors and as a basis on which to reward or support improved retail performance. Most importantly for the study, examining retail satisfaction allows the researcher to isolate performance associated with the observed retail experience from performance associated with superior vehicle design. For example, an automaker with a fresher product portfolio (i.e., more newly designed models in a given model year) may outsell its competitors more on the basis of newer and more popular product than due to the actual purchase experience.

In sum, retail satisfaction is the more appropriate performance metric for the scope of analysis (retail innovation). Unlike the common innovation metrics often favored by policy scholars (e.g., media activity, patent filings, number of new entrant companies), the data enables a higher level of resolution through which to examine market-shaping developments. It also affords a finer level of granularity upon which to base policy recommendations affecting near-and mid-term (i.e. 2 – 7 year) policy interventions. In simple terms, the study aimed to determine whether powertrain choice explained disparities in retail satisfaction, to offer insights based on empirical evidence and emerging best practices for how gaps in retail performance for plug-in vehicles might be mitigated through adjustments in distribution channel strategy, and to inform policy intended to advance the growth of zero emission vehicle markets.

1.6 Theoretical Framework

Distribution channel structure, retail performance and incentive policy are explored from a systems perspective drawing from the literature on innovation and technical change in the management sciences and environmental policy disciplines. The study uses an overarching 'innovation system' framework to undertake an examination of the retail-level influences affecting adoption of plug-in electric vehicles. Implicitly, the research findings may find application in other high-technology vehicle advances aimed at addressing sustainability objectives such as fuel cell electric vehicles (FCEVs). While it adopts the systems perspective embraced in the sustainability transitions literature, the research applies the theoretical framework of Slater & Mohr (2006) in the marketing literature to the challenge of introducing PEVs to the US automotive marketplace.

The contingency theory for high-technology marketing relates the success of new products to whether the innovating firm can match an appropriate distribution strategy to the type of innovation being introduced. It builds on the concepts of 'interface improvement' introduced by Taylor (2008) and 'empowerment' of producer and intermediary firms (Smith and Raven 2012) to inform policy. The research further suggests extensions to the Slater & Mohr model that appropriately account for the role of public sector interventions intended to support sector-wide transitions to more sustainable technological alternatives.

The remainder of the dissertation is organized as follows: Chapter 2 defines key terms, describes the retail automotive landscape and the nascent PEV market. It also discusses key influences that set the stage for more in-depth analysis. In particular, it provides a primer on the origins and influence of state franchise laws and government policy affecting uptake of PEVs. Chapter 3 reviews key management science and environmental policy literatures that shaped the research design and analysis conducted in subsequent chapters. Chapter 4 describes in detail the research methodology, in particular the novel use of a mixed methods approach to include both qualitative and quantitative components to the analysis. Chapter 5 through 7 present the results of the analyses in three parts: Chapter 5 (Part I) presents findings from interview data related to retail industry structure and common practices; Chapter 6 (Part II) describes findings from interview data specific to the retailing of PEVs and; Chapter 7 (Part III) presents results from the statistical analysis of new car buyer survey data related to retail satisfaction. Chapter 8 discusses the findings in light of the research questions and relevant theory governing the introduction of innovative new products to market and policies aimed at supporting their wider adoption. Chapter 9 concludes with a review of the major findings and avenues for future research.

2 Definitions and Background

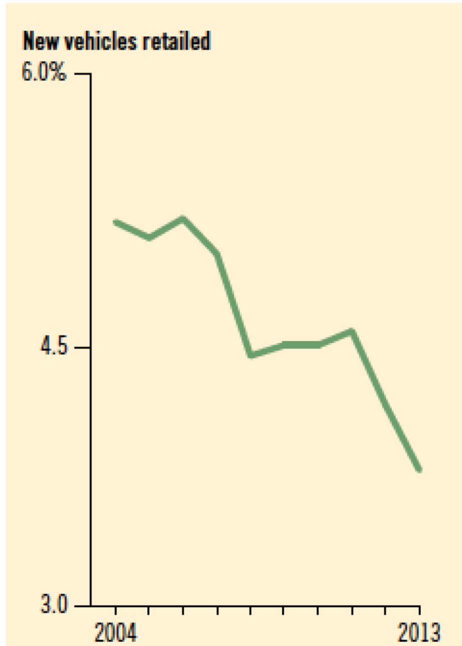
This chapter defines key terms and reviews concepts fundamental to the deeper examination that follows. For the purpose of this study, a PEV is as any light-duty vehicle (less than 8,500 lbs. gross vehicle weight) powered either fully or in part by electricity drawn from off-board sources such as the electrical power grid that is stored onboard the vehicle. This could be either a full battery electric vehicle (BEV), which runs entirely off of electricity stored in the vehicle's battery, or a plug-in hybrid electric vehicle (PHEV). The latter is typically equipped with both a conventional ICE and an onboard battery mated to an electric drivetrain that may power the vehicle solely or in combination with the ICE. Other plug-equipped variants are similarly treated as PEVs in the context of this study. This includes electric vehicles equipped with a small ICE (or BEVx, the "x" denotes the ICE-powered range extender) as well as those equipped with larger ICEs often referred to as extended range electric vehicles ("EREVs").

2.1 Retail Automotive Market Overview

The production, sale and servicing of new cars is a significant driver of the US economy. The Center for Automotive Research (CAR), a non-profit organization focused on auto industry trends, estimates that the auto industry is responsible for more than seven million private sector jobs. The dealer network is responsible for an estimated 1.65 million of these jobs, generating between $54 billion (2014d) and $116 billion in total compensation and contributing $20 billion in annual tax revenue (Hill, Maranger Menk, and Cregger 2015). These taxes support a variety of government services such as constructing and maintaining the nation's roadways (ibid.). For every job created by an auto manufacturer, seven new jobs are created economy wide (CAR

2015a). In its 2015 report, CAR summarized the auto industry's outsize contribution to the US economy, stating "The automotive industry is a critical component of economic growth, with extensive connections across the industrial and cultural fabric of the United States… National and regional employment; research, development and innovation; state and local government revenues; foreign direct investment; education; health care; U.S. trade; and quality of life are all tied to the automotive industry" (2015a, 9). Despite its significance, the U.S. auto industry's share of federal R&D funding stands at just one percent, compared to 27 percent for the aerospace industry and 10 percent for all other manufacturing combined (ibid.).

All 50 states require automakers to sell new vehicles through independently operated franchised dealers. These dealers, numbering 17,655 as of 2013, were responsible for the sale of over 15.5 million new vehicles to private consumers in the U.S., representing 15 percent of all retail sales nationally. The average vehicle selling price the same year amounted to $31,762 (2014d). Despite rising vehicle prices in recent years, margins on new vehicle sales rank at the bottom of every other retail sector except grocery stores (2013a). Notably, in 2013, dealers earned an average of just $69 in per vehicle profit from the sale of new vehicles (0.2%), down from $111 the year prior. Downward pressure on new car margins is largely attributed to increased price transparency made possible by widening Internet use (see Figure 2-1) (2014d). Higher performing profit centers that include used car sales as well as service and parts enabled dealers to achieve overall margins of 2.2% before taxes. Despite this, the dealership business continues to attract large investors seeking higher returns on capital than available elsewhere in the market. Greater profits from efficiencies gained with the culling of less stable dealers during



Source: (NADA 2014d)

Figure 2-1. Average new car dealership gross margin as a percentage of selling price, 2004-2013.

the 2008-2009 financial crisis boosted sales and profits for surviving dealers. The most prominent acquisition took place in October 2014 when Warren Buffett's Berkshire Hathaway purchased the Van Tuyl Group, the nation's fifth largest auto dealership firm (2014f). Further industry consolidation is expected as more "mom and pop" stores and smaller retail chains choose to exit an increasingly challenging business environment (ibid.).

2.2 Distribution Channel Structure and Partner Relations

Kley, Lerch, and Dallinger (2011) described the concept of a business model as comprised of three elements: (1) The value proposition, defined as the promised value of a product offered by a manufacturer to the customer beforehand; (2) value chain configuration, which describes the arrangement of entities responsible for delivering elements of the value proposition; and (3) the revenue model, which describes how the value proposition is monetized (i.e. how and when payment is made in return for the product and to whom) (see also Timmers 1998).

Despite the original intent of innovating firms, business models governing innovative new products often evolve organically according to dynamic market conditions. According to Thomas Marx, who chronicled the history of America's retail dealers, "The franchise distribution system is not the product of a grand plan. It is a cumulative result of auto manufacturer responses to specific distribution problems created by changing economic conditions as the [auto] industry matured" (Marx 1985, 472). In the early twentieth century, fledgling automakers used a variety of means to retail new vehicles to customers. These included wholesale distributors, department stores, factory stores, retail dealers and mail order delivery (Murry and Schneider 2015, Marx 1985). As early as the 1920's, automakers began divesting of these methods in favor of the franchise model in which automakers wholesale vehicles to independently owned dealers. These dealers, in turn, hold them in inventory and retail them to end customers. Divesting of distribution and sales allowed automakers to focus resources on upstream process improvements during a period of intense competition driven by greater scale economies (Marx 1985). This era witnessed industry consolidation in which automotive standards like Studebaker, Nash, and Packard were subsumed by the Big Three.

The retail system went hand-in-hand with the "make to stock" production model, which afforded manufacturers the ability to balance production capacity in an industry characterized by unstable demand, large up-front capital costs, and long product lead-times (Marx 1985). Retail stores also conferred automakers much greater reach into local markets as the industry matured (Macaulay 1966, Kessler 1957, Marx 1985). Moreover, automobiles swiftly evolved into complex and expensive products with a wide array of options and trims. Customers preferred viewing physical product that could be test driven before committing to a purchase. Once purchased, vehicles needed proper maintenance, service and repair. Retail dealers were best situated to offer these highly localized services. They were also armed with more intimate knowledge of local market conditions and therefore better positioned to match supply with actual demand. By separating the agent (the franchisee) from the principal (the franchisor), retail franchises create greater incentives for business to react to local conditions (Lafontaine and Slade 2007, Delacourt 2007).

2.3 Franchise Agreements

Figure 2-2. One-to-many downstream value chain relationship between automakers and dealers.

Figure 2-2 presents a simplified illustration of the distribution value chain for automobile sales. Traditional franchising involves an upstream manufacturer and a downstream retailer. A *product franchise* (sometimes called a *trade name* franchise) is a contractual agreement between two independent entities in which a manufacturer (the *franchisor*) grants a retailer (the *franchisee*) the right to distribute its product using its names and trademarks. For manufacturers, it represents an alternative to direct ownership that still confers some degree of control, the bounds of which are stipulated through "vertical restrictions" in the form of a legal contract. These can include monitoring and enforcement activities, financial incentives and penalties, and basis for termination (Pindyck 2011, Lafontaine and Slade 2005). Because they are decentralized, franchise arrangements have been described as a "market" approach to product distribution.

Franchise relationships in the automotive industry are unlike a *business format* franchise. In addition to selling a particular product, service and trademark(s), it also sells a way of doing business to its franchisees. Also, production mainly takes place at the retail outlet (e.g., fast food) (Lafontaine and Slade 2007). Modern examples of these arrangements include Starbucks, MacDonald's, and Pizza Hut. Dealerships, on the other hand, as *product* or *trade name* franchises, gain the right to purchase a particular manufacturer's product line at wholesale prices and resell it to end customers (Kostecka 1988). How they do so is left to the individual retailers. Though OEMs divested of direct control, automakers introduced a wide range of incentives to encourage dealer compliance with requirements related to maintaining sufficient facilities, tools, equipment, parts, and trained personnel to sell and service the manufacturer's product line (Marx 1985). Also unlike business format franchises, product franchises typically occupy highly regulated spaces. In the automotive sector, these include a large body of stipulations governing licensing for new car sales, employee health and safety, and a variety of consumer protections that vary from state to state (Marx 1985).

As independent businesses, dealers must make substantial investments in facilities, personnel, vehicle and parts inventories, and service equipment. In return, automakers grant dealers exclusive rights to sell its product within a given market area (Marx 1985, Kessler 1957). Dealers add value for manufacturers as a source of highly localized market information. They also facilitate thousands of unique and highly complex transactions, including trade-ins of used vehicles (Marx 1985). Further, dealer services at the point of sale can enhance the demand for the manufacturer's product (Lafontaine and Slade 2005, 6). Dealers add value for customers by providing a 'ready to buy' selection of models and trim lines, by affording customers test drives of the same, and by extending consumer credit to finance vehicle purchases. Dealers also provide post-sale warranty coverage, repair and after-market parts, and localized service and maintenance for the vehicles they sell. Consumers also benefit from various regulatory functions provided by dealers, including vehicle registration, title conveyance, license plates, odometer disclosure and provision of safety information (Delacourt 2007, 183-184).

2.4 The Economics of Franchise Agreements

For reasons mentioned previously, manufacturers may choose to enter a *vertical* relationship by outsourcing distribution and retail activities through voluntary franchise agreements. These arrangements are intended to create mutual efficiencies beneficial to both parties as compared to direct ownership by the manufacturer. To affect these efficiencies behavior must be appropriately aligned. This is achieved through vertical restraints stipulated in the franchise agreement. A vertical restraint is any restriction imposed by an upstream member of a value chain on a downstream member of that chain, typically in the retail setting (Lafontaine and Slade 2005). Restrictions can take a number of forms and include specification of activities by each party, monitoring and enforcement actions, financial rewards and penalties, and conditions for termination.

Controls governing behavior are required in order to address a number of potential market failures inherent to principal-agent relationships in vertical arrangements. The first of these is *hold-up*. Because automakers are the sole source of the dealer's inventory they are in a favorable position to extract concessions from the downstream partner on threat of cutting off the supply of the product. Franchise agreements must therefore address these imbalances to ensure equal footing for both parties to the agreement. Another is *double-marginalization* (also known as the *succession of monopoly* problem). In the OEM-dealer relationship, the automaker has monopoly power in terms of vehicle supply to the dealer. And by virtue of exclusive rights to sell within a geographic area, the dealer possesses local monopoly power over customers within a territory. Where both firms operate independently, each one exercises its monopoly power, pushing a vehicle's price above its marginal cost on two separate occasions. This culminates in a higher price relative to the "single marginalization" price of an integrated firm (Lafontaine and Slade 2005, Pindyck 2011)

Dealers naturally want higher mark-ups on the cars they sell, even if that means selling fewer units than automakers would want in order to optimize manufacturer profits. To contend with this, and where a vertical merger is not an option, the upstream firm, in theory, has two alternatives: It can make the downstream market more competitive by adding more dealers, or it can impose quantity forcing (e.g., by establishing a minimum sales quota or through non-linear rebates or other sales incentives for dealers) so as to prevent the constriction of output that improves dealer margins (Pindyck 2011, Murry and Schneider 2015). In practice, automakers have attempted all of these approaches and in various forms. State-imposed restrictions and dealer pushback, however, has substantially curtailed these options for automakers. Greater price transparency afforded by widening consumer use of the Internet appears to be tamping the double-marginalization effect, however, keeping mark-ups largely in check. However, an extensive literature review by Murry and Schneider (2015) found evidence that the double-marginalization problem is causing substantial distortion in consumer welfare.

Another market failure arises in the form of *free riding* behavior. Dealers must devote substantial resources to sell the manufacturer's product, including facilities, equipment, training and advertising. These investments also benefit the manufacturer, as well as other dealers selling the same brand. Moreover, where franchisees benefit from universally higher product or service quality standards initiated by the manufacturer, dealers do not fully internalize the benefits of improvements initiated locally. Hence, dealers have an incentive to under-invest and free ride on the efforts of OEMs and competing dealers (Lafontaine and Slade 2005). Free riding is particularly problematic where brand reputation matters and where fewer opportunities exist for repeat business as is typical in the auto industry (ibid.). Maintaining high quality standards is a costly endeavor and distributors have an incentive to trade off quality for cost savings. Minimum retail prices (e.g., MSRP), territorial exclusivity and quality standards help alleviate this problem. Even with territorial exclusivity there are spillover effects between adjoining territories and some incentive to free ride. Monitoring is another effective, yet costly way for automakers to ensure brand standards for quality are met (Pindyck 2011, Lafontaine and Slade 2005).

A final market failure relates to *third-degree price discrimination*. This occurs when a firm can segment the market so as to charge a higher price to individuals or groups of customers with lower elasticity of demand (i.e. customers who are less likely to forego a purchase due to higher price). Where differences in willingness to pay (WTP) are large, distributors have a strong incentive to engage in costly learning about consumer WTP, including bargaining, rather than posting a set price (Zettelmeyer, Scott Morton, and Silva-Risso 2006).

Historically, the auto industry has been characterized by large asymmetries in information and WTP across auto market participants (Murry and Schneider 2015). Holmes (1989) analyzed the effects of third party price discrimination in environments of imperfect competition. The study concluded that the uniform price lies between the discriminatory prices, leading to higher prices for some consumers and lower prices for others. Others have shown that the effects of such price discrimination has an ambiguous effect on consumer welfare; some are made worse off while others are made better off (Katz and Shapiro 1994). In general, price dispersion is a common feature of the new and used car markets. Bargaining, which has its roots in the pre-auto era of horse-trading where determining the price of a horse required appraisal of its distinct attributes (Murry and Schneider 2015), remains a core practice of the vast majority of franchise dealers.

2.5 Dealer Franchise Laws

Though ostensibly partners, automaker-dealer relations are fraught by a long history of mistrust and legal conflict arising from inherent inequalities in bargaining power. Dealers, which once comprised mostly small-scale, family-owned stores, depended entirely on the automaker for supply of a very expensive product. In the years prior to global competition, the establishment of an effective oligopoly by Detroit's "Big Three" automakers (GM, Ford and Chrysler) magnified this dependency. By 1958, just eight percent of cars sold in the U.S. were imports. GM alone accounted for half of the US market share by 1950 (Murry and Schneider 2015).

During this period, dealers argued that automakers routinely exploited their new found market power to their advantage (Crane 2015). For example, automakers set terms more favorable to their interests when drafting franchise agreements, including contracts that lacked enforceable obligations or mutuality (the legal principal that binds both parties to perform contractually). Dealers maintained that automakers had great latitude to terminate, or threaten to terminate, dealer franchises, and often pressured dealers to offer concessions that included increased selling quotas or taking unwanted vehicles (Higashiyama 2009, Macaulay 1966). A 1940 study by the Federal Trade Commission, conducted at the urging of dealers, found some instances of automaker abuses but generally found that retail competition ultimately benefitted consumers. Ironically, the FTC accused dealers of a number of anti-competitive and anti-consumer practices such as price fixing, "padding" new car prices and "packing" finance charges so as to conceal the dealer's actual cost from the customer (Crane 2015).

Nevertheless, dealers pursued legal remedies for perceived abuses. Federal and state regulations emerged to protect dealers from unfair practices such as termination of franchise agreements without cause or forcing of unwanted inventory on dealers. A 1956 Senate Committee report found that typical franchise agreements of the time did not require automakers to provide inventory to dealers and allowed manufacturers to terminate the dealer at will without any show of cause (1956).

The first major piece of legislation to intervene on behalf of dealers was the Federal Automobile Dealer Franchise Act of 1956. The *Automobile Dealers Day in Court Act*, or ADDICA, as it became known, granted dealers the right to file suit against manufacturers for violations of franchise agreements in federal courts (Barmore 2014). ADDICA was only partly successful in securing protections for dealers since, where "good faith" was ambiguously described in the statute, courts often sided with manufacturers over its interpretation. In response, dealers sought remedy in state legislatures where their outsize influence in local and state elections gave them political sway. Between 1969 and 1980, approximately 40 states enacted franchise legislation. In 2000, no fewer than twenty state legislatures passed bills that either placed new restrictions on direct-to-consumer sales or tightened existing restrictions (Delacourt 2007). By 2002, every U.S. state had passed franchise laws governing commercial relations between car dealers and auto manufacturers (Higashiyama 2009). Though decades of intensified competition by imports effectively ended the market dominance of the Big Three, whose combined share fell to just 43% of the U.S. market by 2009 (NPR 2009), franchise laws remain intact despite the reduced market power of manufacturers (Crane 2015).

Though varying by state, franchise laws limit the scope and extent of control that automakers can exert on franchise dealers. They also regulate entry and exit of dealers through territorial restrictions and provisions on dealer termination (Bodisch 2009). A major concern of dealers is any unfair advantage a manufacturer might have where it could directly compete against its own franchised dealers. Barmore (2013) characterized two main types of state franchise laws governing new car sales: (1) Universal prohibitions on manufacturer direct sales, and (2) bans on direct sales by manufacturers that already sell through franchise businesses (Barmore 2014). The latter represents the common dominator of state laws, requiring automakers with standing retail franchises to sell exclusively through these outlets. Since all established automakers sell through franchise dealers, this stipulation effectively bans direct sale of vehicles by incumbent manufacturers. A handful of states, however, that include Texas and North

Carolina, go further in that they ban any form of direct sales by any manufacturer, regardless of a firm's current mode of distributing product (ibid).

The past few decades have witnessed the successful fortification of franchise laws by dealer interests. Modern regulations specify that dealers must be independent of manufacturers and prohibit OEMs from levying franchise fees. Provisions further forbid automakers from requiring a specific level of customer service, meeting a minimum advertising spend, requiring a certain amount of inventory, or from charging anything beyond the standard (linear) pricing scale. Moreover, manufacturers are effectively prohibited from terminating dealers. To do so, an OEM must propose a buyout that is acceptable to the dealer; else the matter is decided in arbitration. In principle, provisions of the law seek equal treatment of all dealers within a given state in terms of wholesale prices and allocation of inventory, regardless of dealer performance or other factors. Manufacturers are also barred from operating a new dealer franchise within a certain distance of a current dealer selling the same brand (Murry and Schneider 2015). In practice, however, manufacturers find avenues around some provisions. For example, automakers base the terms of the dealer's floor credit on dealer performance (ibid).

Dealers recently attempted to further strengthen franchise laws in New York and Massachusetts in order to block direct sales from manufacturers like newcomer Tesla Motors, a dedicated producer of BEVs. Proposed bills in both states attempted to ban all manufacturers from operating dealerships as in Texas and North Carolina. The proposed New York state bill died on the floor without vote. A similar Massachusetts bill failed to advance beyond committee and the court ruled against an injunction that would have prevented Tesla from continuing to operate its sole factory store there (Borchers 2014). Nevertheless, in states such as Texas, Arizona, and Virginia, Tesla can operate galleries but cannot discuss pricing, offer test drives, or sell at these locations (Barmore 2014). Dealers fear that Tesla's move could set a precedent for entry by foreign manufacturers, in particular Chinese makes, to compete on an unfair basis with franchise dealers (ibid).

Even prior to Tesla, the emergence and growing influence of Internet commerce has brought increasing attention to potential conflicts between franchise laws and consumer interests. Some have contended that the nationwide patchwork of franchise laws has overstepped any economic rationale, in effect replacing what were once voluntary franchise relationships with mandatory restrictions imposed by state law (Delacourt 2007). Consequently, "opportunities to experiment with new approaches have been severely limited by state laws that essentially enshrine the original dealer-manufacturer compromise" (ibid., 163). In particular, restrictions on advertising, referral fees, direct sales, brokering and other ancillary services have effectively stripped much of the added value Internet services might confer to customers, including lower car prices. Texas, for example, prohibits brokering by any firm that charges a fee or commission for arranging an automobile sale other than a licensed dealer. In California, an Internet referral service is permitted to charge a per referral fee without a dealer license but is forbidden from handling the sales transaction or from accepting a commission (ibid., 166). Dealers, however, maintain that these laws are necessary to protect dealer investments from unfair competition by manufacturers. Critics of state laws counter that manufacturers have no leverage to restrict or limit dealers from competing on equal terms (ibid., 168).

2.6 Plug-in Electric Vehicles

Automobiles as High-Technology Products

Laptops, smartphones and similar consumer electronics are popularly regarded as high-technology products. Less known is the fact that of all patents granted in the U.S., between three to five percent are awarded to the auto industry for automated and connected vehicle technologies, new materials and joining methods, and advanced powertrains and alternative fuels (Hill et al. 2014).

Notably, there is no official definition of the concept of *high-tech* and no consensus on the definition of a high-tech industry or high-tech product (Hill et al. 2014). Automotive products are evolving at an increasingly rapid pace. Today, automobiles are among the most technologically sophisticated products available to the general public. According to a January 2014 report prepared for the Alliance of Automobile Manufacturers by the Center for Automotive Research (CAR), the modern vehicle contains roughly 60 microprocessors, four times as many as a decade ago. Nearly 10 million lines of software code provides instructions to these miniature computers, or about half the lines of code necessary to run Boeing's 787 Dreamliner. Electronics now make up an estimated 40 to 50 percent of total vehicle cost, up from 20 percent less than a decade ago (ibid.).

The CAR report proposed a working definition for "high-tech" industries that includes substantial proportions of R&D expenditures, concentration of technical employees, and geographic clusters of institutions dedicated to development of new technologies, amongst other attributes (see Hill et al. 2014, 5). By these criteria, the report concluded that the auto industry meets the standard of high-tech. The report further observed that the emergence of "converged vehicles," which combines automated and connected vehicle technologies, is potentially paradigm-shifting. These technologies hold increasing promise to enhance safety, increase road capacity, reduce congestion, save fuel and reduce the environmental footprint of future automobiles. Moreover, efforts to comply with increasingly stringent environmental regulations is driving entirely new automotive industry technology as well as increased collaboration with electronics, materials, aerospace, and other industries outside the traditional automotive value chain. High-tech firms Bosch, TRW and Delphi, for example, are developing advanced technology both alongside, and independently of, traditional manufacturers (ibid.).

Why PEVs are (More) Different

In late 2010, established automakers began rolling out the first wave of PEVs in production volumes to private customers in limited markets. As yet unknown is whether plug-ins will attract mainstream customers in volumes sufficient to tip the scales toward wider diffusion of these alternatives. In a recent speech to the Detroit Economic Club, GM CEO Mary Barra proclaimed, “Technology advancements are revolutionizing the auto industry.” So much so, according to Barra, that “This industry will experience more dramatic change in the next decade than it has in the past 50 years.” Barra specifically cites new propulsion systems and alternative fuel sources as key catalysts of this change (2014c).

For the most part, previous automotive advances that addressed social externalities such as air pollution, safety and public health could be met through continuous improvements to core vehicle systems. These incremental technical advances had little impact on customers, and therefore had little implication for manufacturers in terms of the manner in which the product was marketed and sold to end customers. Examples of these types of innovations include the addition of catalytic converters, anti-lock brakes, crumple zones and air bags.

A number of co-evolving technologies that include automated and connected systems, in combination with increasing vehicle electrification, may portend a shift away from the historical pattern of incremental innovation in the auto industry. “Discontinuous innovations” represent advances marked by a fundamental shift in the underlying technical knowledge base required to design or engineer a product or process (e.g., electrical, electrochemical and mechatronic knowledge versus mechanical and combustion-based expertise). Discontinuous technical advances may also have discontinuous market impacts in that they alter current modes of behavior or require completely new or a highly modified set of complementary products to support them (Moore 2014). Existing distribution channels may not be well suited for these purposes. Hence, firms may need to develop new marketing competencies and structures to successfully deliver such advances to end customers. Changes of this more sweeping nature have not been witnessed since the formative years of the automotive industry nearly a century ago.

The study contends that PEVs, and forthcoming fuel cell vehicles, not only involve new technical knowledge, but also spawn substantially new interactions and behaviors and require new infrastructure on which the customer depends. As an example, PEV buyers must learn to charge a vehicle with electricity instead of fueling it with gasoline (Caperello, Kurani, and TyreeHageman 2013). PEVs also usher in entirely new sources of value such as the convenience of home fueling (charging) (Hardman, Steinberger-Wilckens, and van der Horst 2013). Away from home, customers rely to varying degrees on new supporting infrastructure – public charging stations involving new equipment that operates and behaves markedly different than gas pumps (e.g., it can take as long as several hours to fully charge a PEV, compared to roughly five to 3-5 minutes to “fill the tank”).

PEVs involve far more than just the addition of a plug. Though seemingly minor, this single modification spawns requisite changes in customer behavior. Examples of behavioral change include the act of plugging and unplugging the vehicle and use of unfamiliar equipment with different modes of operation (e.g., chargers with varying rates of charge). Other changes include facilitating installation of in-home charging equipment and dependence on navigation systems for routing to charging locations. Moreover, customers may need to get acquainted with new protocols and etiquette for interacting with other motorists. For example, when should a customer relocate their vehicle after charging in a public stall? Is it acceptable for a customer to disconnect an in-use charger for use on the customer's own vehicle?

Such change-sensitive products entail adjustments in how they are brought to market. Changes are needed because innovative new products introduce a high degree of uncertainty into the consumer purchase decision. In the case of PEVs, questions may include any number of the following: *Where to charge*? *How long will it take*? *How much will it cost*? *What public incentives are available*? *Can I make it to the places I need to go and back*?

The relative willingness of customers to accept the risk associated with these questions effectively divides the market between early and mainstream consumers. Each weigh elements of the buying decision differently, have different expectations of performance, and have different rates of adoption. For example, mainstream customers are more risk averse (Rogers 1995) and pragmatic (Moore 2014) than early customers. Also, there tends to be more communication within each of these segments then between them, effectively creating two distinct markets (Goldenberg, Libai, and Muller 2002). Consequently, reaching both early and mainstream customer segments require two very different but complementary sets of marketing competencies (Mohr, Sengupta, and Slater 2013, Slater and Mohr 2006). In the case of buying an automobile, customers look to the dealer to be the subject matter expert; if dealers cannot answer these questions, customers may look elsewhere or they may forego the technology altogether. This can adversely impact PEV market growth.

Success in introducing discontinuous new products hinges on winning over both the early and mainstream markets. Reaching early customers involves carving out a niche in the primary market in which to drive demand through word-of-mouth, to identify the customer's end-to-end support needs, and to scale the distribution infrastructure required to deliver the needed support. To reach mainstream customer segments, manufacturers must ensure that the sales channel is adequately supported and sufficiently motivated to meet the end-to-end needs of main market customers. Manufacturers will struggle to reach mainstream customers without first learning from early customers (Moore, 1991).

A substantial body of literature establishes the effect early customers have on subsequent adopters is conditioned by learning derived from experience with the technology; good experiences promote diffusion while bad experiences delay it (Rogers 1995, Swann 2009). When firms introduce innovative high-tech products there is often a gap between the promised value proposition and the ability of the product to fulfill that promise (Moore, 1991). Closing the gap between the promised and realized value for customers – especially when attempting to move beyond the more accommodative early adopter segment to the more practical and pragmatic mainstream segments – entails the provision of a number of supporting products and services (Moore 1991). These may entail changes in how products are brought to market or entirely new business models (Kley, Lerch, and Dallinger 2011).

2.7 PEV Market Overview

Automakers have sold over a quarter million PEVs worldwide to date. U.S. customers accounted for 39 percent of global PEV sales in 2014, representing 0.7 percent of the total 16.8 million units sold in the United States. Sales are primarily concentrated in "beachhead" markets such as the U.S. west coast. California, for example, captured about three percent of the state's 1.8 million units, accounting for between nine and 10 percent of world PEV sales (Turrentine 2015). In the first six months of 2014, six automakers generated 93 percent of U.S.-based sales (2015d).

Though there are over twenty PEV models sold to the public today, only three models were available nationwide in 2013: The Nissan LEAF, GM's Chevy Volt and the Model S produced by new entrant firm Tesla Motors. Initial MSRPs (Manufacturer's Suggested Retail Price) for the base model LEAF and Volt was $32,780 and $40,280, respectively. These were substantially more expensive than similarly sized conventionally powered vehicles. By one estimate, the LEAF's cost was $15,000 higher than a comparably equipped Nissan Versa (2013d). Nissan dropped the price of the LEAF by $6,000 for the 2013 model year, narrowing the premium to $9,000. By comparison, the plug-in version of Toyota's Prius carried a $6,000 premium to a comparably equipped Prius HEV (ibid.). Tesla launched the Model S at a starting price of $69,900, scrapping its earlier plan to release a lower performing base model priced at $59,900, citing insufficient customer demand.

Of these, sales of the battery-powered Nissan LEAF and the plug-in hybrid Chevy Volt have consistently fallen short of manufacturer targets. In 2012, for example, Nissan sold 23,461 LEAFs against a target of 40,000 units. GM's Volt fared similarly, selling 9,819 units versus a target of 20,000 that year (2013d). Both vehicles are branded as mass market makes, distributed and sold through the manufacturer's traditional retail dealer network. According to registration data from industry research firm R. L. Polk, leases represented 51 percent of all new PEV sales in 2012, compared to roughly 18 to 22 percent of sales for conventional vehicles (2013d). Incumbent automakers have predominantly relied on government-funded deployment efforts and third-party network operators for build-out of PEV charging infrastructure based on two common standards for interoperability across makes. As of this writing, over 781 CHAdeMO and 152 SAE combo fast-charging stations are active across the U.S. today. These are complemented by over 9,000 additional charging stations with much lower rates of charge (2015b). By comparison, conventional vehicles are supported by a national retail network of over 160,000 service stations.

Released in mid-2012 as a luxury model, the Tesla Model S has consistently met its annual production targets, selling every copy it could produce. The EV start-up sold approximately 2,555 units in 2012 (2,650 globally) and 18,000 units (22,477 globally) the following year, surpassing its annual global sales target of 21,500 units for 2013. Approximately 16,500 units (31,655 globally) were sold to U.S. customers in 2014, putting the Model S just behind the Nissan LEAF as the world's best selling EV.

Tesla departs from convention in terms of how it retails its flagship product in a number of respects. First, it distributes the Model S under the luxury Tesla brand via direct-to-consumer online sales at a set, rather than negotiated, retail price. Sales are supported by factory-owned stores and galleries staffed by "Tesla product specialists" who provide information on the product to interested customers. Rather than a destination unto themselves, many any of these outlets are situated in high-traffic locations such as metro area shopping malls. Second, Tesla operates factory-owned service centers that typically support customers in much the same way as traditional dealerships. In addition to service and maintenance and warranty and repair services, centers double as a showroom staffed by Tesla product specialists available to offer test drives for a limited selection of on-hand vehicles. Third, the company has deployed and currently operates a proprietary national network of 302 Tesla-branded “Supercharger” stations as of this writing. These high-powered stations can deliver 170 miles of range in as little as 30 minutes, or more than twice as fast as the industry standards. The company also offers adapters that allow its customers to tap into the national infrastructure of roughly 10,000 industry standard chargers (2015b).

2.8 Overview of PEV Policy

The U.S. Energy Information Administration estimates that the transportation sector is responsible for two-thirds of all the oil consumed in the U.S. Of this, petroleum comprises 93 percent of the total (Hartman 2015). Electrification of the vehicle stock is viewed as a promising avenue for diversifying the nation’s fuel mix to lessen dependence on oil imports while addressing myriad societal externalities. These include energy security and environmental impacts such as air pollution, climate change, and adverse public health impacts such as asthma and lung disease.

No unified national energy policy governing PEVs exists. Rather, a patchwork of federal initiatives aims to encourage the development and sale of alternatives. The Advanced Vehicle Technology Manufacturing (ATVM) program, for example, authorized under President George W. Bush, extends up to $25 billion in loan guarantees for battery manufacturers. The American Clean Energy and Security Act (ACES), passed in 2009, granted tax credits for the purchase of a qualified PEV. The amount of the credit is based on battery size, starting at $2,500 for vehicles equipped with at least a 4 kilowatt-hour (kWh) pack plus $417 for each kWh above this up to a cap of $7,500. The credit phases out over a one-year period for each manufacturer that reaches 200,000 PEVs in cumulative U.S.-based sales. As part of a new national program in which regulated fleet fuel economy rules were harmonized under a single national program, Corporate Average Fuel Economy (CAFE) targets were raised to a mandated target of about 54.5 miles per gallon (mpg) by 2025 (exact target depends on mix of vehicles).

President Obama's 2011 State of the Union address called for one million PEVs on the road by 2015. As part of several initiatives undertaken by the U.S. Department of Energy (DOE), the "EV Everywhere" Grand Challenge included additional investments in battery technology and electric drive systems, charging infrastructure and training for first responders amongst other investments. As part of this initiative, the Workplace Charging Challenge was launched with the goal of a ten-fold increase in the number of companies offering workplace charging within five years. DOE's Clean Cities program is responsible for the lion's share of direct outreach by the federal government to promote PEVs, though such efforts are largely targeted toward adoption by public and private vehicle fleets. The Congressional Budget Office estimates that between 2012 and 2019 the government will spend $7.5 billion in policies to boost the U.S. PEV industry, most of this attributed to the tax credit. This compares to an estimated $28 billion in tax benefits to major oil producers over the same period (2015d).

State policy consists of an even wider patchwork of initiatives. State-level regulation governing plug-in vehicles traces its origins to California's Low Emission Vehicle (LEV) program first enacted by the state's Air Resources Board (ARB) in 1990. Under the threat of losing funding for federal highways due to the state's ongoing inability to meet national air quality standards set by EPA, and deriving its statutory authority under the California Clean Air Act of 1988 (a.k.a. the "Sher Act"), ARB established four different emission performance levels for motor vehicles, including a zero emission vehicle (ZEV) category. The principal rationale for the inclusion of what became known as "the ZEV mandate" was that alternatives to gasoline combustion engines would ultimately be needed to meet the EPA's air standards (Collantes 2006).

The ZEV mandate called for progressive increases in the sales volume of ZEVs by major auto manufacturers. At the time, battery-powered EVs and plug-in hybrid variants were the only available technology. GM had recently debuted its path-breaking all-electric "Impact" (the name later changed to the "EV1"), which in part helped shift the perception that battery technology might offer a suitable substitute for combustion-based vehicles.

Collantes (2006) argued that the ZEV mandate was a highly unusual instance of regulatory policy, describing it as "a rare example of non-incremental policy innovation" (p. 42) intended to accelerate development and deployment of BEVs. The crux of this statement is the recognition that the ZEV mandate implicitly called for the use of technologies of a fundamentally more radical nature than those available at the rule's inception. This was an industry first. Previously, automakers could meet stricter emission requirements through incremental improvements in existing combustion engine technologies. The ZEV mandate, as conceived, would force the direction of technology search outside these conventional boundaries. Most automakers strongly opposed the ZEV proposal. Collantes and Sperling (2008) maintain that the mandate survived review and implementation by burying a requirement for radical technological innovation in a much broader regulatory scheme containing elements with more immediate consequence to stakeholders.

Of the two central features proposed by ARB in the original 1990 LEV regulation – one for distribution of 'clean fuels' and the other for sales of ZEVs – only the latter survived intact (Collantes and Sperling 2008). The mandate evolved to accommodate a variety of pathways for manufacturer compliance with sales mandates that at one time included HEVs and now includes PHEVs and fuel cell electric vehicles (FCEVs). An escalating sales volume requirement, however, remains the kernel of ARB's most recent iteration of the LEV regulation. Known collectively as LEV III, a number of amendments call for "more stringent tailpipe and greenhouse gas emission standards for new passenger vehicles. Combining the control of smog-causing pollutants and GHG emissions into a single coordinated package of standards" (ARB 2012). Specifically, it calls for annual volume increases in ZEV sales such that by 2025 these vehicles would comprise approximately 15.4 percent of new car sales volume in the state. California's Governor's Office published the 2013 ZEV Action Plan includes a roadmap for putting 1.5 million ZEVs on California's roads by 2025. The plan specifically calls on state agencies to "encourage and support auto dealers to increase sales and leases of ZEVs" (2013e, 15). The plan further outlines a wide range of efforts to accelerate adoption of plug-in and zero-emission vehicles statewide that includes recognition of dealers by the governor's office, purchase rebates for consumers, and education and outreach activities.

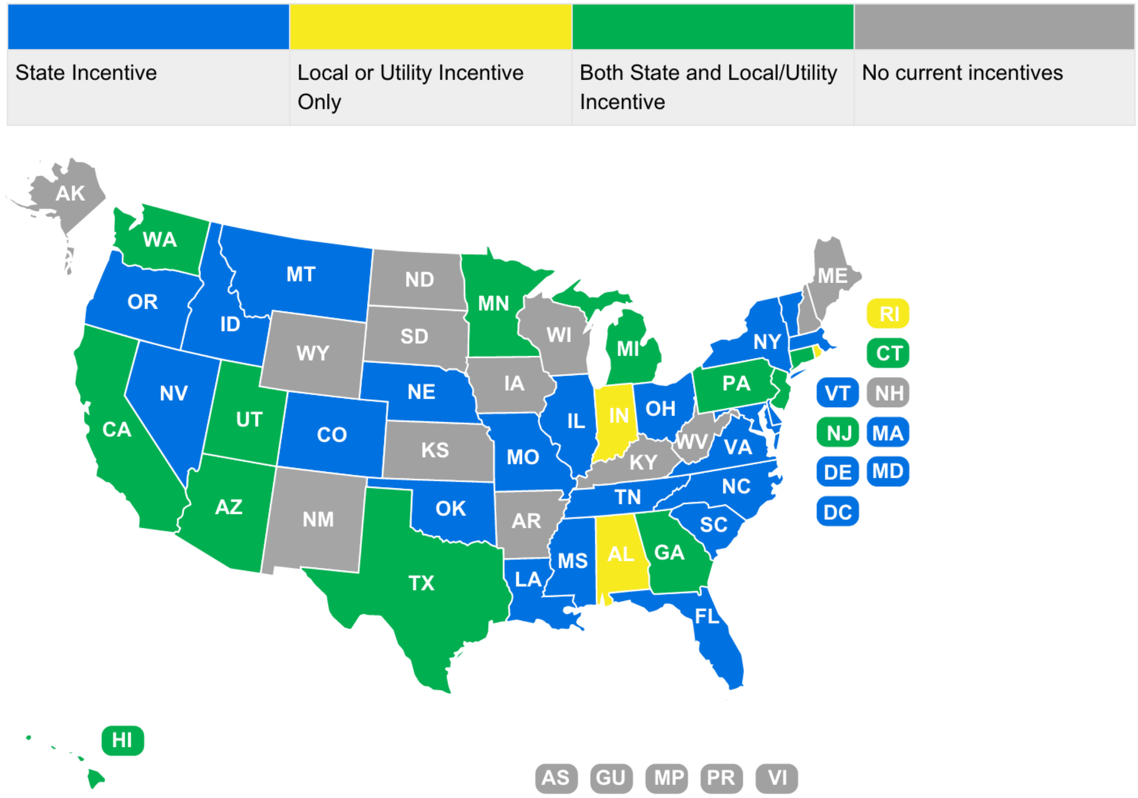


Figure 2-3. State Hybrid and Electric Vehicle Incentives. Source: National Conference of State Legislatures.

Thirty-nine states and the District of Columbia have since joined California in offering incentives for PEVs (Figure 2-3). Incentives range from tax credits for vehicle purchases and charging station installations to direct rebates, HOT/HOV lane exemptions, parking incentives, utility rate reductions, sales tax abatements and other financial inducements (Hartman 2015, 2015d). In October 2013, eight of the ten states that adopted California's ZEV provision united in signing a Memorandum of Understanding (MOU) in which members committed to putting 3.3 million ZEVs on the road by 2025. These states released a Multi-state ZEV Action Plan in May 2014 detailing more concrete steps for achieving this target such as fleet purchase requirements, deployment of public charging infrastructure, and standard rate structures for vehicle charging

(Hartman 2015). State rebates or tax credits range from $1,000 in Maryland to $6,000 in Colorado. California, for example, offers rebates to customers equal to $1,500 for the purchase of a qualified PHEV and $2,500 for a qualified BEV.

2.9 Challenges of Distributed Innovation

The success of innovative new products often rests on innovation in product distribution, especially where innovation breaks from historic industry patterns, entails new modes of consumer behavior and involves new support infrastructure on which customers rely (Mohr, Sengupta, and Slater 2013, Slater and Mohr 2006, Moore 2014). Developing and commercializing innovative new products, however, is rarely the domain of a single entity. Rather, responsibility is distributed among multiple actors and the path to market is conditioned by pre-existing organizational arrangements and patterns of relations in a product's value chain (Coombs, Harvey, and Tether 2003, Crane 2015). The nature of these arrangements can vary from loosely coupled 'arms-length' interactions to closer, more integrated vertical relationships. This path-dependency (Arthur 1989) influences how new products are delivered and received in the marketplace.

Where firms cannot readily substitute distributing agents there is a degree of mutual dependency amongst them; a firm cannot introduce an innovation without the coordinated participation of the others. Hence, the actions (or inaction) of one can constrain the will of the other. But constraint, dependency, and power do not necessarily preclude cooperative relations amongst agents. Rather, innovations can challenge and alter existing patterns of provision, with innovation 'both arising from, and contributing to, the pattern of distributed activities' (Coombs, Harvey, and Tether 2003, 1126).

The introduction of new products intended to address sustainability concerns often compete with incumbent technologies that control channels of market access. In such cases, University of Michigan law professor Daniel Crane contends, "Incumbent technologies often have a grip on established distribution channels through embedded relationships, quasi-exclusive dealing arrangements, and settled customer expectations, which requires proponents of new technologies to locate or create new channels of market access" (Crane 2015, 8-9). While automakers shoulder the burden of compliance with national fuel economy and state-level zero-emission vehicle regulatory requirements, state franchise laws mandate that third-party dealers sell vehicles to end customers (2014a, 2014b). Dealers individually decide which vehicles they sell and how they are sold to customers. Hence, automakers lack direct control over which vehicles are sold or how new innovations are retailed to end customers. Moreover, these same laws may restrict automakers from engaging in a wide variety of distribution-related activities potentially important for bolstering the likelihood of new product success.

3 Literature Review

The study is principally concerned with how innovative new products like PEVs are provided (i.e. produced, distributed and sold) to end customers. In particular, the investigation considers the importance of the retail function, the role of third party "intermediaries" (i.e., new car dealers) and factors that might influence the successful introduction of PEVs to market.

3.1 Grounded Theory

The relative newness of policy research on the subject of new car dealers and environmental innovations means that few testable hypotheses were initially available for analysis. In examining nascent areas of research, and where complex or fluid relationships and emergent properties are of interest, researchers often favor qualitative methods of study (Corbin and Strauss 2014). *Grounded theory* (Glaser and Strauss 2009) offers a roadmap for investigating such topics. Grounded theory finds its origins in sociology with the pioneering work of Glaser and Strauss (1967), who developed a set of flexible procedures for analyzing diverse sources of data for the purpose of constructing valid theory where existing knowledge is highly limited. The method has since found wide application across a diversity of disciplines (e.g., psychology, management science, education).

In grounded theory, researchers analyze data via a process termed *constant comparisons*. As part of this process, the researcher breaks data down into manageable pieces. Each piece is then evaluated for similarities and differences. Data supporting a similar concept (but not necessarily a repeat) are grouped under the same conceptual heading. With further analysis the researcher groups these concepts into broad categories or themes. Themes are further developed in terms of their properties and dimensions, which are then integrated around a core category that identifies the major theme of the study. The core category and other categories, when taken together, constitute the structure of the theory. The properties and dimensions of each category complete the structure by providing the detail (Corbin and Strauss 2014).

Grounded theory confers a number of advantages to researchers investigating relatively new areas of study. It allows the researcher to take a holistic and comprehensive approach to the study of phenomena and affords the opportunity to explore the inner experiences of research participants. It also provides for discovery of relevant variables for later testing via quantitative forms of research (ibid.). In the case of the present study, grounded theory offers an avenue for exploring factors influencing dealer participation in the sale of PEVs and related retail performance. It also equips the researcher with the tools for laying the groundwork from which to develop testable propositions. Where possible, the dissertation proposes and tests hypotheses developed by the researcher as the investigation unfolded.

Eisenhardt (1989) describes grounded theory as the use of case study research to connect observations from previous literature, common sense and experience with empirical data to develop testable, relevant and valid theory. Eisenhardt proposed a roadmap for building theories from case study research that synergized previous work on qualitative methods (e.g., Miles and Huberman 1984), design of case study research (e.g., Yin 1981, 1984), and grounded theory building (Glaser and Strauss 2009). This process is described in below, which guides the research method discussed in the following chapter.

Table 3-1. Process of building theory from case study research (Eisenhardt 1989).

Process of Building Theory from Case Study Research

Step	Activity	Reason
Getting Started	Definition of research question	Focuses efforts
	Possibly a priori constructs	Provides better grounding of construct measures
	Neither theory nor hypotheses	Retains theoretical flexibility
Selecting Cases	Specified population	Constrains extraneous variation and sharpens external validity
	Theoretical, not random, sampling	Focuses efforts on theoretically useful cases—i.e., those that replicate or extend theory by filling conceptual categories
Crafting Instruments and Protocols	Multiple data collection methods	Strengthens grounding of theory by triangulation of evidence
	Qualitative and quantitative data combined	Synergistic view of evidence
	Multiple investigators	Fosters divergent perspectives and strengthens grounding
Entering the Field	Overlap data collection and analysis, including field notes	Speeds analyses and reveals helpful adjustments to data collection
	Flexible and opportunistic data collection methods	Allows investigators to take advantage of emergent themes and unique case features
Analyzing Data	Within-case analysis	Gains familiarity with data and preliminary theory generation
	Cross-case pattern search using divergent techniques	Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping Hypotheses	Iterative tabulation of evidence for each construct	Sharpens construct definition, validity, and measurability
	Replication, not sampling, logic across cases	Confirms, extends, and sharpens theory
	Search evidence for "why" behind relationships	Builds internal validity
Enfolding Literature	Comparison with conflicting literature	Builds internal validity, raises theoretical level, and sharpens construct definitions
	Comparison with similar literature	Sharpens generalizability, improves construct definition, and raises theoretical level
Reaching Closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

Note that Table 3-1 describes an iterative process whereby the researcher begins from a relatively blank slate and inductively arrives at a theoretical construct for the phenomena observed. Stating the research questions focuses exploratory efforts that can include the review of literature the researcher deems relevant from a range of disciplines and contexts. Case selection is designed to concentrate efforts on situations useful for replicating or extending theory by filling conceptual categories (e.g., intermediaries responsible for selling PEVs). Use of multiple data collection methods (e.g. interviews, field notes, survey data), multiple investigators and concurrent collection and analysis fosters a more holistic view of evidence, incorporates divergent views and provides for mid-course adjustments in light of emergent themes. Closure is achieved as additional efforts yield diminishing marginal returns to theory construction (Eisenhardt 1989).

3.2 Organization of the Literature Review

The remainder of the chapter is divided into the sections indicated in Table 3-2 below. The first establishes key terms and definitions that underpin subsequent discussions. The second reviews the origins and key tenets of the systems view of technological change. Systems of innovation theory represents a common perspective underlying the policy and management literatures that follow. These reviews focus on the structure, role and function of organizations that play an intermediary role in bringing sustainability innovations to market. Gaps in both literatures are highlighted. Where appropriate, the author distinguishes content with bolded text that plays a more central role in the analysis versus content provided for context or completeness.

Table 3-2. Organization of the Literature Review.

Section	Heading/Discipline	Research Strand/Sub-strand
7.3	Definitions	
7.4	Systems of Innovation	
7.5	Sustainability Transitions (Policy)	Sectoral Systems of Innovation (SSI)
		Technological Innovation Systems (TIS)
		Socio-Technical Systems (STS)
		Strategic Niche Management (SNM)
7.6	Distributed Innovation in the Management Sciences	Innovation Typology
		Contingency Theory of High-Tech Marketing
		Diffusion of Innovation
7.7	Summary	

3.3 Definitions

This section introduces key terms and definitions important to discussions that follow. Perhaps the most central is the concept of innovation. Economic theories of technological change can be traced back to Schumpeter (1942) who described a three-stage process of invention, innovation and diffusion. *Invention* entails the process of developing a scientifically or technically new product or process. *Innovation* is the process whereby it is successfully commercialized (i.e. brought to market). Lastly, *diffusion* is the process through which the invention is widely adopted. These processes are often collectively referred to as **innovation**.

In the context of this research, a "sustainability innovation" refers to a product proclaimed by interested parties to reduce harm to human health, safety, or the environment. Increasingly, policy attempts to harness market forces to bring sustainability innovations to market. Doing so is typically predicated on widespread consumer adoption. Concern over slow consumer uptake of sustainability innovations, however, has driven increasing attention by policy scholars to the mechanisms for accelerating the processes of technological change. Moreover, growing global pressures for dramatic improvements in sustainability performance may require firms to move beyond the more incremental approaches familiar to many industry players. More innovative new products, however, introduce distinct challenges to firms, including the coordination of other contributing agents responsible for bringing products to market. For example, automakers invest heavily in development of new vehicle features to meet changing customer needs and to stay competitive. A recent report by global market research firm J.D. Power, however, found that technological features have a brief 30-day window for gaining acceptance among drivers. Where dealers fail to explain a technological feature, owners have a greater likelihood of never using it. Consequently, new car dealers play a determining role in technology adoption. (Bond 2015).

The research adopts the term 'provision' advanced by Coombs (2003) to refer to processes involving the production, distribution and sale of products (i.e., goods and services) in the marketplace (p. 1125). In many cases, producers rely on pre-existing relations with other firms to distribute and sell (i.e., "provide") innovative new products to end customers (Coombs 2003). Hence, producers may lack full control over the design and delivery of the purchase experience. Moreover, other entities (e.g., market research firms, trade associations, government) may play a role in supporting the firms charged with a new product's provision to end customers. In the auto industry, for example, manufacturers entrust third-party dealerships with the responsibility for selling PEVs, research firms provide information on market conditions and trends, and dealer trade associations deliver ongoing market information and training on topics of common interest to its constituent members. This can include information and training on emerging technologies like PEVs. Moreover, government-funded programs may support training of dealers selling PEVs as part of broader education and awareness efforts.

The success of innovative new products in reaching mainstream consumers depends not only on how a product's feature set compares to the product(s) it might compete against, but also upon how innovative new products are introduced to customers in the first place. This is because unlike existing products on the market, substantially innovative new products introduce a high degree of uncertainty into the customer's purchase decision. Consequently, the purchase experience must account for these differences to increase the likelihood of success in the market (Mohr, Sengupta, and Slater 2013, Moore 2014). Yet the analysis of innovation processes that occur within the boundaries of a business entity (i.e., the "firm-centric view") continues to dominate the field of innovation studies. Coombs (2003) observes that innovation studies have paid inadequate attention to relationships between, as opposed to within, self-interested agents (p. 1126). Moreover, a review of the literature by Howells (2006) notes that while many studies acknowledge the contributing role of intermediaries in processes of innovation, most view them as peripheral to the main field of inquiry.

The present research adopts a different perspective. It assumes that intermediaries could play a determining role in the successful introduction of substantially new technologies. It therefore takes a distributed, rather than firm-centric, view of the system. The distributed view is anchored in the systems perspective of innovation. The next section discusses the origins of the systems view of innovation. This sets the stage for the discussion of related policy and management science literatures that follow.

3.4 Systems of Innovation Theory

In the systems view of innovation, intermediary firms (e.g., new car dealers) may play an important role in shepherding new technologies to market. The systems view of innovation finds its origins in the evolutionary economics literature. Evolutionary economic theory, which borrowed its epistemology from the evolution of biological systems, examined how actors learn under conditions of uncertainty. Here, firms express variation (in the form of innovation) in a competitive selection environment (the market). How well firms learn and adapt when confronted with variation determines ongoing viability and relative success in the market setting.

Carlsson and Stankiewicz (1991) underscored the need to consider innovation in terms of the entire set of influences affecting the success of any given technology: "Neither firms nor innovations, taken individually, can explain economic change. Instead, they must be viewed as parts of a larger system; various agents interact with each other, and institutions matter" (Carlsson and Stankiewicz 1991, 94). These authors define a *technological system* as

> *…a dynamic network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of technology.* (p. 111)

Here, an innovation system is defined in terms of 'knowledge and competence flows' rather than flows of ordinary goods and services. It is further comprised of constituent actors and their relations, which in turn refer to organizations and institutions that together interact through networks to develop, diffuse and use innovations (Edquist 2005, Markard and Truffer 2008). In this view, **the success of substantially new technologies is predicated not by the action of private actors in isolation, but by the interaction of producer firms with others in the market setting. Central to innovation in this model are learning processes** (Lundvall 1992).

The system of actors, institutions and networks that comprise the selection environment at any given time is often referred to as a *socio-technical regime*, defined by Hoogma (2002, 19) as "the whole complex of scientific knowledge" comprised of engineering practices, production processes, product attributes, user needs, skillbases, institutions, and infrastructures. Socio-technical regimes are characterized by well-established industry structures and actor-network relations that co-evolved with a dominant design (Dosi 1982, Nelson and Winter 2009) and as such become 'instituted economic processes' (Polanyi, Arensberg, and Pearson 1957). Examples include centralized powerplants in energy generation and gasoline internal combustion engines (ICEs) in automotive transport, each of which evolved legal and institutional supports that further the continued dominance of these solutions.

In the systems construct, pre-existing institutional structures play an influential role in shaping the course of innovation activities. *Institutions* regulate interactions between actors and "shape behavior by constituting the set of acceptable interpretations and actions available to them" (Hargadon and Douglas 2001, 478). These take the form of laws, norms and rules with both normative and cognitive dimensions. These shape perceptions, constrain behavior and influence decisions and actions (Scott 1995) via certain frames of reference (Geels and Raven 2006) or paradigms (Dosi 1982) that structure learning processes. *Networks* refer to both formal and informal informational links and connect actors with each other and with the institutions that influence them. They comprise participants in the firm's own value chain, as well as actors and institutions outside the industry's typical boundaries such as governments, trade groups, universities and standards bodies that may span multiple industries. **In the context of innovation, the major goal of networks is to reduce uncertainty** (Freeman 1991).

Learning networks facilitate the transfer of knowledge. Political networks compete to influence the policy agenda. Industry trade associations, for example, often provide both a learning function and a political advocacy function. Though governments readily acknowledge the role of the firm as central to the success of innovations aimed at achieving sustainability objectives, equal in importance is the role of other system actors in achieving these ends. **Sociotechnical regimes invariably shape innovation outcomes (Dosi 1982) and are marked by periods of relative stability and certainty in which incremental technological improvements dominate. These are then interrupted by periods of relative instability and uncertainty with the arrival of some innovative new technology** (Dosi 1982, Dosi and Nelson 1994). Modern electric utilities, for example, contend with reconciling the onset of distributed sources of energy generation by customers that include solar and wind power with a business model premised on centralized power generation. Similarly, automakers are bracing for a future that could involve shared use of autonomously operated vehicles that could potentially undermine traditional sources of revenue.

Neoclassical economic theory presumes that firms possess perfect knowledge and can optimize their response to uncertainty through rational cost-benefit decision processes. Though useful in contexts familiar to firms and other actors, evolutionary economists argued that **rational choice breaks down in contexts involving a high degree of novelty**. In these cases, firms routinely make decisions under considerable uncertainty surrounding changing market, socio-technical, and political-economic conditions (Carlsson and Eliasson 1995, Dosi and Nelson 1994). **While actors may behave rationally, they often interpret and evaluate their choices and consequences based on subjective considerations that may or may not accurately**

reflect the actual competitive landscape (Dosi and Nelson 1994). For example, where automakers face a choice, they may gravitate toward providing vehicles grounded in established ICE-based vehicle architectures, even as new architectures introduced through competitive entry yield potentially new sources of value for customers.

In sum, the decisions of firms are influenced by – and in turn, influence – other system actors through a process of interactive learning under conditions of uncertainty. These processes are inherently path dependent (Arthur 1989): Where they end up is in large part determined by how they got there (Dosi and Nelson 1994).

3.5 Sustainability Transitions

Literature focused on mainstream adoption of sustainability innovations find their roots in systems of innovation theory. This section reviews policy literature describing the adoption of this perspective by scholars studying system-wide transitions to technologies supporting sustainability objectives.

Studies of innovation in the policy field has predominantly been based in qualitative methods and observations, leveraging case studies to describe and characterize systems involving technology development (Bergek et al. 2008, Jaffe, Newell, and Stavins 2002, Taylor 2008). Typically, these focus on the producer of the innovation and technology transfer between these firms and entities that reside upstream of the producer (Howells 2006, Taylor 2008). Scholars and practitioners have dedicated much less attention to the study of entities and processes downstream of the producer that also contribute to technological change. Downstream processes are typically associated with the later stages of commercialization, involve the marketing function and include questions governing a product's value proposition, pricing, promotion and distribution. Also relevant for high-tech products is its initial introduction to the early market and the transition from adoption by early customers to mainstream buyers.

Policy scholars studying technological transitions share the common systems approach elaborated in the previous section, but differ in terms of their analytical focus and the heuristic used. A review of the literature by Coenen and Díaz López (2010) identified three main strands of research in the transitions dialogue: Sectoral Systems of Innovation (SSI), Technology Innovation Systems (TIS), and Socio-Technical Systems (ST-systems). The present research adopts useful elements of each in its analysis of new car dealers and PEVs.

SSI specifically distinguishes between analyses at the *innovation* system level, the *production* system level, and the *distribution-market* system level (Malerba 2002). The latter is of particular relevance to the present study. As an extension of SSI, TIS considers co-evolution of emerging technological domains that **can include both incremental and more radical forms of innovation** and their diffusion in society (Bergek et al. 2008, Coenen and Díaz López 2010). **TIS advances a framework for policy intervention based on the systematic identification of "system failures" (an extension of the 'market failure' concept) that interfere with the function of key processes underlying the transition to widespread adoption.** These processes include mobilizing resources, entrepreneurial experimentation and knowledge development and diffusion (Bergek et al. 2008, Hekkert et al. 2007). Examples of system failures include efforts by dominant industry lobbyists to block regulation favorable to more sustainable alternatives or other incentives viewed as counter to their interests.

ST-Systems considers a broad number of viewpoints with an emphasis on societal processes for fostering a transition to more sustainable alternatives. In this frame, policy intervention is based on the emergence and articulation of a shared vision in which system actors conceive more sustainable future outcomes. **Intervention is conducted via niche experiments in which learning processes and the formation of supportive networks is key to reaching mass adoption** (Coenen and Díaz López 2010). **More recent TIS research, like the body of ST-systems research, focuses on *paradigmatic* ("game changing") transitions to more sustainable technologies and products and services, with particular attention to the energy and mobility sectors**.

TIS examines functional processes common to the body of transitions-based case studies that could limit or prevent widespread uptake of innovations in the market. It also distinguishes between policy interventions targeted at either the formative or growth stages of technological development (Hekkert 2007, Bergek et al. 2008). **In TIS, system-level performance is assessed by how well it "supports firm entry, variety, and formation of niche markets in the first phase, and market expansion and the supply of resources to exploit that market in the second phase" (Bergek 2003, 201). TIS also underscores the need for 'actor-oriented' research for increasing understanding of processes and interactions at the micro (individual system actor) and meso (groups of actors and institutions) levels of analysis (Markard and Truffer 2008)**.

As a sub-strand of the ST-Systems perspective, **studies in Strategic Niche Management (SNM) emphasize the deliberate construction of a technological niche or *protective space* for innovating firms to gain an initial foothold through which mass-market adoption might eventually be reached** (Kemp, Schot, and Hoogma 1998, Schot and Geels 2008). Kohler et al. (2008) defines a niche in the context of policy research as a "loci of radical innovation, from the idea of niche markets, but a broader concept including policymaking and social networks" (p. 234).

Smith and Raven (2012) identify two fundamental properties of protective space creation emphasized in both SNM and TIS literatures: *shielding* and *nurturing*. Selection environments (i.e. markets and institutions) are multi-dimensional and therefore require multi-dimensional protection. The principal purpose of the niche is to shield innovators from the unfavorable selection pressures of the dominant regime. Thus, in SNM theory, a protective space affords interdependent actors the ability to conduct localized experiments with co-evolving technologies, user practices, and regulatory structures (Schot and Geels 2008). **It also provides a temporary space for learning amongst system actors** to gain insight into consumer preferences, emergent product properties, design and interoperability issues, and new ways of using the technology (Geels 2002, Hoogma et al. 2002). **The idea is to reduce commercial and technological uncertainties** (Rice, Leifer, and O'Connor 2002) while simultaneously allowing internal processes and adequate regulation and infrastructure to mature (Pinske et al. 2014, 46). In other words, the protective space buys time to develop the innovation to a point at which it can expand beyond the niche (e.g., Geels 2002, Smith and Raven 2012, Pinske et al. 2014).

Once the niche is established and protected, incremental improvements may eventually position the innovation to compete for mainstream customers and potentially displace the dominant technology (Geels 2002). Government may then consider relaxing support through a controlled phase-out or sunset of protection provisions (Weber and Hoogma 1998). Problem framing in these studies, however, hinges predominantly on bridging the technological and commercial ‘Valley of Death’, in which high risk and long time horizons thwart capital-starved entrepreneurs from proving out technological concepts. Similar challenges arise in scaling innovation to compete commercially against well-entrenched and commoditized conventional technologies. The process of *bridging* involves connecting actors within the niche, as well as linking them with actors outside the niche, in networking environments where shared learning and a common vision could eventually emerge (Smith and Raven 2012).

Both public and private sector entities can carve out protective spaces for innovation. Pinske et al. (2014) conducted an empirical analysis of 9,000 articles published between 1997 and 2010 that described methods by which private and public actors attempt to protect low carbon vehicles (LCVs) from selection pressures associated with innovative new technology. The chief concern is how to attract mainstream customers in the early stages of technology commercialization. LCVs, the authors argue, possess three distinguishing characteristics that necessitate multidimensional protection. First, **the innovation confers a step-change jump in some aspect of performance (or a different value proposition) relative to conventionally powered vehicles**. For example, LCVs can drastically improve fuel economy and enable new conveniences such as home charging and improved performance in attributes such as ride handling and safety characteristics. They may fall short, however, on conventional performance dimensions expected by mainstream customers such as range and time to refuel.

Second, **the technology is *systemic* in nature, meaning that innovation by firms cannot be pursued independently.** Rather, LCVs call for interdependent innovations in which companies may struggle to coordinate and combine innovation activities by disparate parties (Chesbrough and Teece 1996, Coombs 2003). **To contend with systemic innovations, companies not only have to develop new technologies but also a new *ecosystem* of**

supporting suppliers, providers, and complementors (Afuah 2000, Garud and Kumaraswamy 1995, Moore 2014, Pinkse, Bohnsack, and Kolk 2014). **Moreover, it is necessary to shift consumer inertia by emphasizing alternative performance measures and by promoting new product usages and sources of value** (Pinske, Bohnsack, and Kolk 2014).

Lastly, **LCV technologies are *socially embedded*. Social embeddedness suggests that customer preferences are affected not only by the attributes of the product itself but also by the cultural and institutional context in which these products are used** (Geels 2002, Granovetter 1985, Hargadon and Douglas 2001). Use of alternative fuel vehicles, for example, involve products at the intersection of the energy and mobility markets. Each of these markets have particular infrastructures, rules, norms, and regulations that influence an innovation's ability to attract mainstream customers (Yu and Hang 2010). **To reach mass markets, innovative new products need protection from competition in the early stages of market introduction.** Smith & Raven (2012) observed that while the niche is a common feature of the sustainability transitions literature, a systematic method for evaluating this 'protective space' (Kemp, Schot, and Hoogma 1998, Schot, Hoogma, and Elzen 1994) has yet to emerge.

Pinske et al. (2014) distinguish between private and public sector 'protection levers.' Private sector *protection levers* are many-fold and can include detaching the innovation structurally from the core organization (e.g., by creating a separate business unit) (Christensen 1997); cross-subsidizing early products prior to stand-alone profitability (Danneels 2004); strategic alliances to share risks and knowledge with competitors (Porter 1991, Dyer and Singh 1998); vertical integration with suppliers and complementors (Afuah 2001); modular upgradeability to accommodate more incremental adjustments to systemic change by suppliers, customers, and complementors (Garud and Kumaraswamy 1995); ‘robust design’ by entrepreneurs to camouflage innovative new products in the mantle of familiar institutions (Hargadon and Douglas 2001); **and the ‘whole product’ approach in which configuration of the distribution channel is incorporated in the design and marketing of high-tech products** (Moore 1991, 2014, Slater and Mohr 2006).

Where sustainability transitions involve discontinuous, systemic and socially embedded change, **government can complement privately orchestrated protection efforts through *public protection levers*** (Smith and Raven 2012, Pinske et al. 2014). These steps attempt to broker the inherent collective action problem that innovative new technologies face. **Levers include proactive measures by government to support niche formation in the early market stage and subsequently enabling a transition to a growth stage characterized by much wider societal adoption** (Geels 2002, Kemp et al. 1998, Smith and Raven 2012).

Some public protection levers may be more effective than others depending on the type of innovation and the stage of the innovation process (e.g., development or commercialization) (Pinske et al. 2014). For the development phase, examples include corporate tax incentives, public procurement rules, and subsidies. But measures supporting technology development are often inappropriate or insufficient during the commercialization phase to spur a wider transition involving mainstream consumer uptake. **The commercialization stage requires attention to creating a new ecosystem of suppliers and complementors that will be crucial to bridging the gap to mainstream customers** (Afuah 2000, Geels 2002). Increasing attention has turned to the role of government in technology commercialization – in particular, assisting innovators in making the jump from early to mainstream customer segments (Pinske et al. 2014). Protection levers can empower technology producers to mobilize other actors in the network (ibid., 47). Examples of actions supporting technology commercialization include consumer purchase incentives, infrastructure deployment, and education and outreach (Smith & Raven 2012).

Smith and Raven (2012) argue, however, that while empirical studies from both TIS and SNM literatures emphasize the role of institutional and political dynamics that empower discontinuous, systemic and socially-embedded innovations, **they lack specifics as to what *empowering* system actors entails or the mechanisms by which it might be accomplished.** Smith and Raven (2012) describe **the concept of *empowerment* as composed of dual processes that make niche innovations more competitive by adapting the technology to "fit-and-conform" with the norms, standards, and protocols of the dominant regime while simultaneously working to shape or "stretch-and-transform" the dominant selection environment to better accommodate the innovation**. This dynamic is depicted in Figure 3-1.

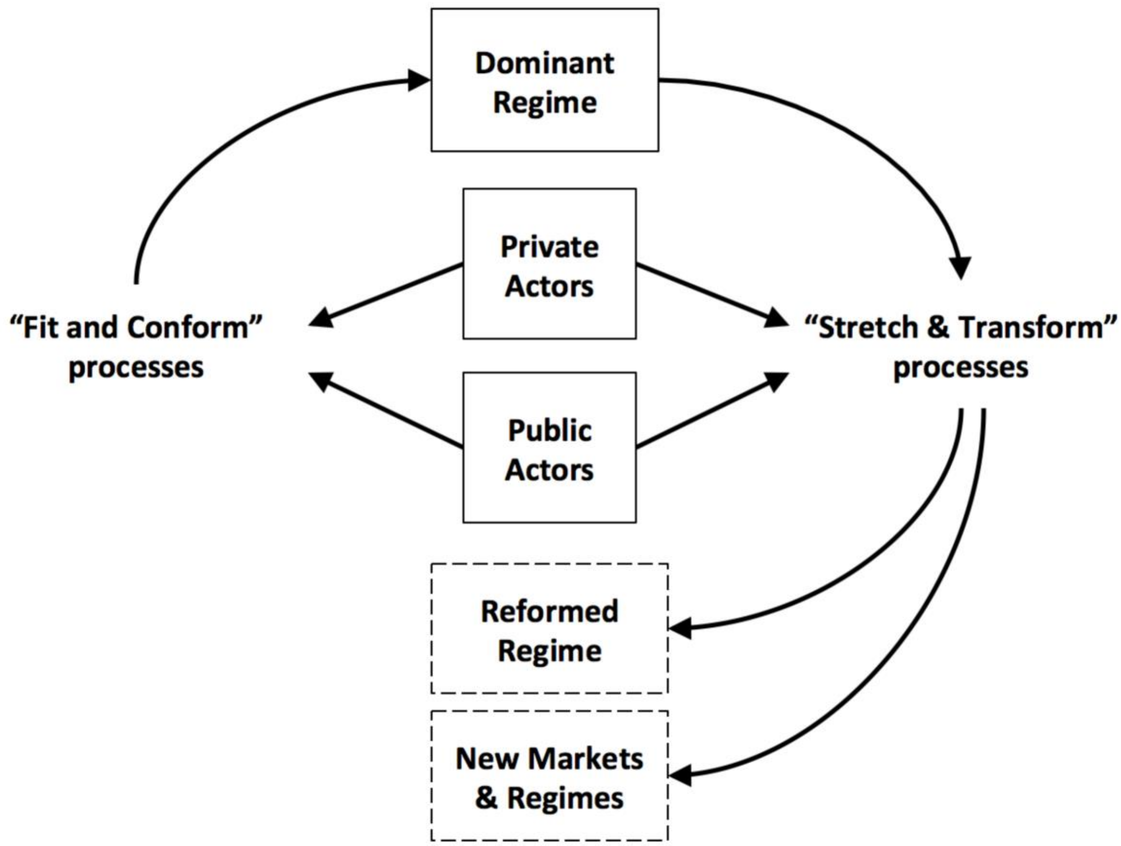


Figure 3-1. Illustration of how innovators may pursue both "fit and conform" and "stretch and transform" processes to shape the selection environment.

The success of Thomas Edison's system of electric incandescent lighting in overcoming deeply embedded institutional barriers, for example, depended on how well its design invoked the public's familiarity with the technical artifacts and social structures of the gas utility, telegraphy and arc lighting industries (Hargadon and Douglas 2001). At the time, the regulatory environment of utilities was developed for the existing gas-lighting industry and manipulated by those same interests to its own advantage. As a case in point, Edison's application for an operating license was opposed by vested political interests of its day and assessed fees that even the gas utilities were not even subject to (ibid.).

Hoogma et al. (2002) had previously identified a "fit-and-stretch" pattern as an important property of regime shifts. **Yet empowerment, Smith and Raven (2012) argue, is the least developed property in the transitions literature and the most essential for enabling or "bridging" niche markets to reach mainstream customers. They call for a more detailed analysis of the underlying actor networks and the "messy" political dynamics of agency (i.e. the capacity to influence change favorable to one's interests) that drive niche development**. **The TIS framework is useful as a high-level conceptual model in this regard in that it offers a systematic process by which to identify 'system level' failures for policy attention. Policy may intervene to address barriers or 'blocking mechanisms' while fanning key drivers or 'inducing mechanisms' affecting innovation for sustainability purposes** (Bergek et al. 2008, Hekkert et al. 2007)

To this end, Taylor's (2008) analysis of the solar photovoltaic (PV) market in the United States draws lessons for policy relating to empowerment of system actors. The study identified policies aimed at "improving the boundary space between innovators and technology consumers" (p. 2831). The focus of analysis is on alignment of intermediaries or "interface actors" responsible for enacting change to better accommodate sustainability innovations. Taylor (2008) defines 'interface improvement' as those policies that act to "enhance the innovative function of the actors who occupy the position in the innovation source chain between technology inventors/manufacturers and end-users" (p. 2842). **These policies, intended to accelerate the pace of innovation and its diffusion, include addressing hindrances downstream of the producer that block wider adoption while enhancing knowledge flows that serve to drive adoption.**

The catalyst for Taylor's distinction was the recognition that various forms of opportunism by downstream intermediaries (i.e. entities between the producer and end customer) adversely affected diffusion of PV technologies. Specifically, abusive sales and marketing techniques that included excessively high bids and false and misleading "lifetime warranty" claims by some installers in California's solar water heater (SWH) market contributed to stagnated adoption in the state despite robust growth elsewhere. California responded with quality control measures that included government certification, permitting and warranty requirements to mitigate opportunism and better control and align the behavior of intermediaries. Opportunism in ZEV markets might include dealers dumping PEVs at below market prices to capture credits (e.g., for volume bonuses) or attempting to switch a potential PEV customer to a conventional vehicle (a.k.a. cross-selling).

The Technology Innovation System (TIS) and Strategic Niche Management (SNM) frameworks hold much potential for understanding and managing technological change but remain largely underdeveloped to be of more practical use (Von Tunzelmann et al. 2008). According to Taylor (2008), there continues to be a weak empirical basis for policy recommendations due to a lack of systematic, retrospective evaluation of the comparative innovation effects of different policy options. Part of the challenge is that the traditional policy yardsticks (e.g., patent filings, media coverage, entry by new firms) for system performance is at such a high level as to be of little practical value for informing policy decisions that affect early market and wider mass market commercialization efforts. In any case, the effectiveness of policy support for various system actors on innovation performance has not been the primary evaluative criterion, unlike such criteria as cost to society, pollution reduction, and energy conservation

(Taylor 2008). **One of the aims of the present study, therefore, is to investigate factors – and possible measures – relevant for determining the innovative function of actors responsible for the provision of PEVs.**

3.6 Distributed Innovation in the Management Sciences

A more robust empirical basis for factors affecting innovation performance downstream of the producer has emerged in the management sciences. Though these typically adopt a firm-level perspective, studies have increasingly expanded the scope of analysis to consider a wide range of factors affecting the capability of firms to bring innovations successfully to market. These include the types of innovation firms contend with and the interaction of firms with system-wide actors, networks and institutions. In the management sciences, the emphasis tilts toward innovation more generally, irrespective of sustainability imperatives. Sustainability innovations share many of the features common to innovation at large, but with a few notable and important distinctions (e.g., they are often discontinuous, systemic and socially-embedded, as described previously). Hence, debate centers around markets, marketing strategies, patterns of competence building, and fostering collaborative networks (Smith and Raven 2012, Von Tunzelmann et al. 2008). This leads to debates about which kinds of innovation are desirable, how they should be brought to market, and the direction of future selection environments in general.

This recognition has led scholars and practitioners to advance the contingency theory of high-technology marketing. **High-technology ('high-tech') markets are unique with respect to the relatively faster pace of technological change, high levels of uncertainty for buyers, and the centrality of information** (Weiss and Heide 1993). **Contingency theory holds that in**

order to successfully commercialize high-tech products, firms must match an appropriate marketing strategy to the type of innovation it aims to introduce (Olson, Slater, and Hult 2005, Slater and Mohr 2006, Vorhies and Morgan 2003).

3.6.1 Innovation Typology

Innovation may take on various forms, yet **ongoing definitional ambiguity continues to hamper efforts by functional and interdisciplinary scholars and practitioners to relate innovation type with the appropriate strategic pathway for commercialization**. These ambiguities center around inconsistencies in how innovation is defined (if defined at all) and the degree of innovativeness associated with various categorizations of new products. Common descriptors for innovative new products include 'radical', 'discontinuous', and 'disruptive' (Chandy and Tellis 2000, Garcia and Calantone 2002, Hardman, Steinberger-Wilckens, and van der Horst 2013). Others include "transformative", "paradigmatic", "systemic", and "path-breaking" (see Garcia and Callantone 2002). These terms stand in contrast to *incremental, continuous* and *sustaining* innovations, which refers to the routine upgrading of products that exploit the potential of existing designs, reinforce existing business models and do not impose changes in consumer behavior (Henderson and Clark 1990, Utterback 1994, Tether 2002, Moore 1991, Mohr et al. 2013).

The term *disruptive innovation,* coined by Clay Christensen, refers to two very specific pathways by which innovations from new entrant firms eventually displace manufacturers that had previously dominated established industries. The first is through a simplified, lower-priced offering by new entrants to a niche segment of customers that incumbents willingly abandon (or ignore) for higher-margin segments (i.e., "low end" disruption). The second is by entry into an entirely new market (i.e., “new market” disruption). In both cases, through continuous improvement of the originally discontinuous innovation, the offering is eventually competitive in the primary market and can take share away from dominant firms. With the release of *The Innovator’s Dilemma* in 1997, the term gained widespread popularity in the media and across scholarly disciplines, from business management to environmental policy. Yet it is commonly used in referring to all manner of pathways by which any firm, not just established manufacturers, may be “disrupted,” whether by changing technology, production processes, or business models. It has also been applied in reference to innovative developments with varying scales of impact, from the fairly small scale (e.g., at the individual firm level) to the entire industry value chain. At question in these references is the lack of specificity as to just who is being disrupted, by how much and over what time frame (Danneels 2004, Markides 2006). More pointedly, scholars argue that the term has little predictive value, since it is typically difficult, if not impossible, to determine *a priori* whether a new product will prove disruptive.

To illustrate, the shift from electro-mechanical to electronic interfaces in the auto industry a few decades ago disrupted (by displacing market share) tiered suppliers of traditional displays and sensors. Further down the supply chain, the shift similarly disrupted automotive repair, since service technicians required a new set of skills (electronic versus mechanical troubleshooting) (Linton 2009). But neither of these developments can be said to have disrupted the auto industry in the sense that established auto manufacturers lost their dominant position.

Contributing to the confusion is the alternating use of innovation terminology to refer to similar phenomena. Unlike disruptive innovation, the term *discontinuous innovation*, variously referred to as *discontinuous product innovation* and more recently *path-breaking innovation*, refers to step change jumps in the performance trajectories of technological innovation. **Discontinuous innovations are those advancements that depart significantly from the historic dimensions of product performance and that destroy existing knowledge and competencies that must be rebuilt around a new technological or market base. These jumps occur in either or both the technical-scientific or market dimensions of performance (or "value offering")** as measured against time or effort (e.g., Colarelli O'Connor 1998, Foster 1985, Garcia and Calantone 2002, Tushman and Anderson 1986, Utterback and Kim 1985). Recent examples include digital cameras, flat screen televisions, and smart phones.

The management literature identifies two dominant stages of innovation that typically follow the S-shaped adoption curves in Figure 3-2. The formative (or emergent) phase is characterized by experimentation, high uncertainty, and many competing technology and business model alternatives. The market is typically small, poorly defined, and difficult to quantify. There are frequent entries and exits into the space by both established firms and new ventures (Dosi and Nelson 1994, Utterback and Kim 1985, Utterback and Suarez 1993). Conversely, the growth phase is instigated by the emergence of a dominant design with an ensuing market expansion and large-scale diffusion of the technology (Anderson and Tushman 1990). This latter phase also witnesses fewer entrants (Utterback and Suarez, 1993), a shift in the nature of technical change from radical to incremental product and process innovations, and a possible shakeout of firms (Utterback 1994).

With the introduction of a discontinuous new product, the cycle repeats. Firm technologies and capabilities that support existing products undergo a period of instability marked by high uncertainty, followed by a period of incremental innovation with relatively low uncertainty (Tushman and Anderson 1986, Utterback 1994). The discontinuity may prove competence-destroying (Tushman and Anderson 1986, Henderson and Clark 1990) not only to manufacturers but to their upstream suppliers (Afuah 2001) and downstream channel partners (Coombs 2003, Mohr, Sengupta, and Slater 2013, Moore 2014) as well. **Firms must acquire new knowledge and competencies associated with the new technology and convert these into new products often with the help of value chain partners** (Henderson and Clark 1990, Utterback 1994). **Moreover, this process often entails regular interaction and coordination with value chain members that is most effectively conducted via various forms of vertical integration** (Conner and Prahalad 1996, Afuah 2001, Coombs et al. 2003). Ownership of key value chain elements confers the highest degree of control over product inputs as well as the end customer experience (Mohr, Sengupta, and Slater 2013, Moore 2014).

A shift from one dominant innovation trajectory to another changes the basis of competition along performance attributes more valued by customers in a new market or in a niche segment of customers in the existing market. This provides an initial base of customers on which firms can incrementally improve the innovation in ways that also shore up performance shortfalls in attributes expected by mainstream customers (Moore 2014, Christensen 1997). Eventually, the innovation may then be able to compete for these customers in the mainstream market (Christensen 1997, Danneels 2004).

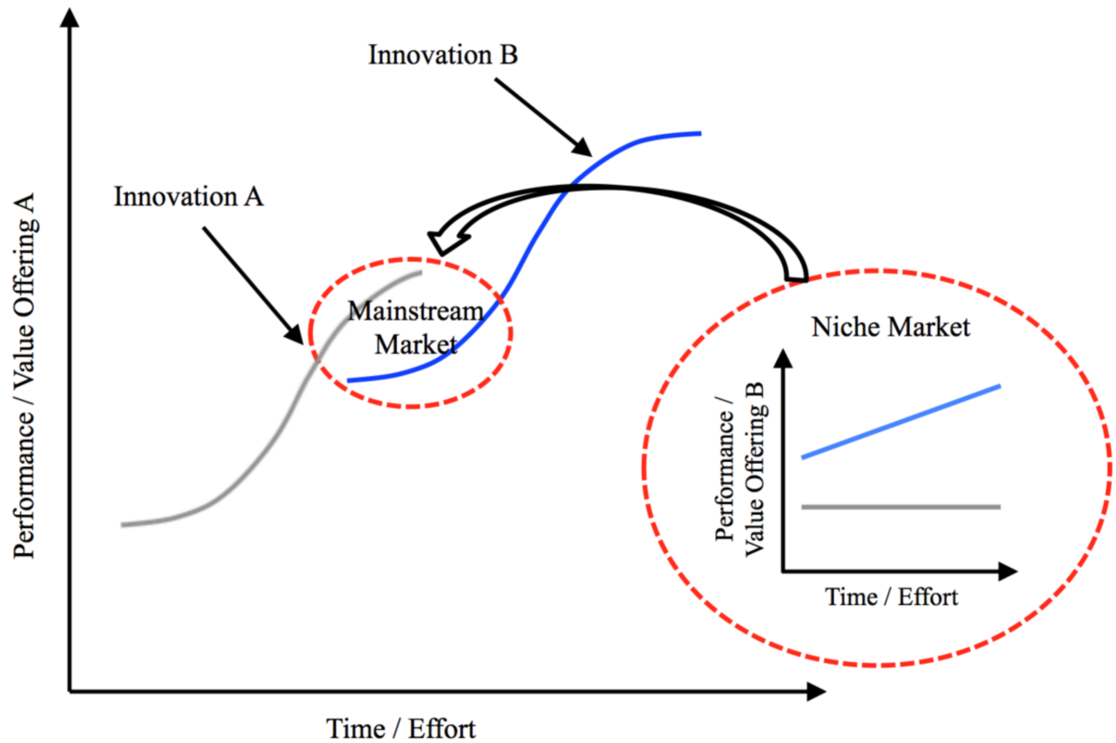


Figure 3-2. Conceptual framework for technological transitions initiated by discontinuous innovation.

Source: Adapted from Foster 1985, Christensen 1997

Figure 3-2 illustrates these concepts. The y-axis represents the current value offering and level of performance expected by mainstream customers in the core market. Examples from the auto industry include horsepower, utility, and fuel economy. The x-axis is the amount of time, effort, or resources an organization must commit in order to achieve any given level of performance to support the offering. The gray and blue curves represent the performance trajectories of the dominant design (A) and new innovations (B), respectively. While the new innovation falls short on key dimensions of performance important to mainstream customers, it appeals to a different set of customers based on some alternative value offering, or its ability to fulfill new dimensions of performance. This could be a niche set of customers in an existing market or customers in an entirely new market.

Once in the niche, continuous improvements to the innovation (blue line) eventually result in equivalent or better performance in attributes important to core customers. At this point the innovation has the potential to penetrate mainstream customer segments in the dominant market. Ultimately, the legacy technology is displaced, though this may or may not “disrupt” the dominant players, depending on competitive response. Digital cameras, for example, initially fell short in terms of screen resolution and picture clarity but were embraced by customers that valued portable “point and shoot” capability. As the product co-evolved alongside complementary technologies (e.g., digital screens, memory cards and hard drives) it was eventually able to compete and displace wet film cameras (Utterback and Acee 2005).

Innovations that can later be described as disruptive are typically predicated on some form of discontinuous innovation. The reverse may not hold true; discontinuous innovations may or may not prove disruptive. Yet these terms are frequently used interchangeably. Moore (2014), for example, spotlighted the need for different market introduction strategies for high technology products. His 1991 book *Crossing the Chasm,* which predates the work of Christensen and his colleagues, alternately refers to ‘discontinuous’ or ‘disruptive’ innovation as describing any new product that requires changes in current modes of behavior and new or highly modified infrastructure and support products and services that customers rely on (Moore 2014). Disruptive innovation, however, has proved the more popular term in both scholarly and media references.

Though Christensen's *Innovator's Dilemma* cited electric vehicles as a particular example of disruption theory at work, a recent assessment of Tesla by the author's colleagues ruled that the company's particular implementation of EV technology fails the test. The determination was based on five key criteria: (1) Whether the product targets a new market or overserved customers with a lower performing and lower priced alternative (it does not); (2) whether it leverages *asymmetric motivation* (i.e., it attracts customers that incumbents are willing to concede as they chase higher margin opportunities) to avoid a competitive response (it does not); (3) whether it improves fast enough to keep pace with customer expectations while retaining its low cost structure (Tesla entered from the high end and therefore never had a low cost structure to begin with); (4) whether it creates new value networks, including sales channels; and (5) whether it disrupts all incumbents or allows for an existing player to exploit the opportunity (as of this writing, luxury automakers Audi, Mercedes-Benz and BMW have all announced electric models intended to compete with Tesla). On all counts, except (4) which went unmentioned, the assessment concluded that Tesla fails to meet the criteria necessary to classify its entry as a disruptive innovation (2015e).

More recent scholarly literature has taken increasing care to clarify references to innovation types through explicit definition (e.g., Govindarajan, Kopalle, and Danneels 2011, Pinkse, Bohnsack, and Kolk 2014). Much of the literature often overlooked these distinctions. As a consequence, disruptive innovation is a term occasionally used in circumstances that all too often either lack these features or in which their presence cannot yet be conclusively determined. Markides (2006) warns, "Lumping all types of disruptive innovations into one category simply mixes apples with oranges" (p. 1), thus confounding efforts within and across disciplines to build on this body of knowledge (Garcia and Calantone 2002, Markides 2006, Danneels 2004).

Also missing is a discussion of other co-evolving complementary technologies and the potential enabling characteristics these confer in combination with the innovation in question. According to UC Davis Business School Professor Andrew Hargadon,

> *Complementary technologies are co-evolving, and this is largely why disruption is not a label applied to a single company or technology a priori — it is the emergence of a new network of technologies, companies, and policies that disrupt. In the end, scholars should not label an input (an emerging technology, business model, etc.) with language for describing outcomes. Nothing is disruptive until it disrupts* (Hargadon 2015).

Moore's (1991) definition of discontinuous innovation is less restrictive, instead highlighting two essential product features unique to high-tech products: (1) It entails a change in the current mode of behavior, and (2) it requires new or highly modified support infrastructure that customers must rely on (p. 10). These features distinguish it from incremental innovations that are supported by, and sustain, the existing knowledge base, business model and supporting infrastructure. **The research adopts this definition for the purpose of the study.**

Given this definition, PEVs represent a discontinuous form of innovation. That is, they entail changes in modes of consumer behavior and new infrastructure on which customers rely. Earlier sections described how PEVs involve unique attributes in the sense that they are also systemic (requiring coordinated action by multiple actors) and socially-embedded (tied to the institutional fabric of everyday living). There is, however, another property of PEVs that could potentially affect successful commercialization. **Innovation relates to a particular component – the powertrain, which allows for changes in the product's architecture while leaving**

components, and the core design concepts they embody, in tact. Henderson and Clark (1990) dubbed these *architectural innovations* and noted that established firms often fail to recognize the nature of the competitive threat such innovations present. This is because dominant firms can typically accommodate such innovations within existing frameworks, at least initially.

A new or significantly changed component can enable reconfigurations that focuses attention on new component interactions affecting product performance while preserving the nature and function of other core components of the product (ibid.). **These new linkages and interrelations can unleash new sources of value for consumers.** Batteries for PEVs, for example, can be placed at the floor pan level, freeing up space under the hood for additional cargo and lowering the center of gravity to enhance stability. New architectures, however, present challenges for incumbent firms in mature industries, especially where capital and tooling costs are high. Since organizational processes are routinized around stable incumbent designs, dominant firms may opt instead to integrate new components within existing architectures. **Consequently, potentially new sources of value made possible through reconfiguration may go unrealized. By extension, dominant firms may similarly leverage existing channels of market access to deliver the product to consumers. These channels may or may not be well suited to the task.** The marketing literature reviewed in the next section elaborates on this concern.

3.6.2 The Contingency Theory of High-Technology Marketing

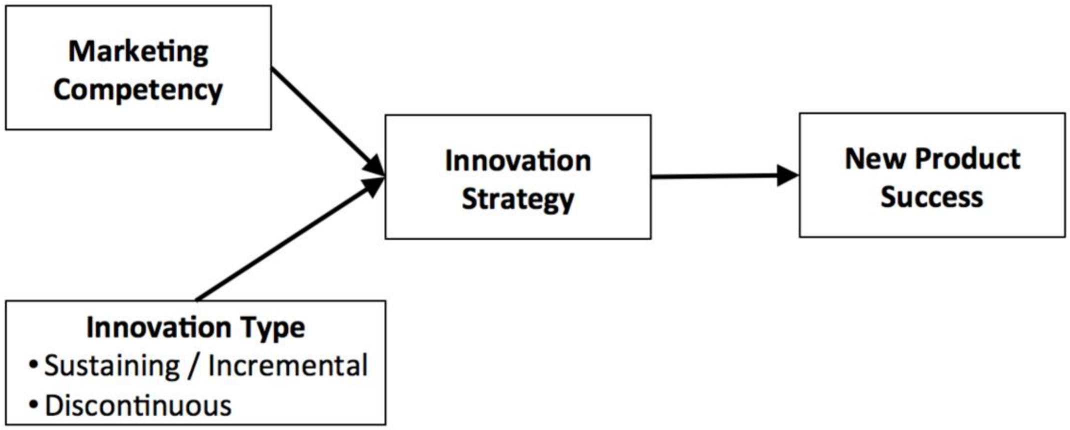
A growing body of literature posits that different forms of innovation call for different product introduction strategies (Olson, Slater, and Hult 2005, Slater and Mohr 2006, Vorhies and Morgan 2003). These strategies are alternately referred to as firm strategy or the firm's business model. Afuah (2004) defines a business model as the set of activities a firm engages in, the resources it leverages, and how and when it performs the activities to create low-cost or differentiated customer value and to position itself to appropriate that value (i.e. to capture rents). Other researchers decompose the firm's business model as constituting three fundamental elements: (1) the value proposition or offering; (2) the value chain configuration, which describes the arrangement of entities responsible for delivering elements of the value proposition; and (3) the revenue model, which describes how the value offering is converted into firm revenues (Timmers 1998, Kley et al. 2011). A firm's marketing function may play a role in any one or combination of these three components of product strategy (Mohr et al. 2013).

According to Olson et al. (2005), **"superior performance is contingent on how well the structure and behavior" of a firm "are aligned with the requirements of a specific strategy"** (p. 50). In their study of the trucking industry, Vorhies and Morgan (2003) found that firm success with introducing innovations is predicated on alignment of the marketing function with a business strategy appropriate to the innovation type. Moreover, this finding was generalizable across a broader spectrum of industries.

Resource-based theory holds that firm-specific assets such as culture, organization and core competence are key determinants of firm performance in bringing innovations to market (Barney 1991). Afuah and Utterback (1997) describe two divergent views on the theory of firm strategy: (1) A *product-market position view*, which holds that a firm's profitability depends on the attractiveness of the industry in which the firm competes, its positioning in the industry, and its local environment (Porter 1990, 1991, 1997); and (2) the *resource-based view*, in which a firm earns profits from having competencies and firm-specific assets that are scarce and difficult to replicate (Rumelt 1997, Teece 1984). But these skill bases are not necessarily fixed, and **competencies once useful for exploiting certain markets may be rendered obsolete by structural changes such as deregulation or technological discontinuities** (Tushman and Anderson 1986, Henderson and Clark 1990).

'Dynamic capabilities' theory is a more recent extension of the resource-based perspective (Morgan, Vorhies, and Mason 2009). It addresses how firms adapt to changing market conditions and gain competitive advantage by developing new internal competencies (e.g., Newbert 2007, Priem and Butler 2001). These competencies are best described as the ability to reconfigure available resources in new and different ways to implement appropriate strategies (e.g., Teece, Pisano, and Shuen 1997). Two inter-related and complementary firm capabilities matter most to firm performance with respect to innovation: (1) It's market orientation (or 'know-what' knowledge resources), and (2) it's 'know-how' deployment competencies (e.g., Olson et al. 2005).

The contingency theory of high-tech marketing applies this concept to the specific intersection of internal marketing competencies and business strategy for high technology products. It states that the ability of firms to develop new knowledge and reconfigure available resources to conceive and match an appropriate strategy to the innovation type affects both innovation and competitive performance. In other words, **innovation performance is tied to how well firms organize structurally and behaviorally to recognize and respond to different innovations with a strategy well matched for that innovation type** (Olson, Slater, and Hult 2005). Figure 3-3 depicts the basic structure of the relationship at the firm level.



(Adapted from Mohr et al. 2013)

Figure 3-3. The Contingency Theory of High-Tech Marketing: Relational diagram between marketing competency, innovation type and innovation strategy on new product success.

Resource-based theory would hold that the capacity of a firm to conceive and execute appropriate marketing strategies depends on the company's existing competency base. In other words, a firm's attitude toward innovation (or strategic posture) is highly influenced by how the firm is currently organized and the strategic approach to innovation the firm has historically cultivated. This strategic frame is based off of previous decisions to pursue particular forms of innovation best suited to a firm's particular market. **Thus, organizational skill sets that were appropriate for commercializing some types of technological innovations may not be well suited to other types** (Slater and Mohr 2006).

This phenomenon can result in a certain degree of strategic 'myopia' when new innovation threats emerge (Christensen 1997, Christensen and Raynor 2003, Foster 1985, Henderson and Clark 1990). Therefore, **a firm that historically pursues incremental**

innovation to serve its core market, for example, may lack the competencies needed to respond to other forms of innovations introduced by competitors (e.g., discontinuous or architectural forms of innovation). A possible outcome of this dynamic is that firms may respond to the discontinuous innovation using the very same resources, knowledge base and strategies used to introduce incremental product advancements to core customers (ibid.). Put another way, "to a hammer, everything is a nail".

Miles et al. (1978) described the complex differences in the structural/behavioral posture of firms toward innovation using a market-orientation typology that places firms in one of three camps: prospectors, analyzers, or defenders.

Prospectors are firms that take a technology leadership position and are organized to develop innovative new products and to enter new markets. This requires cross-functional cooperation amongst specialists who are given substantial latitude from rules and policies to pursue creative solutions. To do so, prospectors focus on observing how customers use products in normal routines and work closely with lead users and innovators (the first customer segment to adopt who recognize and can articulate needs. Prospectors search outside the firm for insight and expertise, often across technologies and industries. They also conduct experiments to learn via trial and error in order to inform and adjust go-to-market approaches (Lynn, Morone, and Paulson 1996). In sum, prospector's use of a large number of specialists operating in a decentralized, informal organizational structure in which knowledge is gained through observation of lead users and innovators and where experimentation (and failure) is more tolerated. They are the most market-oriented of the strategic types (Conant, Mokwa, and

Varadarajan 1990, McDaniel and Kolari 1987, McKee, Varadarajan, and Pride 1989, Slater and Olson 2001).

Analyzers are fast followers focused on introducing improved or less expensive products introduced by prospectors while defending core markets and products. Analyzers operate in both dynamic and stable areas of the business, relying on a hybrid of more formal, centralized rules and process adherence alongside specialists housed in more informal and decentralized structures. The process of defending the core business, however, creates inherent tension between the dual but often contradictory goals of meeting the needs of existing customers while keeping pace with developments instigated by prospectors (Miles and Snow 1978, 78). This dual purpose, however, involves a deliberate trade-off: an Analyzer "can never be completely efficient nor completely effective" (p. 80).

Defenders focus on providing quality products at the lowest cost. They trade the effectiveness afforded by marketing flexibility for efficiency through standardized rules and practices. These organizations rely on centralized and formal marketing structures to minimize costs (Ruekert, Walker Jr, and Roering 1985, Walker Jr and Ruekert 1987). Olson et al. (2005) further argue that defenders have both a competitor-orientation in addition to cost, since competitors serve as the benchmark against which prices, costs, and performance can be compared.

A firm's organizational posture toward innovation affects its ability to respond to innovation threats via an appropriate marketing strategy (Vorhies and Morgan 2003, Olson et al. 2005). The contingency approach to marketing strategy is rooted in systems perspectives that view the firm as a social system composed of interdependent subsystems that are coordinated by business policies and practices. These in turn interact with the business environment to achieve an objective (Luthans and Stewart 1977, Zeithaml, "Rajan" Varadarajan, and Zeithaml 1988). Moore's (2014), Christensen's (1997), and Christensen and Raynor's (2003) guidance for firm strategy finds its origins in the contingency model for marketing of high-technology products. This model aligns with 'dynamic capabilities' theory in that it presupposes firms may cultivate competencies in keeping with changing market conditions. This better enables firms to match an appropriate market strategy to different innovation types.

Moore (1991) popularized the notion that *high-tech* products require distinct marketing strategies to be successful. As discussed in the previous section, Moore's focus was on products in high-tech industries that are based on discontinuous forms of innovation. Moore specifically defines market-disrupting innovation as those that require a change in the current mode of behavior or that require modifications in complementary products and services that customers rely on (2013, p. 13). "In all these cases, the innovation demands significant changes by not only the consumer but also the infrastructure of supporting businesses that provide complementary products and services to round out the complete offer" (ibid**.). A fundamental discriminator of these technologies is the relatively high degree of uncertainty they introduce into the customer purchase decision. This is because risk extends beyond the product to uncertainties associated with ongoing support that might prevent customers from realizing the full value of the purchase** (Moore, 1991).

Moore's findings are built on the Technology Adoption Life Cycle model in which successful innovations are taken up in sequential and predictable stages by increasingly risk-averse customer groups along a bell-shaped curve (Rogers 1995). Each stage is associated with adoption by a population sub-group (segment) with a distinct demographic and psychological profile (the combination of which are often referred to as a segment's *psychographic* profile). The normal, bell-shaped distribution curve is widely accepted and confirmed by research using the Bass model of diffusion (Mahajan, Muller, and Bass 1990). **For new products, diffusion of innovation theory underscores five key product characteristics upon which the success of innovation rests: relative advantage (the value-price offering relative to the technology it seeks to displace); compatibility with existing values and practices; simplicity or ease of use; trialability (customers gain exposure to the product with minimal commitment); and observable results (customers must see the product or it's benefits).**

Moore (1991) built on the work of Rogers, revising the diffusion model by delineating a gap or *chasm* between the early and mainstream customer groups that interrupts the smooth progression of diffusion from the former to the latter category (Figure 3-4). Moore (1991) argues that **companies introducing discontinuous new products should first establish a beachhead in the mainstream market by launching a product that meets the needs of niche customers, generates word of mouth, and most importantly discovers the end-to-end needs of customers. The purpose is to establish a position of market leadership prior to launching a broader assault on mainstream customer segments.**

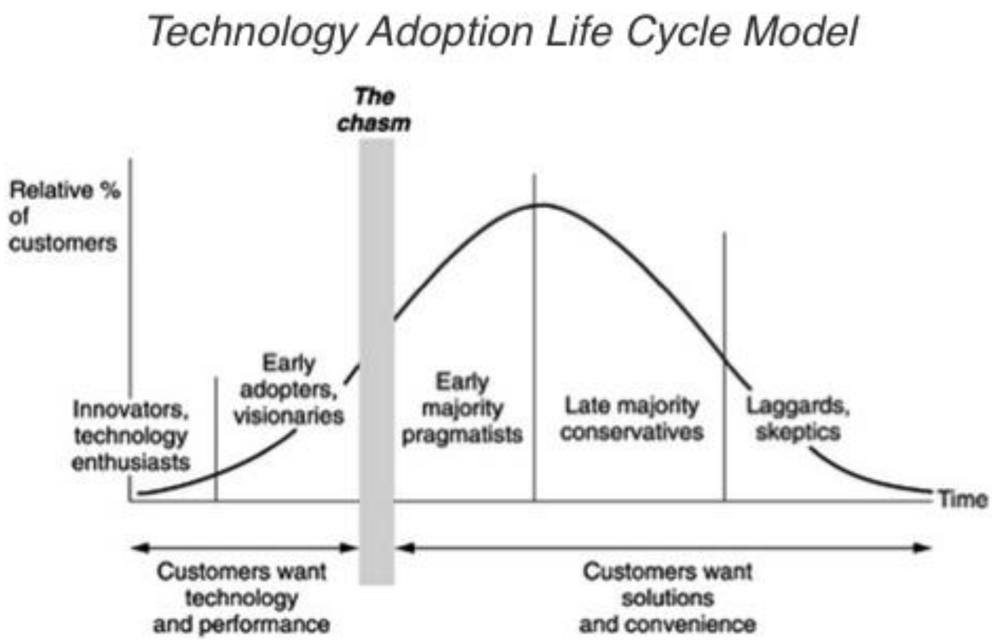


Figure 3-4. Moore's (1991) Revised Technology Adoption Life Cycle curve emphasizing the gap between early and main market customer segments.

Though Moore's work detailed the diffusion of innovation in business-to-business contexts, similar phenomena mark business-to-customer exchanges. An extensive examination of the consumer electronics industry by (Goldenberg, Libai, and Muller 2002) provided empirical evidence of a chasm or 'saddle' that is generalizable across industry boundaries. The "saddle effect" refers to a pattern of sales characterized by an initial peak, then a trough followed by sales that exceed the initial peak. **This pattern is associated with a bifurcation of the market between early and mainstream customers that fundamentally behave as two independent markets. Each references other customers within their respective market more than between, and adopt at different rates and based on different product attributes** (ibid.).

When contending with discontinuous high-tech innovations, the critical determinants of success are the initial market or customer segment(s) that the company

chooses to pursue, the tools it uses, and the organizational channels it employs to gather market data and influence customer decisions (Moore 1991, 2014, Olson et al. 2005, Mohr et al. 2013). Moore (1991) identified the inherent difficulty innovative high-tech products face when moving from early to mainstream customer segments as a problem of marketing that can be overcome with differentiated strategy. Moore argues, for example, that **for high-tech discontinuous products, the traditional *sales-driven* approach of mass-market strategies should be avoided in favor of a *market-driven* strategy focused on establishing a niche market**.

According to Moore, **creating demand and discovering and assuring the end-to-end support needs of customers should be the central focus when introducing a discontinuous new high-tech product. A niche market strategy is best suited for this purpose.** It enables enterprises to focus product support so that it can "efficiently develop a solid base of references, collateral, and internal procedures and documentation by virtue of a restricted set of market variables" (p. 66). Moreover, because a niche market is more tightly bounded than a mainstream market, "it is easier to create and introduce messages into it, and the faster these messages travel by word of mouth" (ibid.). Numerous studies of the buying process in high tech markets show that word-of-mouth is the number one source of information buyers reference; strong word-of-mouth reputation is therefore essential for breaking into new markets (e.g., Moore 2014, Goldenberg, Libai, and Muller 2002, Mohr, Sengupta, and Slater 2013).

Secondly, **reaching mass-market customers is predicated by having first established the ability to meet the end-to-end support needs of mainstream customers**. These customers are more risk-averse and pragmatic then early customers. They will expect the complete set of products and services to meet their needs and they will reference others within their segment (Moore 1991, Goldenberg, Libai, and Muller 2002). Going straight to the mass market without having first established a niche market with early customers is like “trying to start a fire without kindling” (Moore 1991, 67). A critical competence derived from early market learning and leveraged to drive main market adoption is the creation of a complete, end-to-end “whole product” solution that meets the needs of mainstream customers. Moore describes the “whole product” concept as an all-encompassing design approach that incorporates the customer’s purchase and post-purchase experience alongside customary product-specific considerations such as features and performance.

Consistent with Christensen’s concept of the ‘innovator’s dilemma’, a firm’s strategic posture results in different capabilities and resources that position them to better target different market segments (Slater et al. 2005, Slater and Olson 2001). **Innovation performance is based in part by the match between target market selection and the strategy employed to reach it** (Slater and Mohr 2006). Slater et al. (2005) investigated performance of firms introducing high-tech products based on targeting adopter segments by strategy type. For prospectors, they found a positive relationship between targeting the early customer segments (innovators, early adopters) and performance, and a negative relationship between the mainstream segments and performance.

Shifting the firm’s customer orientation is central for established firms contending with discontinuous innovation. Slater and Narver (1998) argue that "market-oriented” businesses can avoid the innovator's dilemma by being committed to understand both the expressed and latent needs of their customers through the processes of acquiring and evaluating market information in a systematic and proactive manner and to continuously creating superior customer value" (p. 30). Research by Govindarajan and Kopalle (2004) established that a focus on emerging customer segments rather than on mainstream customer segments is a predictor of new discontinuous product success. Additional research by Atuahene- Gima, Slater, and Olson (2005) and Narver et al. (2004) show that a proactive, market-oriented posture is more strongly associated with new product success than a posture focused on the expressed needs of existing customers only (i.e. "customer-led"). Importantly, these activities are not mutually exclusive; cultivating an emerging customer orientation ('market-led') alongside a mainstream customer orientation ('customer led') can coexist within firms (Narver et al. 2004). The root causes of the innovator's dilemma, as stated by Slater and Mohr (2006), is the 'tyranny of the served market' and the organizational rigidities of analyzer and defender firms.

Prospectors often struggle to reach mainstream customers to successfully commercialize innovation. This finding supports the notion of a chasm between early and mainstream customer segments. In contrast, Slater et al. (2005) reached the opposite conclusion for firms using an analyzer strategy. For analyzers, they noted a positive relationship between targeting the early adopter and early majority segments and performance, and a negative relationship between targeting the innovator segment and performance. The finding suggests that the challenge for market share leaders lies not only in creating solutions that innovators value, but also in creating a niche upon which to build a solid base of support infrastructure, collateral and procedures, and upon which to introduce differentiated messaging that stokes word-of-mouth effects (ibid.).

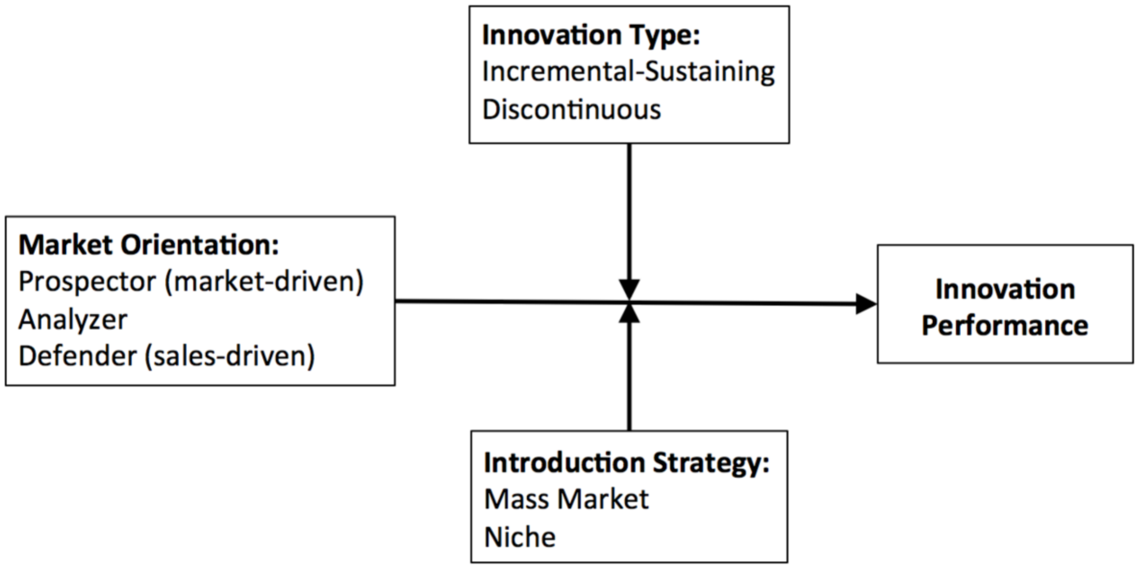
Market share leaders tend to excel at targeting early and late majority segments, representing the bulk of customer demand (approximately two-thirds of the market).

Consequently, market leaders tend to fit the analyzer and defender profiles discussed previously (Slater and Mohr 2006). These profiles possess the marketing and operational competencies needed to succeed in those segments (Slater and Olson 2001, Slater, Hult, and Olson 2005), "but these market leaders are largely unsuccessful when attempting to introduce innovations into niche markets" (p. 29). This is because defenders tend to be cost-oriented and risk-averse while analyzers attempt a balance between cost and customer-orientation (i.e. between efficiency and effectiveness). Consequently, analyzers tend to err on the side of incremental innovation and the market introduction pathways suited for such innovations. The implication is that in instances when prospectors introduce a discontinuous, and potentially disruptive innovation, analyzers must develop new and often contradictory competencies to compete effectively (and thus avoid the innovator's dilemma).

For established leaders, according to Slater and Mohr (2006), developing the market competencies to successfully reach early customer segments is critical but not the only element of success:

> *Not only does the firm need to conceptualize and develop the innovation in the first place; it must also be successful in reaching more than just a niche market of innovators-early adopters. In other words, it must overcome the innovator's dilemma as well as cross the chasm.* (p. 31)

For prospectors, the central challenge is in developing the marketing competencies to cross the chasm and the infrastructure to reach mainstream segments with a clearly differentiated value proposition (Rogers 1995) **and appropriate distribution channel** (Moore 2014, Slater and Olson 2001). Figure 3-5 illustrates the interaction of target market, adopter segmentation, market-orientation and strategy on innovation performance.



(Adapted from Slater & Mohr, 2006)

Figure 3-5. Firm Competency and the Contingency Theory of High-Technology Marketing.

Afuah and Utterback (1997) argue that in times of technological upheaval, technology evolves as the actors exploiting it interact. Hence, competencies once useful in exploiting certain markets may be rendered obsolete by structural changes such as deregulation or technological discontinuities (p. 184). **Moreover, capabilities useful in one stage of technological evolution may be less so in a subsequent stage.** Afuah (2001) argues that firms should develop competencies in dynamically reorganizing functions and partners to better contend with shifts in technology or to enable systemic change. **This may be achieved through vertical integration with new members of the value chain and disintegration from existing ones.**

Moore (1991) **maintains that a firm's ability to interact with partners in the innovation source chain becomes a key factor in successful technology commercialization. Developing a "whole product" solution for mainstream customers requires firms to develop**

internal competencies or to partner with other actors to ensure compatibility across elements of the end-to-end solution (also Mohr et al. 2013, 246). **The objective is to de-burden the more pragmatic customer from the complexities that stand between them and realizing the full benefits of the innovation.**

According to Moore (1991), **distribution channel strategy and pricing play a determining role in the success of new discontinuous products. Of foremost importance, is a path to mass-market customers that meets their needs. Secondarily, pricing must motivate the channel** (p. 164). Channels are optimized for different purposes and can be categorized as *demand creators* or *demand fulfillers*. Direct sales forces are an example of the former, whereas retail superstores is an example of the latter. **Channels optimized for high volume delivery are ineffective for development of an end-to-end solution** (e.g., Moore 1991, Olson and Slater 2005, Vorhies and Morgan 2003). Moore contends that **all else equal, direct sales is the preferred alternative for introducing discontinuous new products to market. This is because it confers maximum control over the customer experience, can be optimized to create demand, and can support the end-to-end needs of customers.**

Retail outlets, on the other hand, are best suited for well-institutionalized products in mature markets where customers value access to a broad selection of products at the lowest possible price and where access to credit is needed. Moore maintains that **retail outlets are structurally unsuited to 'cross the chasm' from early to mainstream customers because they do not create demand, nor do they develop whole products (p. 172). However, other avenues are not always available to producers. Hence, it is incumbent on manufacturers to de-burden the channel from the pressures of developing a 'whole product' solution so that**

resources are freed to fulfill demand for the product. In such cases, firms may employ an intermediate distribution approach, which could include leveraging techniques from direct sales to supplement the existing channel during the transition. Dedicated retail outlets (e.g., Bose, Smith & Hawkins, Apple) can help drive new brands into the market but have witnessed varying degrees of success. In the end, according to Moore, "retail simply cannot sponsor discontinuous innovations because they require the channel to spend a disproportionate, and ultimately unproductive, amount of time on something that gives too low a rate of return" (p. 173).

3.7 Summary

This chapter surveyed the technological transitions and management sciences literatures for insights on the nature of innovation and the unique challenges firms face bringing certain types of innovation to market. It also offered several frameworks for guiding the investigation. Broadly, the innovation systems perspective offers a useful lens through which to examine how producers and downstream actors (e.g., dealers and customers) shepherd innovative new products to market. It further directs the focus of the investigation toward the behavior of, and interaction between, system actors and the learning networks and institutional settings affecting their behavior. Tables 3-3 through 3-5 catalogs key insights from the literature survey and how these influenced the direction of the research. For example, this study adopts a principal tenet of TIS that directs the effort toward identifying the emergence of inducing or blocking dynamics that affect system performance (i.e., PEV market growth) at a given level of analysis (e.g., at the retail level). It further embraces the centrality of niche creation as a pathway by which discontinuous, systemic and socially-embedded innovations like PEVs can reach both early and mainstream customers. Moreover, it directs the investigation toward differences in distribution channel strategy and keying on alignment of actor interests within these strategies.

Table 3-3. Summary of select insights from the review of the systems of innovation and sustainability transitions literatures.

Research Strand	Sub-strand	Select Insights	Source(s)	How Applicable to PEV Research?
Systems of Innovation		Pre-existing institutional structures play an influential role in shaping the course of innovation activities, especially during periods of greater technological instability	Hargadon & Douglas 2001, Coombs 2003, Dosi & Nelson 1994	Automakers rely on dealers to sell PEVs; does this influence how PEVs are brought to market?
		The goal of networks and learning is to reduce uncertainty	Freeman 1991	What uncertainty do dealers face? What learning processes reduce uncertainty?
Sustainability Transitions (Policy)	SSI	Distinguishes between innovation, production and distribution-market levels of analysis	Malerba 2002	Provides context for examining distribution pathways
	TIS	Useful for conducting actor-oriented analysis that ties micro-level (organizational) decision-making to meso-level system behavior	Markard & Truffer 2008	Provides context for investigating dealerships and tying behavior to retail-level dynamics
	TIS	Provides conceptual frame for systems-oriented innovation research with the goal of identifying inducing and blocking dynamics ("system failures") for policy intervention	Bergek 2008, Hekkert et al. 2007	Dissertation adopts concept of examining drivers and barriers affecting dealer participation in, and quality of, the PEV retail experience
	SNM	Focuses on the role of niche markets as a protective space for development of discontinuous innovations; public and private sector actors both have a role in creation of protective space	Kemp 1998, Schot & Geels 2008, Pinske et al. 2014	Are OEMs and dealers working to create a niche market? What is the role of policy in this regard?
		Low carbon vehicles are distinguished as discontinuous, systemic (requires coordinated action) and socially-embedded (affected by institutional rules, norms and values of both energy provision and mobility domains).	Pinske et al. 2014	These distinctions apply to PEVs. Investigate whether they affect the ability of channel partners to effectively retail PEVs
	SNM	For systemic innovations, reaching mainstream customers requires creating a new ecosystem of suppliers and complementors	Afuah 2000, Geels 2002 (see also Moore 1991)	How do OEMs and dealers determine what this ecosystem is? What is being done to create this ecosystem?
	SNM	Power dynamics among self-interested actors could affect niche development	Smith & Raven 2012, Coombs 2003	Consider alignment of OEM-dealer interests; do power dynamics interfere with cooperation needed for selling PEVs?
		"Interface Improvement" policies can enhance the innovative function of actors that lie between technology producers and end users; this includes addressing blockages to wider adoption while enhancing knowledge flows that help drive adoption	Taylor 2008	Consider what function(s) retailers of PEVs perform. What stands in the way of performing these functions?

* SSI = Sectoral Systems of Innovation, TIS = Technological Innovation Systems, SNM = Strategic Niche Management

Table 3-4. Summary of select insights from the review of the innovation management literature.

Research Strand	Select Insights	Source(s)	How Applicable to PEV Research?
Innovation Management	Disruptive innovation applies to two specific pathways whereby dominant firms are displaced by new entrants	Christensen & Bower 1995, Christensen 1997, Danneels 2004	Innovation that conflicts with distribution channels does not appear to fit the classic definition of "disruptive innovation"
	Defines discontinuous innovation in the marketing context: (1) It entails a change in the current mode of behavior, and (2) it requires new or highly modified support infrastructure that customers must rely on	Moore 1991	By this definition, PEVs represent a discontinuous form of innovation
	Defines architectural innovations as those that involve a new or changed component that allows for changes in the product's architecture while leaving other components, and the core design concepts they embody, in tact	Henderson & Clark 1990	By this definition, PEVs represent an architectural form of innovation. Consider whether this creates new sources of customer value. How do OEMs and dealers communicate this value?
	Architectural forms of innovation like PEVs may be difficult for incumbent firms to commercialize due to lock-in with pre-existing channels, structures and decision filters	Henderson & Clark 1990	As an architectural innovation form, automakers may leverage pre-existing distribution channels by default; consider potential conflicts with distribution partners
	For discontinuous innovations, firms must acquire new knowledge and competencies associated with the new technology and convert these into new products often with the help of value chain partners	Henderson & Clark 1990, Utterback 1994	Investigate how OEMs and dealers acquire new knowledge related to providing PEVs to customers. How are competencies developed? Is training specialized?

Table 3-5. Summary of select insights from the literature on high-technology marketing.

Research Strand	Sub-strand	Select Insights	Source(s)	How Applicable to PEV Research?
High-Technology Marketing	Contigency Theory	Different forms of innovation call for different product introduction strategies	Moore 1991, Vorhies & Morgan 2003, Olson, Slater & Holt 2005, Slater & Mohr 2006	May be the most relevant theory for PEVs. Do different distribution strategies affect retail performance?
	Contigency Theory	For high-tech discontinuous products, the traditional sales-driven approach of mass-market strategies should be avoided in favor of a market-driven strategy focused on establishing a niche market.	Moore 1991, Mohr, Sengupta & Slater 2013	Consider what aspects of mass-market strategies employed by automakers are at odds with sales of PEVs
		Successful introduction of discontinuous innovations relies on channels that can create demand and assure the end-to-end support needs of customers	Moore 1991	Do dealers contribute to demand creation? Are the needs of PEV customers different and if so, how are they being met?
	Contigency Theory	Success introducing innovation is is tied to how well firms organize structurally and behaviorally to recognize and respond to different innovations with a strategy well matched for that innovation type.	Olson, Slater & Holt 2005, Vorhies & Morgan 2003	For PEVs, success may extend beyond the firm to the structure of relations with distribution partners
	Diffusion of Innovation	Customer adoption of risky high-tech products occurs in sequential stages according to customer risk tolerance, demographics and psychological factors	Rogers 1976, 1995	Since sales of PEVs by dealers is voluntary, might adoption by dealers also follow this pattern?
	Diffusion of Innovation	Key to mainstream uptake of risky new technologies is relative advantage, compatibility with existing values and practices, simplicity and ease of use, trialability and readily observable results	Rogers 1995	These precepts may also hold for uptake of risky new technologies by intermediary firms (i.e., auto dealers)
	Diffusion of Innovation	High-tech markets often witness division between early and main markets in which each act as largely independent markets	Moore 1991, Goldenberg 2002	Automakers and dealers may need to develop new competencies to reach both markets
	Contigency Theory	Organizational skill sets that were appropriate for commercializing some types of technological innovations may not be well suited to other types	Slater & Mohr 2006	The skills OEMs and dealers developed for providing ICEs may or may not be appropriate for commercializing PEVs
	Contigency Theory	Since efficiency trumps effectiveness, reaching early market may be challenging for dominant firms	Vorhies & Morgan 2003, Slater & Mohr 2006	Consider that established automakers may choose dealers as most efficient path to PEV customers. But is it effective?
	Contigency Theory	Access to main market customers may be challenging for new entrant firms	Moore 1991, Slater & Mohr 2006	Entrant Tesla may face challenges reaching mainstream customers due to lack of established distribution infrastructure.
	Contigency Theory	Proposed "whole product" strategy involving extension of product design to distribution channel considerations	Moore 1991	Does incorporating distribution channel strategy into PEV design achieve higher retail performance?

4 Research Methods

The following chapter consists of a detailed description of the research methodology, including instrument(s), data collection, compilation and analyses. The researcher describes key terminology and variables in detail, as well as the procedures used to ensure valid data for answering the research questions. The researcher also elaborates the thematic analysis and statistical modeling approaches used to evaluate the research questions and hypotheses in this chapter.

Figure 4-1 lays out the research design. I used a novel mixed method approach (Jick 1979, Creswell 2014) in which I collect and analyze two distinct sets of data. The first is national 2013 survey data on retail satisfaction reported by new car buyers as part of the annual Sales Satisfaction Index (SSI) study conducted by global research firm J.D. Power. I initially analyze this data to address the first research question: *Do PEV buyers report differences in the quality of the dealer experience compared to ICEV buyers?* As a corollary to this question, I further assess how this result compares to the retail experience reported by buyers of PEVs from start-up Tesla Motors. Tesla Motors is distinct from other automakers in that it retails PEVs through a direct-to-customer model using factory-owned stores, service centers and charging infrastructure.

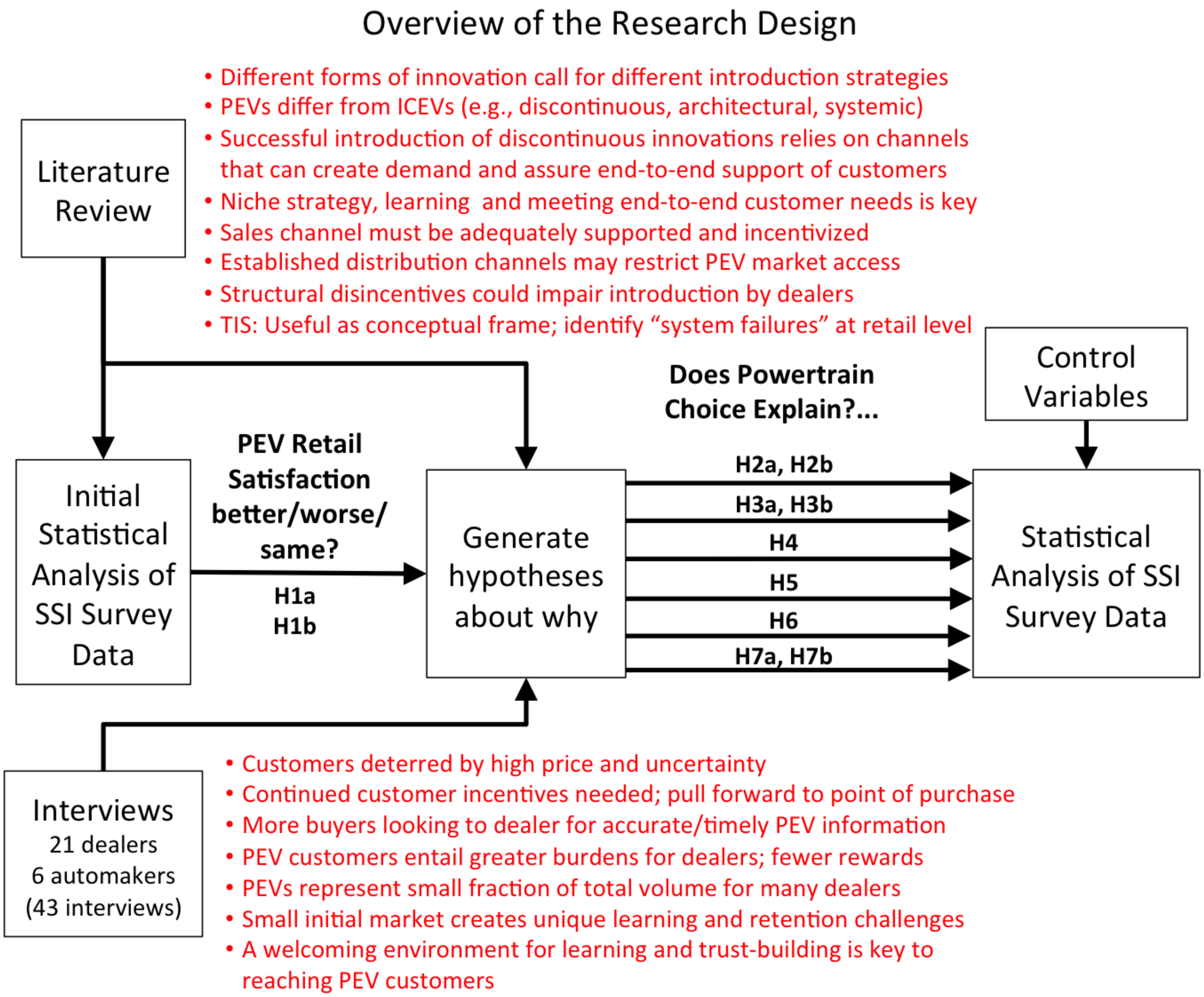


Figure 4-1. Overview of the research design.

Based on these initial findings (detailed in Chapter 7), I conducted 43 qualitative interviews with automakers (Tesla included) and new car dealers to explore various factors that might contribute to observed disparities in retail quality delivery. These interviews inform the development of hypotheses related to these factors. I then developed models to test these hypotheses statistically leveraging the SSI survey data. This approach inherently provides some convergent validity for the research by seeking information on a topic area from multiple sources. Incorporating qualitative interview data also provides a “bottom up” approach to building theory and testable propositions related to a problem where little information is currently available (Eisenhardt 1989).

4.1 Dataset #1: Interview Data

Research Design

A key component of the research consisted of interviews with automaker representatives, dealer principals (owners or general managers of retail distributors) and sales staff sampled from a cross-section of California-based new car dealerships and retail stores. A grant from the California Energy Commission funded interviews in the state’s major PEV markets. These included the Bay Area and the greater Sacramento, Los Angeles, and San Diego metro regions.

Sampling was intended to cover key dealer attributes (principally market area, manufacturer representation and PEV volume) and influences that might impact dealer participation in, and success with, PEV sales. This included dealers in metro and suburban areas with at least six months of experience selling PEVs. As a cooperating partner in the study, the California New Car Dealers Association (CNCDA) connected the research team with executive-level contacts at dealerships that matched the criteria specified. Whenever possible, the researchers selected dealers representing a make for a given area in the top quartile of PEV sales and one dealer representing the same make(s) outside this top quartile.

The research team developed an interview protocol that described steps for preparing, conducting and documenting the data collected during the interview sessions. Interview protocols, including topics and potential questions, were developed for each interview population and included dealer principals, salespeople, and senior-level automaker representatives with experience in PEV-related commercialization efforts. The protocol served as a general guide to ensure coverage of key topic areas and a degree of consistency among interview populations. Interviews were semi-structured to allow both interviewer and interviewee to explore topics that might emerge organically during the conversation. A copy of the protocol document is provided in Appendix A: Interview Protocols.

Whenever possible, interviews were conducted by two researchers in the form of in-person meetings with the owner or general manager at the dealer facility, followed separately by a member of the sales team. Interviews typically lasted between one to two hours, and were guided by a set of specific topic areas. For example, the interviewee's history in sales and with the dealership; retail organization, training and practices; motivations for selling PEVs; up-front requirements and incentives; attitudes toward new technologies; and perceptions about barriers, opportunities, and incentive programs for PEVs (see Appendix A). Interviews were typically followed by a tour of the dealer's facility. Photographs and other marketing materials were also collected during these visits.

The interview team reconvened after each session to discuss preliminary themes and to consider whether questions should be eliminated, modified, added, or emphasized. Interview recordings were transcribed electronically and then imported into QSR NVivo, a software package that provides a robust toolset for management, coding and analysis of qualitative research data (Bazeley and Jackson 2013).

To identify themes in the data, the research team employed a three-step coding process that included open (or semantic) coding on the first reading to surface and assign initial codes, axial (or thematic) coding to review and examine initial codes, and selective coding to locate illustrative examples of identified themes (Neuman and Kreuger 2003, Braun and Clarke 2006). The research team divided into groups to review assigned transcripts and compiled a summary. The team reconvened as one body to review each of the summaries to surface initial themes representing common ideas, experiences, and perceptions across interviews (Braun and Clarke 2006). Observations are drawn from a total of 43 interviews, including six from OEM representatives with specialized knowledge in marketing and retail strategy for advanced vehicles, and 38 dealer interviews from 20 retail site visits. A list of the retail outlets (stripped of their identifiers) mapped against the selection criteria is provided in Appendix B.

4.2 Dataset #2: Customer Retail Satisfaction Survey Data

The researcher analyzed survey data provided by global market research firm J.D. Power and Associates. J.D. Power surveys U.S. customers about their purchase experience as part of the annual *Sales Satisfaction Index (SSI)* study. Data consists of a nationwide survey of new car buyers who purchased a light-duty vehicle for private use from dealers selling models from 54 different original equipment manufacturers (OEMs). The objective of examining this data is to determine whether PEV buyers report differences in retail quality as measured by retail satisfaction. The researcher then tests hypotheses developed from interview insights on the survey data. J.D. Power coded the data so as to enable the researcher to distinguish between data from buyers of PEVs as opposed to conventional ICE vehicles.

The objective of J.D. Power's annual *SSI Study* is two-fold. The first is to create a mechanism for clear feedback and rewards for dealers to improve brand performance related to customer satisfaction. The second is to provide a tool for informed discourse between automakers and dealers on the subject of customer perceptions, choices and behaviors that could influence vehicle sales. Since its inception in 1987, the *SSI Study* has served as a key gauge of retail performance based on customer satisfaction with new car dealers. Today, it is widely used as an industry benchmark for dealer performance. Standard practice has evolved such that automakers now incorporate performance-based measures of retail satisfaction as a basis for compensation and bonus payouts to dealerships and individual sales staff. The SSI Study provides the single largest and comprehensive database for investigating factors influencing the customer's assessment of the quality of the retail experience when purchasing a new car.

4.2.1 Research Instrument, Sampling Plan and Methodology

A detailed description of the survey instrument and sampling methodology is available from J.D. Power & Associates and referenced in this work (2013b). An overview is provided here for context.

The *2013 SSI Study* employed an inferential statistical design to investigate the population of new vehicle buyers nationally. The sample was obtained from new vehicle registrations collected by market research firm IHS/Polk, as well as retail delivery records from select makes. Respondents in this study include owners of new model-year (MY) 2012 through

2014 light duty vehicles bought (or leased) for private use and registered between April and May of 2013. The data included feedback from 29,040 respondents, representing a 13.5% response rate (2013b).

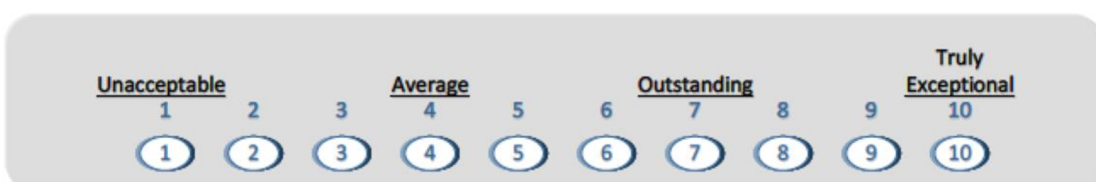
The sample for each model year was randomly selected to approximate the national mix of new light-duty vehicles sold by each manufacturer during the sample period. All response data was then weighted to reflect the actual sales volume for each make and model. This allows J.D. Power to use the SSI value as an index upon which to compare the quality of retail delivery among automakers. Each random survey represented an independent sample. Hence, the unit of measure was at the individual buyer level. The researcher had no control over the selection of respondents, the choice of vehicles purchased (or leased), or the dealerships or retail facilities customers chose to visit. The data includes participants residing in all 50 U.S. states.

An oft-encountered issue in social science research is the generalizability of empirical research results beyond the sample population (Berk and Freedman 2010). The sampling procedure, however, and relatively large number of respondents used for this study, allow for inferences at the population level. Moreover, the data contained a sufficient sample size that met requirements to evaluate relationships between the response variables and the independent variables using a linear mixed effects modeling (LME) approach (White 2009). The researcher details the LME method used in the analysis later in this chapter.

J.D. Power derives the SSI score from a weighted composite of ratings compiled from new vehicle buyers and "rejecters". The survey defines *rejecters* as new vehicle buyers who shopped a particular make or dealer but ultimately rejected in favor of a different make or dealer. The Buyer Index (BI) results from the aggregated scores of new car buyers. The Rejecter Index (RI) results from the aggregated scores of rejecters. Each receives a 50% weighting to arrive at the SSI score. All derived scores (SSI, BI and RI) are presented on a 1,000-point scale.

Because the survey as designed collected data at the make level, the researcher lacked a mechanism for determining whether a buyer rejected a plug-in or a conventional vehicle (the notable exception here is Tesla Motors, whose sole product is an electric vehicle). Hence, the findings presented in this dissertation consist of buyer responses only. Since the analysis relies solely on buyer data, SSI is synonymous with the Buyer Index (BI) score detailed in the *SSI Study Methodology* document (2013b). Rejecter data, had it been included, would have resulted in lower retail satisfaction scores. The findings presented in this dissertation thus overestimate retail satisfaction reported by new car customers and can thus be considered a conservative estimate.

This study analyzes retail performance using the unweighted raw buyer satisfaction scores as rated by respondents. This affords a direct, rather than derived, measure of customer satisfaction. The survey presents these ratings on a four-anchor, 10-point response (Likert) scale (Figure 4-2).



Source: J.D. Power & Associates

Figure 4-2. Response Scale for the 2013 SSI Study.

The survey assessed four distinct components of the new car purchase experience at the selling dealership: The facility (including inventory), the salesperson, 'working out the deal' and the vehicle delivery process (see Appendix C). Questions probe 17 different attributes of the new car buying experience, including factors influencing choice of make, model and dealer, time spent at the retail facility, salesperson and dealer staff performance, details on vehicle delivery performance, and customer demographic profiles (2013b).

J.D. Power distinguishes between premium and non-premium makes in its annual rankings. This is because sales processes, as well as customer expectations, may differ significantly between these segments. A make is classified as belonging to the premium category when more than 50% of model sales are in the premium segment. Conversely, a make is classified as non-premium when more than 50% of sales are in the non-premium segment (2013b). Appendix D provides a comprehensive list of makes and their respective categorization. The 2013 SSI Study captured all 12 PEV models offered for sale to the general public in 2013 by eight vehicle manufacturers (Table 4-1). Of these, the study categorizes only Tesla Motors as belonging to the premium segment. Because J.D. Power coded the data so as to distinguish between buyers of PEVs and conventional vehicles, it was possible to assess performance reported by these two populations.

Table 4-1. Plug-in Electric Vehicles included in the 2013 SSI Study by manufacturer.

Manufacturer	Make	Model	Type
Daimler AG	Smart	Fortwo ED	BEV
Ford Motor Compamy	Ford	C-Max Energi	PHEV
Ford Motor Compamy	Ford	Fusion Energi	PHEV
Ford Motor Compamy	Ford	Focus EV	BEV
General Motors	Chevrolet	Volt	EREV (PHEV)
Honda Motor Company	Honda	Fit EV	BEV
Honda Motor Company	Honda	Accord PHEV	PHEV
Mitsubishi Motors	Mitsubishi	i-MiEV	BEV
Nissan Motor Co., Ltd.	Nissan	LEAF	BEV
Toyota Motor Corporation	Toyota	Prius Plug-in	PHEV
Toyota Motor Corporation	Toyota	RAV4 EV	BEV
Tesla Motors, Inc.	Tesla	Model S	BEV

Source: J.D. Power & Associates

The *2013 SSI Study* did not include PEV models from start-up manufacturers CODA Automotive and Fisker Automotive, nor did it include models introduced after the *2013 SSI Study* period such as the BMW i3, Cadillac ELR, Chevy Spark EV, or Fiat 500e. Collection of registration data is voluntary in the state of California and Tesla Motors declined to participate for strictly internal reasons. Consequently, the data includes responses from Tesla buyers residing in states outside California only.

4.2.2 Protection of Human Subjects

UC Davis' Institutional Review Board (IRB) exempted from review interviews conducted in connection with this dissertation (see Appendix E). Also, the source data supplied by J.D. Power shared no personally identifiable information. Hence, the privacy and confidentiality of buyers was not applicable in this study. Regardless, the researcher, as well as members of the research team, coded and secured data in adherence to policies. Vehicle identification numbers were used to code individual buyers, and no other personal identifiable information was present in the data sets.

4.2.3 Data Acquisition and Preparation

This study examined the *2013 SSI Study* data set provided by J.D. Power & Associates (November, 2013). Data were compiled and examined in multiple ways to ensure a robust evaluation. The researcher excluded responses with missing data from the study. One important assumption was that missing data were considered a random process and not associated with individual buyer demographic factors or other buyer characteristics. Results report the size of the resulting sub-sample used.

4.2.4 Research Questions

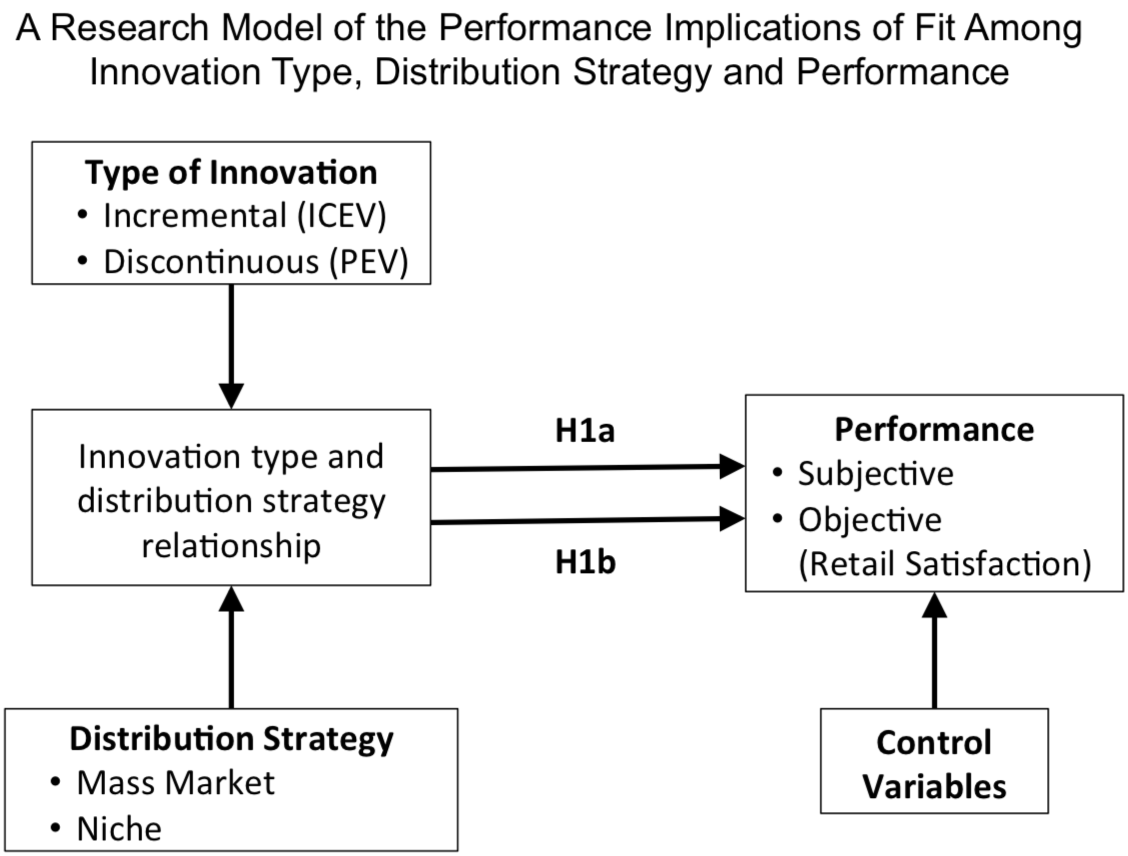
The literature review, in combination with interviews conducted by the researcher, provided insights on potential factors that could influence retail quality delivery for PEVs, as well as other variables of interest (e.g., incentives and disincentives potentially affecting delivery of a quality retail experience to PEV buyers). The researcher analyzed the *2013 SSI*

Study data to explore the effect of several of these factors (and their interaction) on key response variables. These included retail satisfaction, time spent at the retail facility by customers and other incentive-related characteristics of interest. These are grouped accordingly and described below.

Group 1: The researcher evaluated the following question relating to retail satisfaction:

1a *Does powertrain choice explain sources of variation in customer ratings of retail satisfaction with dealers?*

The contingency theory of high-tech marketing, reviewed in Chapter 3, suggests that channels used to deliver historically incremental forms of innovation to market may be less effective for introducing PEVs. As previously discussed, PEVs represent a more radical type of innovation in that they are discontinuous, architectural, systemic and socially-embedded. Given this, the researcher considered whether powertrain choice would explain variation in retail satisfaction. To examine this question the researcher proposed the research model illustrated in Figure 4-3.



(Adapted from Slater and Mohr 2006)

Figure 4-3. A research model for predicting retail performance based on innovation type and distribution strategy.

Established automakers introduced PEVs using existing mass market distribution channels (i.e., dealers). Hence, the researcher predicted that for non-premium makes, PEV buyers would rate dealers lower than ICEV buyers in retail satisfaction (H1a). Tesla Motors, on the other hand, used an innovation-specific distribution strategy featuring a direct-to-consumer model with factory-owned stores, service centers and charging infrastructure. Consequently, the researcher anticipated buyers of PEVs from premium makes (of which Tesla represents the sole offering) would report higher retail satisfaction than buyers of ICEVs from dealerships (H1b). To summarize:

H1a: *For **non-premium** makes, a difference in retail satisfaction with dealers exists between PEV and ICEV buyers.*

H1b: For **premium** makes, *a difference in retail satisfaction exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.*

Group 2: The second group of research questions examined the amount of time spent at the retail facility. Again, findings from the interviews inform the development of the hypotheses that follow. These included:

2a *Does powertrain choice explain sources of variation in the total time buyers spent at the retail facility?*

Interviews with dealers revealed a perception that most PEV purchases involve longer total transaction times (defined as the moment the customer enters the dealership to exiting the dealership after purchasing a new vehicle) than conventional vehicle purchases. For this reason, the researcher hypothesized a difference in total (and by stage of the buying process) transaction times between PEV buyers and ICEV buyers. More specifically, the researcher predicts that PEV buyers would report longer total and by stage transaction times than ICEV buyers. Because Tesla Motors relies predominantly on online sales and purchase transactions (and represents the sole premium PEV make during the study period), the researcher anticipated that PEV buyers would report shorter total and by stage transaction times than ICEV buyers. To summarize:

H2a: *For buyers of **non-premium** makes, a difference in total transaction time at the selling dealership exists between PEV and ICEV buyers.*

H2b: For buyers of **premium** makes, *a difference in total transaction time exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.*

2b *Does powertrain choice explain sources of variation in the time buyers spent at the retail facility during the vehicle delivery stage?*

The vast majority of dealers interviewed stated that for PEV buyers, they typically experienced a much longer time to execute the vehicle delivery stage. Hence, the researcher hypothesized that PEV buyers would report a longer vehicle delivery stage (after accounting for demographic factors). The researcher theorized this relationship would hold for both non-premium and premium makes. To summarize:

H3a: For buyers of **non-premium** makes, *a difference in the duration of vehicle delivery at the selling dealership exists between PEV and ICEV customers.*

H3b: For buyers of **premium** makes, a *difference in duration of the vehicle delivery stage exists between customers who bought a PEV direct distribution and customers who bought an ICEV through established dealers.*

Group 3: The third group of research questions examined several <u>other response variables</u> of interest. As with the previous groups of research questions, insights gleaned from interviews inform the development of the hypotheses put forward. These included:

3a *Does powertrain choice explain sources of variation in the percent of buyers who switched from a competing make (a.k.a. the percent of "conquest" buyers)?*

Several dealers indicated that because of limited availability, buyers of PEVs may be more likely to switch from a competing make in order to access the technology. A number of dealers also noted that many PEV customers are new to the brand. Therefore, the researcher hypothesized that for non-premium makes, a positive relationship exists between choice of a PEV and switching from a competing make (after accounting for demographic factors). To summarize:

H4: For buyers of **non-premium** makes, *a difference in the percentage of buyers representing conquest sales exists between PEV and ICEV customers who bought through established dealers.*

3b *Does powertrain choice explain sources of variation in the percent of buyers intending to return to the selling dealer for paid services?*

In interviews, dealers suggested that due to limited availability, more buyers likely travel outside local dealer territories convenient to their home or workplace to purchase a PEV. Moreover, dealers maintained that customers expect lower service and maintenance associated with PEVs, and especially BEVs. Therefore, the researcher posited a negative relationship between choice of a non-premium PEV and the percent of buyers intending to return to the selling dealer for paid services (after accounting for demographic factors). To summarize:

H5: For buyers of **non-premium** makes, *a difference in the customer's likelihood of returning to the selling dealer for paid services exists between PEV and ICEV customers who bought through established dealers.*

3c *Does powertrain choice explain sources of variation in the percent of buyers who reported that the dealer attempted to sell a vehicle the buyer did not want (a.k.a. "cross-selling")?*

Interviews revealed that many salespeople may be uncomfortable selling an unfamiliar technology like PEVs. Moreover, a 2014 Consumer Reports investigation suggested increased cross-selling associated with sales of PEVs (Evarts 2014). Due to potential lack of salesperson familiarity with the technology, the researcher posited that dealers would be more likely to cross-sell PEV buyers into a vehicle they did not want (after accounting for demographic factors). To summarize:

H6: For buyers of **non-premium** makes, *a difference in the percentage of reported cross-selling by dealers exists between PEV and ICEV customers who bought through established dealers*.

3d *Does powertrain choice explain sources of variation in the percent of new vehicle buyers intending to remain loyal to the make?*

For the same reasons stated in *1a*, the researcher hypothesized a negative relationship between non-premium PEV buyers and intended make loyalty. Conversely, the researcher anticipated a positive relationship between premium PEV buyers and intended make loyalty (after accounting for demographic factors). To summarize:

H7a: For buyers of **non-premium** makes through established dealers, *a difference in intended make loyalty exists between between PEV and ICEV buyers.*

H7b: For buyers of **premium** makes, *a difference in intended make loyalty exists between PEV buyers who bought through direct distribution and customers who bought an ICEV through established dealers.*

4.2.5 Variables Overview

The researcher used an inferential statistical modeling approach in which retail performance, as measured by buyer satisfaction with the retail purchase experience, was treated as the outcome variable. Also treated as outcome variables were select factors relevant to addressing the research questions that could affect buyer satisfaction. As mentioned in the previous section, the researcher favored the use of raw retail satisfaction ratings (as directly indicated by new vehicle buyers in the survey instrument) over the indexed scores computed by J.D. Power.

Examining observed buyer ratings, as opposed to computed scores, allowed a more direct examination of the individual factors influencing retail satisfaction. The primary objective of this portion of the study was to investigate variation in buyer ratings as a function of complex relationships between the powertrain chosen by the buyer (e.g., plug-in electric versus conventional ICE) and multiple demographic factors. These included information about buyer gender, race, education level, household income, marital status, and age or generational affiliation (see Table 4-2 and 4-3). The researcher examined these relationships using a modeling framework that included interactions between variables.

Table 4-2. Independent factors used in linear and generalized linear mixed effects models to identify sources of variation in the following responses: retail satisfaction (RS), time spent (TS) and various buyer characteristics of interest (BC).

Abbr.	Description	Parameters	Effect	Model
ST	Buyer's state of residence	1	Random	RS, TS, BC
R	White or non-white	1	Fixed	RS, TS, BC
G	Gender (male or female)	1	Fixed	RS, TS, BC
M	Marital status (married or unmarried)	1	Fixed	RS, TS, BC
E	College degree (yes or no)	1	Fixed	RS, TS, BC
I	Household income (see Table 4-3)	3	Fixed	RS, TS, BC
N	Age group (by generation, See Table 4-3)	3	Fixed	RS, TS, BC
P	Vehicle powertrain type (PEV or ICEV)	1	Fixed	RS, TS, BC
X	Buyer was decided on an exact vehicle beforehand	1	Fixed	RS, TS, BC

* Dashes denote continuous variables in which only one parameter (the coefficient represents the slope) was estimated.

Table 4-3. Levels of categorical independent variables used in model analysis.

Abbrev.	Variable	Levels	Specification
G	Gender	Male Female	
E	Education Level	College degree No college degree	
M	Marital Status	Married Not married	
I	Household Income	Low Mid High Very High	< $40K $40K - $124,999 $125K - $249,999 $250K or more
R	Race	White Non-white	
N	Generational affiliation (by birth date)	Gen Y Gen X Baby Boomer Pre-Boomer	> 1977 1965 - 1976 1946 - 1964 < 1946

4.2.6 Model Form

The researcher employed a linear mixed effect (LME) modeling approach to evaluate relationships among study variables (White 2009). Inferential and statistical models attempt to reliably estimate the effect of each independent variable on the response variable. Problems investigated in the social sciences often involve effects unique to, and that vary with, a particular group or class. The most familiar types of random effect are the blocks in observational studies (e.g., geographic region or markets) repeated across sites or times. Since buyer data was clustered (i.e., grouped) within market areas, the researcher deemed it appropriate to include a random effect to account for intraclass correlation among samples. The researcher chose to employ mixed effects models to allow fixed and random effects into the model structure. This allowed the researcher to explicitly model the variance-covariance structures in these relationships. Fixed effects involved parameter estimates of variables of primary interest to the researcher (e.g., powertrain and demographic parameters).

Using the LME model was the appropriate approach for this study to prevent confounding the fixed effect parameter estimation from unaccounted for correlation among samples (Faraway 2006). Therefore, the LME design allows the researcher to model a continuous response as a function of both continuous and categorical independent variables, including interactions, while accounting for potential correlation among samples. Furthermore, the error terms and random effects were permitted to exhibit both correlated and non-constant variability (Wood 2006).

LME assumes the data has normally distributed errors and includes fixed and random effects (Bolker et al. 2009). These took the general form:

$$y = X\beta + Zb + \varepsilon$$

where y is the response vector, X and Z are the design matrices corresponding to the fixed and random effects respectively, β is the fixed effects vector, *b* is the random effects vector, and ε is the error vector. By accounting for the random effects in the study, the researcher can make inferences about a larger population. A list of independent factors and variable classification (fixed vs. random) is provided in Table 4-2 and Table 4-3 in the previous section.

For continuous response variables, the researcher used the default Gaussain error distribution in the LME model. For response variables that were categorical and binary (e.g., where the buyer's stated intent was reported as "definitely will" or not), the researcher used a generalized linear mixed effects model (GLMM) by specifying a binomial error distribution.

4.2.7 Model Development and Evaluation

The researcher addressed each group of research questions by investigating sources of variation in the response associated with each question. For *Group 1* questions, retail satisfaction served as the response variable. For *Group 2* questions, time spent at the retail facility served as the response. Several response variables comprised *Group 3* questions and included various buyer characteristics (e.g., intended loyalty). For each, the researcher investigated sources of variation attributable to differences in demographics and choice of powertrain.

For each of the responses of interest, the researcher examined the data in a multi-step approach using the *R* statistical software package and *R Studio* tool suite. The first step (Step I) involved creating several models involving demographic factors that might influence each response variable and determining the model supported by the most evidence. The second step (Step II) compared this model with the additive and interaction effects of powertrain choice. All responses involved at minimum a two-step analysis.

For Step I, the researcher identified the best-approximating model comprised of demographic factors using a selective evaluation procedure for each response variable. More specifically, the researchers fit demographic effects to account for variation in the response that might otherwise confound the predictor variables of interest (e.g., powertrain choice). For example, because these data represent an unbalanced survey design, meaning the number of surveys were not equal across different groups (e.g., males vs. female), demographic effects might confound the response variable if some groups have substantially greater representation than others. However, the predictor variable of interest can be evaluated robustly by first fitting demographic effects to the response and treating these terms as additive fixed effects for each retail performance response (RS, TS and BC). This resulted in multiple competing models.

The researcher compared evidence for models using an information theoretic approach (IC). As described by Burnham and Anderson (2002), the IC approach relies on the deviance of Kullback-Leibler information (Kullback and Leibler 1951). The information theoretic approach has advantage over frequency-based hypothesis testing in that it does not rely on *p*-values. Instead, the IC method allows for a comparative evaluation of models in which differences in expected predictive power is quantified. The researcher used maximum likelihood estimation (MLE) for model comparison (Zuur 2009). First, the researcher calculated a log likelihood (LL) function, which is an indication of the goodness of the model fit. The IC method assumed the degrees of freedom (*df*) are accurately estimated for random effects. The researcher also assessed models using Akaike's Information Criteria with a second-order bias correction for sample size (AIC*c*) as the differential metric for this analysis (Akaike 1979). The purpose of calculating AIC*c* was to account for the tradeoff between bias and variance in identifying the least complex but most explanatory model. In other words, the penalty associated with AIC*c* discourages over-fitting the model (i.e., adding more parameters, which improves goodness of fit). AIC can be described as:

$$AIC = -2\log(L) + 2K$$

with second order bias correction *c*:

$$AICc = AIC + \frac{2K\ (K+1)}{n - K - 1}$$

where *n* denotes the sample size and *k* denotes the number of parameters. AIC*c* allows for greater penalty for extra parameters, and thus prevents overfitting. The researchers then used AIC*c* to eliminate models that lacked support from the data to identify the *best-approximating model* (i.e., the most supported combination of demographic factors). More specifically, the analysis used the likelihood ratio test (Burnham and Anderson 2002), approximated by the chi-square (χ^2) distribution. The LRT took the form:

$$LRT = 2(logL_1 - logL_0)$$

Where L_0 represents the null and L_1 represents the best-approximating demographic model. The analysis used the LRT and the difference in AIC*c* (ΔAIC*c*) between the best-approximating model and the model of interest. The researcher retained the best-approximating alternative model, identified by the lowest AIC*c*, for the next step in the sequence. Per Table 4-4, ΔAIC*c* ≥ 2.0 indicates significant difference in variation explained between the model of interest and the best-approximating model. For example, if ΔAIC*c* ≥ 2.0, than it lacks fit compared to the best-approximating model. A ΔAIC*c* ≥ 7.0 typically indicates a strong significant difference.

Table 4-4. Heuristics for assessing strength of evidence for candidate models.

$\Delta AICc_i$	Explained variation between model of interest and best-approximating model
< 2	Substantial evidence
4 – 7	Considerably less support
> 10	No support for the candidate model

(Source: Burnham and Anderson 2002)

Third, the researcher calculated an Akaike's weight, *w*, which represents the conditional probability of the model of interest as the best model in the candidate set of models. Akaike's weight is calculated as follows:

$$w_i = \frac{\exp\left[-\frac{1}{2}\Delta AICc_i\right]}{\sum_{i=1}^{N} \exp\left[-\frac{1}{2}\Delta AICc_i\right]}$$

where N is the number of models and *i* represents the model of interest. For example, if w = 0.75, then the corresponding model would have a 75% conditional probability of being the best-approximating model of those considered in the analysis. The cumulative Akaike's weight, C*w*, indicates the probability of that model, or any model ranked higher (i.e., lower AIC*c*), being the best model within the consideration set. For example, if C*w* = 0.75, than that model or any model ranked higher than the model of interest has a 75% conditional (relative) probability of being the best-approximating model.

In Step II, the researcher compared the best-approximating model consisting of demographic factors that was identified in Step I with a more complex model that consisted of additive effects directly related to each research question. This was done, for example, by incorporating the buyer's choice of powertrain as an additive effect in combination with demographic factors. Evidence for the best-approximating model from Step II was then compared to evidence supporting the best-approximating model from Step I, as well as the null model comprised solely of the random effect. For the predictor variable of interest to receive support from the data in Step II, two criteria were required: (1) The best-approximating model consisted of the additive variable related to each research question and (2) ΔAIC*c* for the demographic effects only model (from Step I) was ≥ 2.0. This comparison allowed the researcher to quantify support for variables related to each research question. Similar to Step I, a ΔAIC*c* ≥ 2.0 indicates significant difference in variation explained between the model of interest and the best-approximating demographic model, and a ΔAIC*c* ≥ 7.0 indicates a strong significant difference. The same multi-part process was repeated for the data set consisting of premium makes only.

4.2.8 Parameter Estimation

The researcher applied maximum likelihood estimation (MLE) techniques to reduce bias in information criterion between models with mixed effects (Zuur 2009). Zuur (2009) describes MLE as a statistical framework for determining model parameters by maximizing the probability (likelihood) of returning the observed data. After models were ranked based on fit and a best-approximating model was identified, the restricted maximum likelihood (RELM) procedure was used to compute model parameter estimates. RELM is an alternative to maximum likelihood (ML) in which less biased random effect parameter estimates are generated than corresponding estimates using ML (Bolker et al. 2009). Once parameter values were estimated, the researcher focused on drawing statistical conclusions from the data by testing hypotheses, examining the parameter estimates and their confidence intervals and "…selecting the best model(s) and evaluating differences in goodness among models" (p. 131).

Step I consisted of developing multiple models incorporating demographic factors and identifying the best-approximating model within the model set. These took the form:

$$\beta_0 + \beta_1 \text{E} + \beta_2 \text{R} + \beta_3 \text{G} + \beta_4 \text{I} + \beta_5 \text{M} + \beta_6 \text{N} + Z_1 \text{ST} + \varepsilon$$

See Table 4-2 in the previous section for descriptions of each variable and the response with which it was examined. The coefficients (βs) represented the fixed effects of factors of interest in explaining sources of variation. For example, β_1 = the fixed effect coefficient for education (E); β_2 = the fixed effect coefficient for race (R), etc. The coefficient Z_1 represented the random intercept to account for intraclass correlation associated with the buyer's state of residence (ST). Finally, ε = normally distributed residual error.

The null model (random-effect only) provided an estimate of the mean response. For binary response variables the researcher used a GLMM and specified a binomial error distribution for the response variable. For example, for research question 3a, *Does powertrain choice explain sources of variation in the percent of new vehicle buyers who switched from a competing make (aka the percent of "conquest" buyers)?*, the response variable *conquest buyer* (*C*) was binary (0 = a buyer who purchased the same make of vehicle as their last vehicle; 1 = a buyer who switched from a competing make of vehicle, e.g., from a Honda to a Ford). The null or intercept-only model (random effect only, no fixed effects) estimated the probability of switching to a different make in this example.

The researcher also explored evidence for estimated parameters of interactions among variables (e.g., G × E) to investigate differences among combinations of categories (e.g., between females with high and low income levels). The researcher tested no higher than two orders of interaction among factors. Each model consisted of a different fixed effect structure. These were evaluated using the IC procedure described previously to identify the best-approximating model structure.

In Step II the researcher evaluated powertrain choice as an explanatory factor while accounting for variation represented by the demographic factors from Step I. The researcher applied the LME framework in which the model took the form:

$$[\mathrm{DF}_R] + \beta_P\,\mathrm{P} + Z_1\,\mathrm{ST} + \varepsilon$$

where DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intraclass correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

Question 2a is treated differently. Here, the researcher desired rough approximations of time spent at the retail facility by phase of the buying process as a basis for more detailed analysis of particular phases. For this reason, the researcher used a simple linear model that took the form:

$$Time_{phase} = \beta_1 \text{P} + \varepsilon$$

where $Time_{phase}$ = time spent by the buyer at the retail facility by phase of the purchase transaction; β_1 = coefficient for powertrain choice (P); and ε = normally distributed residual error. Since the researcher desired approximations of these durations, the model did not account for sources of variation explained by demographic factors. All other questions in this group used the model form and two-step information theoretic approach described previously.

4.3 Limitations in Data Analysis

4.3.1 Interview Data

Design, collection and interpretation of interview data is inherently a time and resource-intensive process. Due to time and resource constraints, obtaining a representative sample was not a feasible option. Consequently, the research pursued a purposive sampling program in which the research team established particular criteria for the selection of dealers in each of the metro regions investigated. The interview design was intended to survey a quantity of dealerships sufficient to capture common perceptions. Nevertheless, the researcher faced a number of unavoidable limitations.

First, the researcher limited interviews to dealerships that sell PEVs. The data therefore lacks information from dealers that do not offer PEVs for sale. This includes dealers that deliberately declined an opportunity to sell PEVs as well as dealers who were not given the opportunity to sell PEVs in the first place. Consequently, insight regarding the rationale for declining the opportunity, as well as the perceptions of dealers desiring to participate but not included, were not available.

Second, the state-funded research grant limited expenditures to in-state dealers only. Consequently, there is a risk that the interview data captured represents insights and perceptions unique to California markets and not necessarily representative of dealers nationwide. Moreover, analysis of in-state dealers risks missing information that may be unique to other U.S. states, as well as information that may prove common to all states other than California.

Third, CNCDA, a key partner in the study, afforded the researcher access to statewide dealer principals for the purpose of obtaining interviews with dealer management and staff. In this way, CNCDA acted as the gatekeeper between the research team and California dealerships. As an industry trade association, CNCDA may have a vested interest in the dissertation findings and may therefore bias the sample in such a way as to protect those interests. To minimize sampling bias, the researcher provided specific objective criteria to the CNCDA liaison for selecting dealers for inclusion in the study (e.g., by market area, minimum sales volume, experience selling PEVs, etc.). All dealers interviewed met these criteria. The researcher further minimized bias by using snowball sampling (i.e., pursuing referrals from referrals) to better ensure collection of a broader diversity of information.

Finally, there is always a risk of subjective research bias driven by the agenda of the researcher. Several steps were taken to manage this risk. First, the researcher developed interview protocols to better ensure consistent treatment of interview subjects across samples. Second, interviews were conducted by pairs of researchers wherever possible. In the few instances where interviews could not be conducted by more than one researcher, at least one additional member of the research team was assigned to code, summarize, and provide feedback from the interview transcript to the research team. Further, all interview transcripts were analyzed by at least one member of the research team who was not present during the interview. Inter-rater reliability was not measured, however; rather, the researcher took the aforementioned steps to minimize potential for bias.

4.3.2 Survey Data

Statistical analysis of the survey data encountered a number of limitations. First, the SSI study is a make rather than a model-level study. An objective of the study is to explore the perceptions and attitudes that may have led a customer to reject a particular dealer in favor of another dealer, regardless of the make (a.k.a. “rejecters”) (2013b). With the exception of Tesla, for cases in which the buyer rejected both the make AND the dealer, it was not possible for the researcher to conclusively determine whether the model rejected was equipped with a conventional or plug-in electric powertrain. The examination therefore omitted all rejecter data. Thus, the satisfaction ratings presented here are consequently higher and should be interpreted as representing a conservative approximation of actual ratings. For example, Chevrolet garnered an overall satisfaction score of 831 when computed using only buyer data as compared to the overall SSI score, which includes buyer and rejecter data, of 686. Another consequence of excluding rejecter data was the omission of other potentially contributing factors that led to rejection of dealers, makes and potentially PEVs as an alternative technology.

Second, the SSI survey lacks questions specific to alternative fuels. Since its inception in 1987, the focus of the SSI survey has been to provide a comparative benchmark upon which automakers and dealers can judge the relative performance of independent retailers against industry-wide customer satisfaction criteria. The standard of retail practice on which survey questions are based developed in line with the long-time dominance of the liquid-fueled vehicle infrastructure. Historically, the survey explores consumer attitudes and opinions under the presumption of widespread customer familiarity with the underlying technologies and fueling infrastructure supporting internal combustion engines. Missing, however, were questions that probe the introduction of more radical new technologies, features, and products that fundamentally conflict with these underlying assumptions.

The survey did explore the sufficiency of retail-level support for more incremental improvements in vehicle functionality such as navigation systems and mobile device integration. However, it overlooks advances with the potential to more critically impact the buyer’s ownership experience. These include how and where to fuel (charge), how far the customer can travel before needing to recharge, and how much savings the customer might realize. Furthermore, the introduction of zero emission vehicles, at least amongst incumbent automakers, has principally been driven by technology-forcing mandates complemented by myriad purchase incentives from all levels of government. The SSI study was never intended to consider the influences of government policy on consumers; hence, an exploration of the effect of incentives on dealer and customer behavior is absent from SSI survey data and therefore not available for analysis.

Third, as alluded to previously, the SSI study does not probe psychographic factors relevant to the introduction of more radical new products and technologies (i.e., that conform to the Technology Adoption Lifecycle Model). For example, the study does not collect information associated with the respondent's risk profile, predisposition for high-technology products and ideas, or the degree to which these respondents are likely to share their experience with others. Consequently, the data may miss considerations important to adopters of more radical technologies such as the provision of product or technology-specific support infrastructure and services. As such, the data may offer an incomplete picture of factors influencing plug-in buyer satisfaction with the purchase experience. Regardless, demographic factors that typically serve as proxy indicators for the technology adoption profile of new vehicle buyers were captured. These include income level, education, and age groups. Early adopters, for example, are generally better educated and more affluent than the general population.

Also lacking is research that identifies factors unique to the introduction of more radical technologies (such as those posed by alternative fuels, advanced powertrain or autonomous vehicles) and how factors discussed in this study or others, are situated across different retail settings. It is possible that using the SSI study as a measure of retail satisfaction is not sensitive to multiple retail paradigms, but instead perpetuates values consistent within a single industry paradigm. For example, the idea of "working out the deal" contains a number of presumptions (e.g., conducting certain activities in-person rather than electronically or negotiating with a salesperson) that stem from a preconceived notion of what works best within the given retail system.

Fourth, limitations in computing power prevented the ability to control for intraclass correlation (ICC, defined as variation that can be explained by factors common to particular samples over time or across geographic areas) in predictor variables for both market location (i.e., state of residence) and vehicle make. The researcher controlled for geographic ICC by randomizing the buyer's state of residence using a mixed effects modeling method that includes both fixed and random effect terms. It is possible that factors unique to a particular make could explain variation in the response variable. If so, the inability to control for this phenomena could mask or otherwise confound efforts to discern other factors that play a determining role in buyer satisfaction.

Also, the small sample size and unavailability of data from Tesla buyers residing in the state of California further limits the analysis. To date, California has proven the largest market for purchases of plug-in vehicles nationally. The absence of California data may result in the omission of factors affecting retail satisfaction that may only have been known from studying these data. It could also affect the relative influence of known factors. Also, since only one premium-level make (Tesla) offered a plug-in vehicle for sale during the study period, findings for this segment reflect sources of variation unique to this one manufacturer. While this allows for direct contrasts between Tesla and industry retail models, small sample size limits the granularity of the analysis. Consequently, more detail information that was available in the analysis of non-premium data may not be available for premium level data due to inadequate statistical power.

Finally, SSI – or any comparative measure of customer satisfaction drawn from customer inputs – represents an imperfect measure. First, customer responses (ratings) are observable from customer satisfaction surveys but true customer satisfaction is not. Despite the use of an anchored rating scale, each customer may have a different basis for measuring their level of satisfaction. For example, some customers may purchase vehicles more often than others, and therefore may have a different reference set from which to base their score. In such cases, even where a dealer delivered an identical retail experience, scores may vary. Moreover, manufacturer-level differences may similarly affect ratings of dealer performance. For example, a dealer representing a make in which the model line-up is nearing the end of its lifecycle may be less likely to invest in facility, training or other commitments that a dealer with a fresher model portfolio might make.

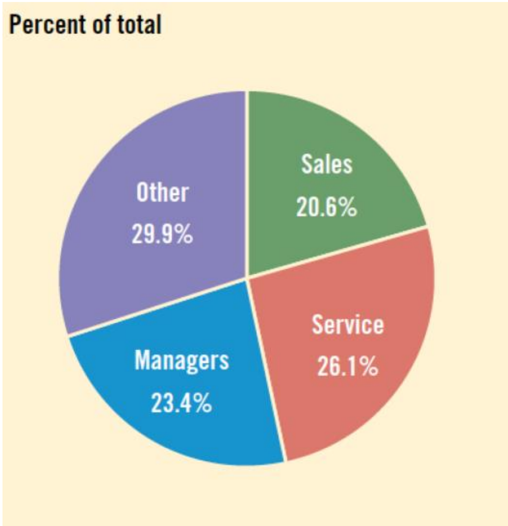
Second, dealers routinely game satisfaction surveys. For example, dealers may attempt to influence survey results verbally (e.g., by underscoring the urgency of receiving top scores), by offering inducements such as free oil changes, or even going so far as to post suggested survey responses to influence the survey process (2012a). Survey administrators and manufacturers recognize take steps to minimize the influence of these activities (e.g., J.D. Power revises the survey every three to five years). Despite this imprecision, survey results confer useful information to automakers and dealers regarding customer expectations and relative performance.

5 Results I (Interviews): Retail Structure and Practices

This chapter lays out the first of three chapters detailing the results of this research project. Based on literature review and interviews with dealers and automakers, it describes retail industry structure and common practices. Chapters 4 and 5 are based on interview results and my reading of the literature. Chapter 5 lays the groundwork for the follow-on discussion of issues specific to plug-in vehicles in Chapter 6. Chapter 7 presents findings from the statistical analysis of national survey data from new car buyers. This includes descriptive data about plug-in vehicle buyers and their unique characteristics, as well as the inferential statistical findings about the relationship between the study variables. It represents the final chapter of the results section of the dissertation.

5.1 Business Organization

With the recent exception of Tesla Motors, automakers sell all new vehicles through franchised new car dealers. As of 2013, 17,655 franchised new car dealers operated in the United States . In 2013, the typical U.S. auto dealer employed 57 people on an annually payroll of $3 million. Figure 5-1 breaks down employment by position in the dealership. Managers include management of sales staff. These individuals may also conduct vehicle sales transactions. The number and type of employees, however, varies significantly among dealerships depending on store characteristics such as size, location, makes handled and distribution of sales among departments (ibid, 14).



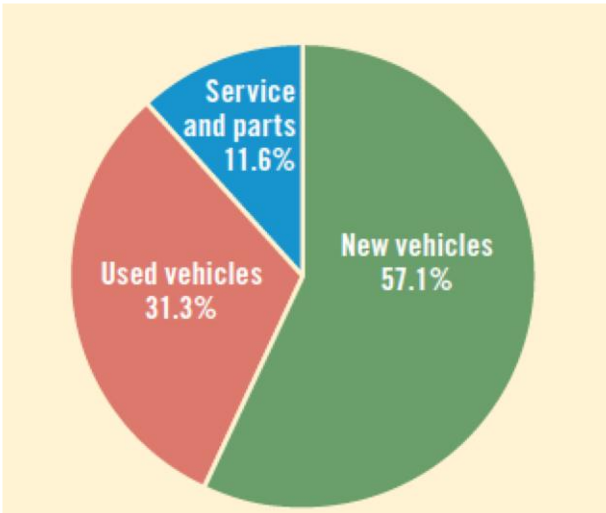
Source: NADA (2013) and U.S. Bureau of Labor Statistics

Figure 5-1. Dealership employment by position as a percent of total.

The majority of dealerships are privately held. Most new car dealers also sell used cars (Murry and Schneider 2015) and provide an array of support and services for customers. Business units typically consist of new car sales, used car sales, parts, and repair service. A little over one-third of dealers also operate body shops (NADA 2014). Some also maintain in-house finance companies. The average new car sold for just under $32,000 in 2013 (ibid.).

Dealers generate the preponderance of their revenue through new vehicle sales. Profitability, however, is increasingly driven by the used vehicle and service and parts departments. Figure 5-2 shows dealer revenues by profit center. Gross margin on new vehicle sales fell to 3.8% (just over $1,200 per vehicle) in 2013 from 4.2% the previous year. Contrast this with a gross margin on used vehicle sales of 13.3% (about $2,400 per unit at an average selling price of $18,111) (NADA 2014, Murry and Schneider 2015). Finance and Insurance

(F&I), service contracts and other aftermarket products generated 38.8% of dealer gross profits in 2013. For years 2005-2009, parts and service comprised the largest source of dealer net profits, followed in order by used car sales, new car sales, collision repair, financing and finally insurance products (Senter 2013). As a percent of sales, total dealership net profit before tax equaled 2.2% in both 2012 and 2013.



Source: NADA (2013)

Figure 5-2. Dealer revenue by department.

5.2 The Sales Process

Processes and practices can vary widely from dealer to dealer. This section discusses common practices in the industry. A typical sales transaction is illustrated in Figure 5-3.

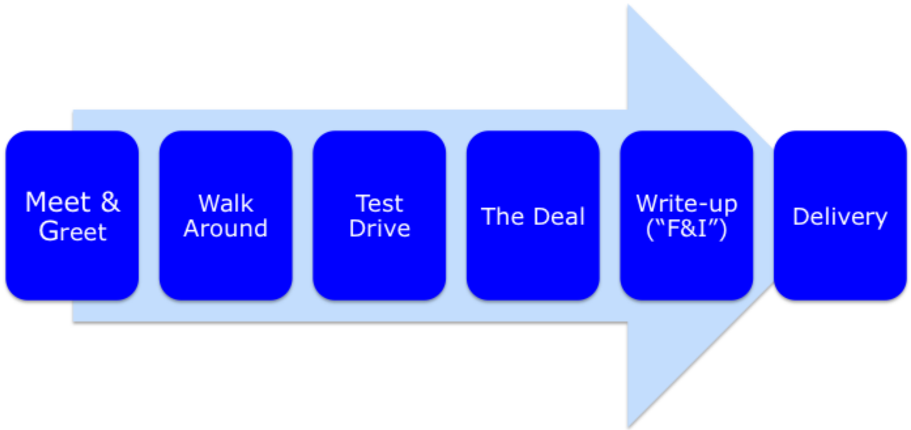


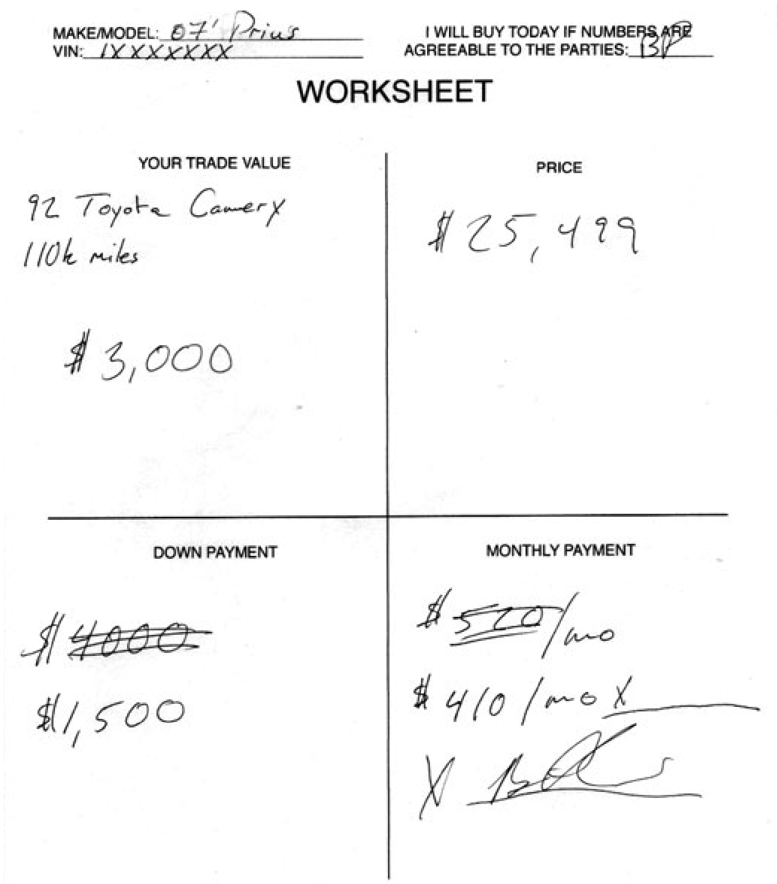
Figure 5-3. Typical new car sales transaction.

The process consists of a series of sequential stages that begins with the engagement of a salesperson with a prospective buyer visiting the lot. Roughly 90% of customers that visit a dealership already know which vehicle they have in mind and have performed background research to narrow down the choice of make, model, color, trim package, MSRP and invoice price of the vehicle.

Customers may have spoken with another salesperson or dealer representative previously. The engaging salesperson may redirect the customer appropriately in such cases. The process typically proceeds with a walk around of the vehicle that includes a run-down of the vehicle's features. This may include opening the hood for a description of the powertrain or sitting in the vehicle and reviewing interior features (e.g., legroom, sound system, visibility). This also affords an opportunity for the salesperson to entertain the customer's questions and to learn more about the customer's needs and wants (e.g., budget, purchase timeframe, trade-in).

The salesperson then offers an accompanied test drive in which the customer is afforded an opportunity to drive the vehicle on public roads. During the test drive the salesperson reviews pertinent vehicle features and may instruct the customer to perform specific operations or exercise certain maneuvers to emphasize aspects of the driving experience or to differentiate the vehicle from its competitors.

After the test drive, the salesperson may move to “close the deal.” Vehicle purchases are typically complex transactions involving several elements that include determining the customer’s trade-in value, down payment, financing mechanism and monthly payment (e.g., loan or lease), as well as optional equipment and services, and final selling price. The vast majority of dealers use a negotiated price model. A common technique to facilitate these discussions is the “four square” worksheet (Figure 5-4).



MAKE/MODEL: 07' Prius
VIN: 1XXXXXXX

I WILL BUY TODAY IF NUMBERS ARE AGREEABLE TO THE PARTIES: BP

WORKSHEET

YOUR TRADE VALUE	PRICE
92 Toyota Camery 110k miles $3,000	$25,499
DOWN PAYMENT	**MONTHLY PAYMENT**
$~~4000~~ $1,500	$~~520~~/mo $410/mo X

Figure 5-4. Sample "four square" worksheet used by dealers to facilitate vehicle sales transactions.

The salesperson may not have final authority to approve key elements of the deal. In such cases, the "four square" worksheet attempts to bound and simplify the dealer-customer negotiation to resolve key aspects of the transaction. These include the trade-in value, down payment, selling price and monthly payment. The salesperson may request permission to run a credit report for a more accurate gauge of financing terms. As in the sample illustration in Figure 5-4, the worksheet may request the customer's initials or signature. While not legally binding (though many customers are unaware of this), such items are intended to signal the customer's willingness to proceed to the formal write-up of a purchase agreement. Doing so may or may not be contingent upon gaining approval of a supervisory sales manager.

Once the numbers are penciled out, the customer moves to the next stage of the transaction, or "F&I" for finance and insurance. This may involve a hand-off from the sales representative to a member of the finance team. Here, an F&I representative draws up a full sales contract, including financing and additional products (e.g., regular service and maintenance, window tinting, extended warranty). The sales contract and attendant paperwork are printed and the customer is presented with several contracts for initial and signature. Assuming all items are in order, the final stage of the process is to take delivery of the vehicle.

In delivery, the salesperson or another designated employee typically retrieves the customer's newly purchased vehicle to a designated delivery area. All protective coverings are removed from the vehicle, which may be washed and gassed up at this point. The salesperson presents the buyer with the keys or key fob. Also during delivery, the salesperson may take the opportunity to introduce the customer to the dealership's service department manager and to configure in-vehicle navigation, stereo, apps and other telematics systems (e.g., pairing the customer's mobile phone). The salesperson may review location of key items such as the owner's manual, service and maintenance schedule, and location of the hood, trunk and gas cap releases as well as the spare tire or tire repair kit. The salesperson entertains any final questions from the customer before the buyer drives off the lot with their new vehicle.

Customers spend an industry-wide average of just over four hours at the dealership transacting a new vehicle purchase. The researcher emphasizes, however, that sales process and practices vary greatly among dealerships. While the description presented here is intended to illustrate a typical experience, it is not intended to represent the experience at all dealerships. By example, some dealers implement a set ("no haggle") pricing model, grant authority for salespersons to authorize selling terms, or use no-commission compensation structures for sales personnel. Practices may also vary from dealer to dealer due to local influences such as whether the dealer holds title to the land free and clear of a lender, union influence, size of the dealer's territory and differences in state consumer protection laws.

5.3 Salesperson Compensation and Incentives

Compensation and incentives vary widely among dealers as well. While service and back office personnel typically receive hourly or salaried pay, sales staff (including sales managers) typically operate on commission and bonuses. These may take various forms and are typically divided into earnings derived from profit off the sale of the vehicle itself (a.k.a. "front-end" profits) or from earnings derived from the sale of ancillary products associated with the vehicle purchase (a.k.a. "back-end" profits). Typically, a salesperson receives a percentage of the dealer's gross profit (selling price minus the dealer's cost) on the sale. The dealer's cost consists of the vehicle's wholesale price (the amount paid to the manufacturer by the dealer) and overhead (a.k.a. "pack") minus several items the manufacturer reimburses, rebates or returns to the dealer typically on a quarterly basis (2012b). These typically include "dealer holdback" (equal to 2-3% of invoice or MSRP), flooring assistance (a reimbursement equal to around 1%

of invoice to offset the dealer's carrying cost to maintain sufficient inventory), and a "trade spend" allowance (an amount equal to roughly 1% of invoice to partially offset advertising expenses). In contrast to floor sales staff that receive commission based on gross, sales managers typically earn commission on profit net of advertising and flooring assistance.

In addition to this front-end commission, a salesperson may earn additional commission or bonuses from the sale of vehicle service agreements, extended warranties, or after-market equipment ("back-end" profit). Some dealers also reward salespeople with a flat bonus for customers that bring a trade-in to the transaction. Moreover, manufacturers periodically offer additional incentives that include a flat bonus (a.k.a. "spiff") or a variable bonus (a.k.a. "spin") to salespeople that sell a particular model. Dealers also typically offer a volume-based bonus in which the salesperson receives a graduated retroactive increase in commission percentage (e.g., from 20% to 30%) for achieving certain sales volume thresholds for a given month.

Manufacturers similarly incent dealers at the facility level. In addition to holdback, trade spend, and flooring assistance, automakers may reward dealers with a substantial flat bonus for hitting monthly volume targets or through "stair-step" programs in which automakers confer an increasingly larger retroactive per-unit bonus to the dealer. For example, Ford recently introduced a stair-step program in which dealers that achieve 80% of their sales targets earn a $200 bonus per unit, $400 for reaching the full target, and $600 for going 10% over the target (Paris 2015). Dealers may in turn return a portion of this bonus to the sales force. Dealers may also give up amounts from incentives and pass them on to customers during price negotiations. Manufacturers routinely offer customer incentives as well. The discount comes in the form of a straight discount off of MSRP that the customer can apply to the down payment or to lower the monthly car payment (a.k.a. “cash on the hood”).

In sum, compensation and incentive structures are extraordinarily complex, vary widely among dealers and manufacturers, and shift regularly at the national and regional level with changing market conditions. Incentive structure plays an outsize role in dealer and salesperson behavior and are a key instrument whereby dealers align salespeople, and manufacturers align dealers, to pursue their interests. The principal-agent problem looms large in the franchise system. Interests that benefit dealers may not benefit customers. For example, where front-end profits are squeezed dealers may press customers to sign up for additional products they may not need or want. Similarly, interests that benefit manufacturers may not serve the interests of dealers. Moreover, interests that benefit either may not benefit particular model lines or products. For example, stair-step volume incentive programs create greater price dispersion among customers, with some paying much more and others much less for a new vehicle, which can adversely impact inter-dealer relations and customer satisfaction (NADA 2015). Since new models compete on price against other dealers and against the same model in the used-car market, it can also drive down vehicle resale value.

5.4 Training and Product Launches

Dealer training can take a variety of forms and may comprise any one or combination of in-house, offsite and web-based sessions delivered by dealers, OEMs or third-party consultants. Salespeople typically receive initial training from the dealer upon hire. This training focuses on orienting the new employee to the dealership’s culture, philosophy and specific sales process.

Dealers often afford sales people additional training opportunities to hone sales skills or to learn new processes or approaches.

Manufacturer-led training is often product focused and accompanies the launch of a new model or a substantial refresh of a current model. On these occasions, automakers typically convene regional training at offsite locations but may conduct onsite training at larger dealers. Training may entail commitments ranging from half-a-day to as many as a few days of involvement and typically affords sales personnel an opportunity to test drive the vehicle. Course content covers a wide swath of subjects from vehicle features and pricing to showroom presentation, customer communications and follow-up. It also covers a number of topics required by law or internal directive. Dealers may dispatch a portion of the more seasoned sales or service staff as representatives who are then expected to train others upon return. Automakers may leverage field support teams to provide supplementary or ongoing training support. Manufacturers also make web-based training modules available to their dealer networks as a resource for refresher and ongoing training.

Automakers occasionally launch initiatives aimed at improving customer service and loyalty by improving dealer processes and practices. Ford, for example, launched its “Consumer Experience Movement” in 2010 to bolster retail satisfaction by improving dealer-customer communications. Ford co-created the program alongside its dealers, offering to split the cost of training dealer staff evenly with them. Nevertheless, by the end of 2013 only 847 of the automaker’s 3,286 dealers participated (though these dealers accounted for over half of all Ford sales) (LaReau 2015).

5.5 Marketing and Facility Investments

Marketing efforts by automakers are similarly complex, diverse and conducted at various levels internal and outside the organization. Marketing budgets are typically parceled out by product line and executed by the automaker at the national ("Tier Zero") or regional ("Tier 1") level. Efforts usually tout specific product features such as power, towing capacity and fuel economy, often relative to competition, and involve ad campaigns and placement in TV, radio, print and online forums. Many correspond with particular sales campaigns featuring discounted pricing or finance terms. Regionally aired spots commonly direct customers to the manufacturer's website or their local dealer for more information. Dealers in the region typically contribute to a pooled account that fund these efforts and therefore have some say in terms of the messaging. OEMs also commonly practice targeted marketing in which the automaker directs specific messages tailored to different customer segments and broadcast through channels popularly frequented by those customers. For example, automakers may place ads for muscle cars and trucks alongside sporting events and sports-related magazines, websites and blogs.

Individual dealers and dealership groups typically conduct marketing campaigns at the local level ("Tier 2"). Ad buys are correspondingly on a much smaller scale and budget and intended to direct traffic to a specific dealer or dealer group based on differentiating features such as selection, service quality and price. Automakers usually subsidize these expenditures to encourage dealers to sell at greater volumes than might otherwise be economically optimum for the dealer. Automakers, however, are playing an increasing role in targeting customers at the micro level through Internet-based advertising.

Automakers similarly encourage dealers to periodically update or expand their facilities to meet changing trends in consumer preferences, shifting market conditions and other corporate objectives related to branding and providing a better and more uniform retail experience for customers. Dealers may lack the resources or incentives to make these sometimes costly investments. Hence, automakers commonly subsidize a portion of facility upgrade cost to gain wider compliance from its dealer network.

5.6 Tesla's Direct Distribution Model

As a dedicated producer of electric vehicles, start-up Tesla Motors pursued an entirely different distribution strategy for its initial models. First, Tesla targeted the premium end of the market and focused on building its reputation as a premium brand. This involved not only dedicating resources toward assuring a quality product on par with established automakers and their decades of manufacturing experience but also ensuring a superior retail experience for customers making the switch to electric driving. In stark contrast to established automakers, Tesla combines a build-to-order production system with a direct-to-customer (D2C) sales model based on prices it sets rather than prices negotiated between dealers and customers.

Tesla also owns and operates its retail outlets, service centers and even its own branded charging infrastructure. Stores are situated in well-trafficked shopping destinations rather than on separate properties where customers must make a dedicated trip to learn more about the product or interact with store representatives. Tesla further instituted a commissionless compensation scheme for its retail representatives, which it dubs "product specialists".

Differences in compensation extend to the service department as well. Tesla pays its service technicians an hourly rate, which stands in contrast to the industry-wide shift by dealers to flat rates based on performing particular jobs. In a flat rate compensation scheme, dealers pay technicians the same amount for the job whether it took one hour or four hours to complete. Tesla also designed its vehicles for over-the-air (OTA) firmware and software updates. In some cases, the company can address faults, problems and complaints through a wireless update, thereby obviating the need for a customer to visit the service center. Tesla further designs its models with substantial all-electric range with included lifetime free charging at any of its fast-fill "Supercharger" locations. The company is also piloting battery-swap capability at a station just north of Los Angeles where customers can replace a depleted battery with a fully charged one at a cost comparable to filling up a conventional vehicle.

Tesla's website is unique in the industry in terms of the information available and the tools and resources it provides to customers. These include a national map of Supercharger stations that allow the customer to view current and future build-out of Tesla's fast-charging infrastructure. It also includes a range-estimator where customers can see how range performance varies with choice of model trim and speed, outside temperature and AC or heater operation. The site also features charge time and cost calculators, decision aids to help customers decide which optional equipment best suit their driving needs, home charger installation guides and references to Tesla-recommended electricians and solar installers. These differences translate to a uniquely different buying experience for the company's customers.

5.7 External Relations

Though standalone entities, dealers interact with OEMs in a variety of respects. Figure 5-5 depicts these relationships.

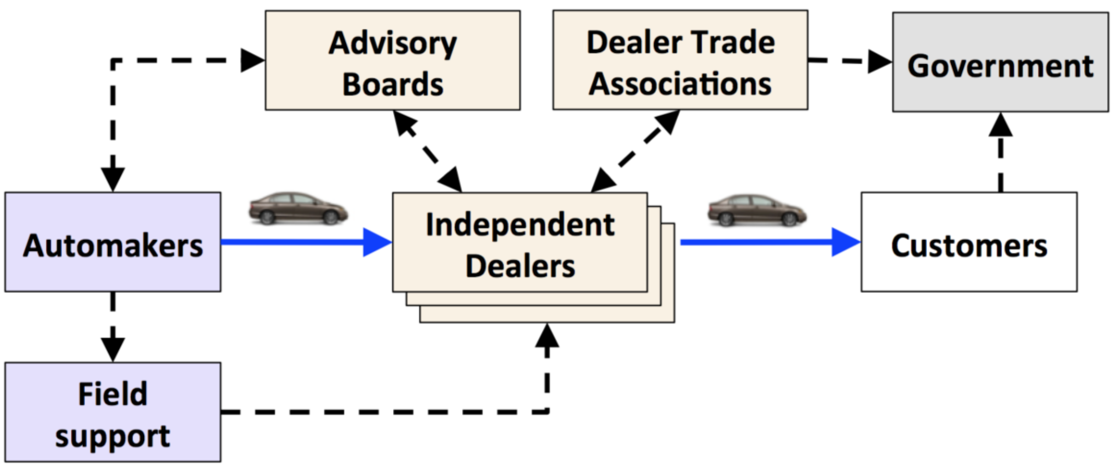


Figure 5-5. Distribution channel organization and value chain

In the above figure, product flows from the automaker to its dealer networks where it is retailed to customers. Dealers then support these customers with warranty, service, repair and other services. As previously discussed, automakers maintain an arms-length relationship with dealers in order to ensure compliance with myriad state franchise laws. In this loosely coupled relationship, the level of interaction and cooperation may vary markedly among OEMs.

Automakers commonly maintain field organizations charged with more tactical responsibilities such as troubleshooting and resolving OEM-dealer challenges, ensuring dealers have the resources to succeed, and maintaining the integrity of relations between OEMs, dealers and customers. Dealers also interact with automakers through regional advisory boards comprised of representatives from both organizations. Boards meet periodically and serve as a strategic level forum for information sharing, feedback on products and programs, and issue resolution.

Dealer trade associations serve as a resource for dealers in their respective jurisdictions by collecting and disseminating industry and market trends, delivering education and training, and by representing the interests of franchise dealers at the national, state and regional level. Trade associations also referee market activities to ensure compliance with dealer and consumer protection laws, communicating infractions to motor vehicle departments and other state agencies and watchdogs. These organizations actively represent the interests of their constituents in court and routinely engage in lobbying activities at all levels of government.

6 Results II (Interviews): Plug-in Electric Vehicles

This chapter reviews the major themes that emerged from conversations specific to PEVs with dealers, their sales staff, and the automakers they sell product for.

6.1 More Demands, Fewer Rewards for PEV Dealers

6.1.1 PEV customers are different

Dealers universally described PEV buyers as (1) different from the general customer a dealer typically sees and (2) demanding greater support as a result. Dealers distinguished what they referred to as 'early adopter' customers from 'mainstream' customers by several characteristics. Early adopters are older, more affluent, better educated and predominantly male. More come from multi-vehicle households. Dealers described them as 'having done their homework' in terms of research (mostly online) not only on vehicle features but elements specific to electric mobility. These include complementary technologies such as charging equipment, installation and cost to operate, local utility rates and EV discounts, and myriad public incentives such as tax credits, state and local rebates, and HOV lane decals. A number of dealers described PEV customers as knowing more about the car than their sales people. Said one dealer principal, "They'll [PEV customers] know more about the cars than most of the staff."

According to a dealer association representative involved in dealer education efforts, early adopters are more like luxury vehicle buyers. "They expect knowledge about every aspect of the vehicle, anything that could go wrong, and that not necessarily what you see if somebody is looking to buy a Nissan Sentra." In other words, early adopters of PEVs want all the answers and they expect the dealer to have them. Consequently, plug-ins demand more product knowledge than conventional vehicles, with many subjects (e.g., incentive eligibility, local utility rate structures and discounts, and public charging availability and use) well outside customary areas of expertise.

Dealers further described PEV customers as fitting a certain buying profile. The earliest customers typically held strong environmental views or were devotees of plug-in technology. These were typically followed by more budget-conscious commuters driven more by the economics of the purchase and a desire to beat traffic than by their views on sustainability or the environment.

6.1.2 Steeper Learning Curves

Sales staff expressed some misgivings over the ability to gain mastery over topics important to PEV customers. Electric utility rates, for example, can vary substantially from one utility district to the next, and even from customer to customer based on a household's individual use profile. Rate discounts for PEV owners vary between districts, if offered at all. Further, individual air districts and municipalities may offer incentives of their own. Residents of counties in the San Joaquin Valley, for example, are eligible for an additional $3,000 rebate for purchase of qualified zero-emission vehicles. Eligibility for all or a portion of the federal tax credit is based on the customer's tax liability, which is often unknowable until tax time. Consequently, some dealers expressed reservations about sharing this information with customers out of concern for legal liability. Some choose to avoid these conversations outright. Some sales representatives reported being instructed in OEM-led training to refer the prospective PEV buyer to their accountant.

The breadth and variety of incentives, each with unique qualifying requirements, contribute to the steep learning curve reported by dealers. Incentive programs may also cause significant disruptions to dealer operations. One salesperson recounted a state incentive program in which PEV buyers received free home charging equipment plus an allowance against installation cost. While popular with customers, it wreaked havoc at the dealership. The salesperson explained that the program released funding for a fixed amount of chargers on the first Tuesday of each month. To claim the incentive, dealers had to present a bill of sale to the state. The program often quickly ran out of supply. Consequently, prospective customers deliberately delayed purchase until release of the next monthly allotment. Lines formed at dealerships the first Tuesday of each month, overwhelming dealers and interrupting timely service to other customers. As a result, dealers learned to avoid mention of the program unless raised by the customer.

6.1.3 Greater Consequences (Higher Risk)

Accurate information on the topics discussed in the previous section can be crucial to the customer's ownership experience. Said one sales manager, "You need to know all. You need to be an expert. You need to be interested." This is because, he went on to explain, "Everything about… that electric car that you haven't disclosed will have something to do with their [the customer's] decision making." In other words, in contrast to conventional vehicles, many aspects of a PEV more greatly impact the purchase decision. Neglecting to inform the customer of the availability and use of public charging, for example, could have far greater impact on the customer's experience with the car relative to, say, neglecting to explain how to pair their cell phone with the car's infotainment system. The consequences of overlooking some detail are potentially far greater for PEV customers.

Greater consequences means heightened risk in the form of legal implications for PEV sales. Consumer protection laws loom large in the retail automotive space. These subject dealers to legal liability for misstatements or for communicating misleading information to customers. Said one dealer principal, "I can't make a mistake". Failures or missteps can result in law suits or other costly remunerations from dealers or automakers.

6.1.4 Greater Burdens

Dealers further expressed reservations about the commitments involved when taking on prospective PEV customers. A common refrain was that PEVs involve a much longer sales process than conventional vehicles. The sales process refers to the point of first contact with the customer by a sales representative to the point of closing the sale. Dealers described early adopter PEV customers as particularly discriminating, requiring more time from sales staff to answer questions, provide test drives, and cultivate relationships that result in a sale. From a salesperson's perspective, this additional time represents a cost of doing business as any added time could have been spent closing another sale.

Also considered a component of the 'sales process' is the amount of time spent transacting the vehicle purchase. 'Transaction time' measures the total time a customer spent at the retail location from the point at which the customer walks in to the showroom (or lot) to the point they drive off with a new car. Many dealers contended that PEV purchases, and in particular the delivery stage of the transaction, take longer than conventional vehicle purchases. Dealers uniformly reported longer delivery times for PEVs, adding anywhere between ten and thirty minutes to typical routines. As one interviewee relayed, "[A salesperson] can deliver a car in a half hour. You're not delivering a [PEV] in a half hour. You're looking at… nothing less than an hour."

6.1.5 Fewer Rewards

Compounding concerns over lengthy sales engagements is dealer uncertainty around the near-term profitability of plug-in vehicles. Most claimed selling PEVs at substantial discounts to MSRP. This, a number of dealer principals claimed, equated to lower profitability than conventional models and left little reward for sales members who earn commissions based on some percent of the front-end profit. In such cases, sales staff earn a small lump-sum bonus ranging between $150 and $200 called the "mini" (short for "mini deal"). Sales staff confirmed these misgivings. Since the vast majority of sales staff earn a living from commissions, these sums may appear unattractive relative to other more profitable vehicles. Some OEMs attempt to offset these counterincentives to PEV sales by conferring spiffs or spins, or by rewarding greater credits toward reaching monthly volume targets. The latter might yield a bonus or increased commission percentage retroactive to all units sold. In this way, sales staff are encouraged to leverage increased sales of PEVs as a vehicle for reaching their monthly volume targets.

Dealers similarly expressed few opportunities for 'back-end' profit. As discussed previously, *back-end profit* refers to a number of other sources of profit resulting from the sale of a new vehicle, including optional upgrades and products, warranty repairs, marginal interest charges on vehicle financing (aka "dealer reserve"), or revenue from trade-ins. Many PEV buyers, especially buyers of plug-in hybrids, choose not to purchase optional charging equipment. Even those that do yield only modest marginal profits (less than $50). Others such as window-tinting have proven popular for some dealers, yielding an additional $100 to $150 in profits.

Since a majority of PEV sales are special leases, often to the most creditworthy and informed of customers, affording little opportunity for additional profits from dealer reserve. Dealers further report that PEVs require even less warranty repairs or service and maintenance than conventional vehicles, which has gradual improvements in vehicle reliability have eroded over the years. As one dealer aptly stated, "We've hurt ourselves by making a product that's really, really good."

Also, some dealers claim that PEV transactions see fewer trade-ins on the basis that many customers acquire a PEV as an additional household vehicle. Dealers increasingly value the trade-in as a relatively higher margin source of profit and often reward salespeople for securing the customer's pre-owned vehicle. Some dealers also expressed concern that an alarming trend toward low residual values for some PEV models could erode potential profits on the back-end of a PEV lease when it returns to their lot. Moreover, lower residuals translate into higher monthly payments for new PEV models, which further erodes value for customers and potential profits for dealers. In sum, the combination of fewer trade-ins on the front end of a sale and lower residual values on the back-end may undermine profits for both dealer and salesperson. In addition, dealers foresee no new revenue streams emerging from the sale of PEVs. To make matters worse, a number of dealers expressed concern over lower customer satisfaction ratings that often come with more demanding PEV customers. Lower ratings typically translate into lower payouts from the automaker.

In sum, dealers (both principals and sales representatives) conveyed that selling PEVs entails steep learning curves, greater demands on the sales team and dealership, and increased liability concerns and disruption to operations that equate to substantial business risk. Hence, the time to recoup investments in PEVs and the path forward to profitability remains highly uncertain.

6.2 Motivation

Given the greater burdens and risks described above, what motivates dealers to voluntarily embrace sales of PEVs? Several common themes emerged from conversations with PEV dealers.

First, for dealers in favorable markets, selling PEVs can make business sense. Favorable conditions include access to more affluent customers and proximity to HOV lanes in congested metro areas. Relatively more progressively-minded communities (e.g., greater environmental awareness) also contribute to the decision. Second, PEVs represent a deliberate strategic investment. Whether dealership owners and principals embraced PEV sales or not, all acknowledged the challenge of near-term profitability. Viewpoints, however, diverged between top-quartile dealers and those selling fewer PEVs in the same dealer market area (DMA). This was apparent as much by what was said as by what was not said by dealer principals.

Top-quartile dealers were distinguished by product champions at the executive management level. These figures ensured that the entire organization was aligned behind PEV sales and supporting the sales team and their PEV customers. Said one top quartile dealer principal, “Everybody has got to be involved from the senior management down”.

In contrast to relatively lower volume PEV dealers, top dealers went beyond the default logic of ‘we generally sell what the factory makes’ to expound on their motivation for offering PEVs. Many expressed the view that vehicle electrification is a long-term industry trend. Accordingly, these dealers aim to position the business for competitive advantage by taking steps to ensure that customers equate the dealership with friendliness toward plug-in vehicles. For many, this means building on existing efforts to differentiate the dealership as environmentally friendly, for example by upgrading facilities to solar and/or achieving LEED certification. In this regard, PEVs represent a progressive step along a path aimed at attracting more environmentally-aware customers through greater environmental stewardship. Via brand association, these dealers aim to win new customers (“fresh faces”) from competing vehicle makes and dealers, thereby expanding market share. In many of these cases, sales staff referred to one or more dealer principals as “product champions” who provide top-down leadership and continuity of support throughout the entire organization. In contrast, lower selling dealers may not be as motivated by these considerations. According to one automaker, “That drives the decisions and the effort on the showroom floor.”

Lastly, entry barriers to selling PEVs range from mild to moderate. Requirements vary greatly by manufacturer, but dealers reported the initial outlay for dealers to sell PEVs typically runs between $10,000 and $100,000 for training and equipment. Much of this cost is associated with installation and certification of a special service lift for automotive grade battery packs. Automakers will typically require purchase and installation of a minimum number of chargers as well (two seems to be the average). Typically, these are relatively inexpensive Level 2 chargers (unless trenching or other facility retrofits are required), with one dedicated for the sales lot and one for the service area.

Automakers also commonly require at least one member of the sales and service staff to receive specialized training for selling or servicing PEVs. For service technicians, this typically involves earning a specialized certification to perform work on high-voltage electrical components. Depending on the existing level of technician expertise, this can require between 40 and 120 hours of dedicated training. Some automakers also require initial certification by dealers as an authorized PEV outlet prior to selling PEVs. Mechanisms for ongoing certification, however, were more opaque. Some salespeople noted that a dealership could gain initial certification to sell PEVs and yet continue to sell them even after PEV-trained sales staff moved on. Given the high turnover rates common in the industry, interviewees speculated this may happen fairly regularly and to the detriment of sales quality.

6.2.1 Training

A number of automakers establish 'certification' requirements as a precondition for dealerships that wish to sell PEVs. These may require all or a portion of sales and service personnel complete a minimum level of PEV-specific training. While training for service technicians can run from 40 hours to upwards of 120 hours, sales staff may receive as little as 30 minutes of training on PEV-specific topics such as charging equipment and options, charging infrastructure and public incentives. Continuing PEV training for sales staff often relies on web-based tutorials.

Where PEVs may represent a small portion of dealer sales or where initial demand for PEVs is low or subject to significant swings in demand, retention and recall of PEV-specific information can be challenging. Dealers emphasized that salesperson competence, as well as salesperson confidence, are mutually reinforcing. Competence is a by-product of hands-on learning achieved through regular exposure and repetition that builds on one success after another. Each PEV sale leads to greater competence selling PEVs, leading to greater confidence to make more PEV sales. As one dealer aptly stated, “A salesperson is never more confident about selling a car then the day he sold one.” Weak initial demand, or demand that is shared across a pool of sales representatives, translates into fewer interactions for individual sales personnel, undermining repetition and retention of PEV-specific information. Some dealers complained that occasional swings in factory supply interrupted this cycle, especially near the end of a model year. Thus, momentum plays an outsize role in competence building and learning retention.

Further compounding this dynamic is the fact that employee turnover of floor sales personnel is extraordinarily high in the new car business, often running as high as 100% for the roughly one-third of sales personnel with less than a year’s experience at the dealership. Many attributed this to the inherent cut-throat nature and insecurity of commission-based sales jobs, differences in dealership culture, and the tendency of sales members to migrate to hot-selling products offered by competing automakers or even in other industries (e.g., home mortgages). Automakers underscored that at dealerships talent tends to follow trends, leaving less rewarding products more prone to languish on dealer lots. Salary-based compensation, profit-sharing schemes and other benefits offered by some dealers aid in combatting these challenges.

Automakers provide resources to dealers to aid them in navigating a highly mobile workforce. All OEMs maintain internal websites, and most make model-specific training modules available to dealer sales staff that cover such topics as product features, pricing, financing, and incentives. A number of sales interviewees noted these often lacked information more broadly pertinent to PEVs as a category such as specifics on charging infrastructure, public incentives and utility rate discounts. One automaker instituted hotlines staffed by product experts reachable by both customers and dealer sales staff for answers to PEV-specific questions. Another automaker noted they were gearing up to deploy teams to visit dealerships for PEV-specific training. Yet another emphasized that they had greater success using salaried personnel for PEV sales. One dealer principal cited the deployment of tablets (iPads) to 100% of their sales force as a particularly useful OEM-supplied tool for addressing the myriad questions of PEV buyers. "Instead of fumbling around, he can just go right to his iPad… [and] find the answer."

6.3 Retail Innovation and Emerging Practice

Interviews uncovered a number of retail-level innovations instituted by dealers, as well as some automakers, to aid PEV marketing and sales efforts. A small handful of top-selling PEV dealers in particular took extraordinary steps that distinguished them from typical dealers selling PEVs. This section reviews approaches common to these early “dealer innovators”.

6.3.1 Competence-building

Up to and during the initial months of release, some automakers implemented web-based ordering to help navigate PEV customers through an otherwise complicated purchase process. This typically involved collecting customer information, scheduling a home electrical inspection and charger installation quote (if needed) and directing the customer to a local dealer responsible for facilitating the transaction. Customers also could select color and trim and submitted a small deposit to secure the order. Though automakers intended these as an aid for dealers and customers alike, some dealers complained of design issues and poorly coordinated efforts that left them ill-equipped to support early customers. For example, dealers lacked visibility to vehicle build status to answer questions from concerned customers. “They created a tremendous amount of turmoil by doing it”, said one dealer principal. The automaker ultimately retired the site.

Manufacturers also shared that how dealers choose to delegate PEV transactions to their sales teams may play a role in their relative success. Many dealer innovators initially designated one or a couple seasoned, tech-savvy sales staff as PEV product specialists on alternate shifts. Often, these were Internet sales managers knowledgeable and passionate about technology at large and PEVs in particular. These individuals expressed a willingness to go to great lengths to work through initial hiccups and meet the demands of early customers. Approaches varied, with some designating a single PEV specialist to whom all prospects were routed by members of the sales team. Others engaged their full sales staff in transacting PEV sales but funneled them through PEV specialist-managers.

In many cases, PEV specialists at dealer innovator locations drove a PEV on a regular basis. This was either a privately acquired personal vehicle, a service loaner, or a demonstration vehicle (a.k.a. "demo car") supplied by the automaker or dealer for test drives, marketing, and other purposes. Sales representatives emphasized that their full immersion with a plug-in, "living with a PEV" as one put it, aided and accelerated their comprehension of the technology. In particular, living with a PEV allows a salesperson to experience all of the unique benefits, hiccups and bumps that come with owning a PEV. This allows salespeople to develop and hone effective language for conveying the unique value of PEVs to customers. It also allows them to effectively address customer concerns unique to the technology. This is often accomplished using specific "talking points" or "sound bites" that distill difficult or complex information into readily understandable and digestible information for prospective PEV buyers. Driving a PEV regularly, these salespeople claimed, aids this process. Others used borrowed car agreements to give customers on the fence an opportunity to take the car home without obligation for an evening to see if it would work for them. They simply return the car the next day.

Salespeople also emphasized the importance of discussing vehicle pricing in terms of total monthly cost, factoring in not only savings from lower payments resulting from lease specials and government incentives, but also from savings in gasoline costs, service and maintenance, and reduced commute times.

6.3.2 Emergence of Regional PEV Gurus

Automakers shared some of the emerging trends in the early PEV market. In California, roughly 20% of dealers carrying PEVs account for 80% of sales. The state has also witnessed the emergence of regional EV experts or “EV gurus”. These dealer representatives gain their reputation for superior PEV knowledge through word-of-mouth referrals, online chatrooms and bulletin boards, and speaking engagements as the “go to” person for all things EV. In interviews, these individuals discussed the importance of “trust building” that can be demonstrated by having driven the vehicle themselves and by making themselves available to customers in various forums (e.g., online, ride and drive events, user group meetings, etc.).

6.3.3 Learning Environment

These same representatives stressed the importance of creating an inviting atmosphere for prospective PEV customers. This is sometimes best facilitated, these PEV gurus stressed, in offsite venues (e.g., online or at ride and drive or other events). This is because customers may fear the prospect, real or perceived, of sales pressure from commissioned salespersons. The Internet, on the other hand, offers a safe space for customers to interact with knowledgeable representatives in a pressure-free environment. PEV specialists can then leverage these conversations to drive traffic to the dealer via word-of-mouth referrals.

Commissions, according to several interviewees, creates a pressure-filled environment that is not conducive to customer learning or overcoming the inherent distrust between the customer and the salesperson. “I put a flat fee [bonus] on every new car,” said one dealer principal, “so they [salespeople] don’t have to worry about the negotiations as much as selling the car." Two of the dealer principals interviewed had implemented a set pricing model (a.k.a. "one price" model) throughout their dealership. The first had extensive previous experience with a "no haggle" model and implemented it to great success. The other had much less experience and ended up folding it after a six month pilot. Regardless of the outcome, both agreed that with no haggling more resources were freed up to focus on product knowledge and toward ensuring the customer ended up with the right vehicle for their needs. Customer satisfaction improved. Said one dealer principal, "That's pretty exciting to people that they buy a car that they didn't even know existed, but it fits exactly what they needed better than they thought."

Facility considerations also factor as important. PEV specialists emphasized that PEVs are a *lifestyle* product. In other words, customers associate PEVs with a certain lifestyle, for example the "green" lifestyle or the "commuter" lifestyle. To market PEVs successfully, dealers must help customers "connect the dots" between PEVs and the lifestyles they lead or aspire to lead. Interviewees pointed to facilities that co-locate PEV models in LEED-certified facilities and alongside complementary technology products like Level 2 chargers or solar canopies as prime examples. Some had acquired HOV lane access decals from the state motor vehicle department and affixed them to vehicles on the lot and/or showroom floor (see Exhibit 6-1). One dealer touted this technique as a great "conversation starter" regardless of whether the customer came in with the intent to buy a plug-in vehicle.

Exhibit 6-1. On-lot marketing of PEV models, complementary technologies (note solar canopy and Level 2 chargers, *Left*), and HOV decals (*Right*).

In addition to novel use of physical space, some leading PEV dealers exercise initiative in the virtual arena as well. Dealers typically maintain an online presence that at minimum lists vehicle inventory and pricing as well as descriptions of the store and its staff. PEV dealer innovators go further. Some provide dedicated real estate on the dealer web page for PEV models and links to supporting PEV-related products and services. Designated PEV specialists may participate in online forums and chatrooms for PEV drivers. These settings often provide a robust source of information for dealers as participants raise issues and discuss fixes for various problems that emerge, sometimes well ahead of formal notifications from the factory. The forums also provide an opportunity for dealers to answer questions, inform customers, and ultimately guide prospective buyers to the dealership. Finally, dealers with more robust web-based marketing efforts employ targeted marketing techniques that use common keywords and phrases entered by online car shoppers to reach PEV customers and attract them to the dealership.

6.3.4 Outreach

PEV dealer innovators further stand apart from their peers by taking initiative in a number of other respects. This can take the form of grassroots outreach by sales staff to local EV user groups who often assist sales people to develop leads through public education and outreach, often at little or no cost to the dealer. Examples include facilitating ride and drive events at high-traffic locations like community fairs and festivals. Some dealers have proactively pursued leads at local employers, particularly targeting technology companies with large corporate campuses. Dealers paired these efforts with preferred pricing packages negotiated with the automaker to target these communities. Finally, PEV salespeople often developed their own collateral with PEV-specific information and links for additional after-sale support and assistance. Many also cited the importance of following up with customers at regular intervals post purchase.

6.4 Insights on Industry Incentives

Automakers detailed a number of tools they dispatch to incent dealers to sell PEVs more effectively. These include use of industry-standard incentives such as spiffs and spins, credits toward volume bonus and recognition targets, and dealer contests. Ford, for example, launched a competition in which salespeople from dealers across the country vied to put on the best 'walk-around' (or 'show and tell') demonstration of the features and attributes of the company's PEVs. Winners received a bonus and recognition for the salesperson and the dealer they represented. The company then shared videos and scripts from the best performers with its dealer network. OEMs occasionally conduct similar contests at the regional level.

Automakers, however, acknowledged the limits of these tools for influencing dealer behavior. According to one OEM representative deeply involved with preparing dealers for alt fuel vehicles, “These tools have not evolved to the more significant challenge ahead of us.” In particular, the ability to create demand and deliver a uniform, high-quality experience to the differentiated needs of these buyers. “Dealers are highly process oriented”, the OEM representative elaborated. Historically, introducing a new technology (e.g., OnStar, XM radio, GPS, Bluetooth) that relied on a dealer to execute a new or different process proved an Achilles heel. Each dealer has their own procedure and these can vary not only across dealerships but within each one. For example, a dealer might have twenty stores but only five of any given make. Differences extend to ownership structure as well. Publicly held dealers have different requirements then privately held operations.

Moreover, in terms of demand-building, that role rests principally with the manufacturer. “Our [the automaker’s] job is to create the demand that shows up at their dealership,” said one automaker representative. Dealers are there to fulfill that demand. “It is rare that salespeople actively go out and develop clients.” Another put it more bluntly. “The idea that dealers will be educators of the public… is not going to happen.” In sum, automakers must build awareness and demand before the buyer ever arrives at the dealership.

OEMs and dealers further explained that the current system highly discourages cross-selling of customers into a different vehicle then the one they had in mind when visiting the dealer. Customers do their research online and consult their social networks when deciding on which vehicle to buy. 90-95% of customers arrive at the dealership primed to choose among particular models on a short-list of competitors in a particular size category (e.g., Honda Civic versus Toyota Corolla, or Nissan Pathfinder versus Ford Explorer). Introducing another variable into the decision calculus risks losing the sale.

Cross-selling puts automakers at risk as well. "Our fear", admitted one OEM representative, "is that we don't want incentives so strong for EVs that customers get pushed into a car that they don't understand, have a bad experience and become avoiders of [the make]." Hence, OEMs and dealers alike underscored that the practice of cross-selling is neither condoned nor routinely used. This holds in both directions, whether the goal is to get a customer out of a conventional car and into an EV, or to get them out of an EV and into a conventional car.

6.5 Insights on Public Incentives

Interviewees readily offered their opinions of public incentives for PEVs and their insights for improving on them. This section reviews the key themes that emerged on this topic.

6.5.1 Continued Government Supports Needed

Dealers expressed universal agreement on the need for continued government supports for PEVs. Those adjacent commute corridors cited single occupant access to the HOV lane as one of the most powerful incentives in their marketing arsenal. One dealer captured the sentiment of several interviewees: "If you take the HOV incentive away… we saw that with the hybrid… we went from selling 30 a month to seven."

Dealers also widely supported California's clean vehicle rebate program (CVRP) and noted its value in selling more vehicles than they might otherwise. "I tell everyone about the

$2,500. Most of them don't know actually. So that's what… sells the car," one salesperson stated. Dealers and sales personnel alike signaled that current amounts were appropriate and should continue for the near to mid term. Most agreed these programs were not particularly burdensome from a paperwork or overhead perspective.

6.5.2 Pull Incentive Benefits to the Point of Purchase

When asked about how to improve existing programs, many dealers urged front-loading public incentives for maximum impact on PEV sales. As a case in point, dealers emphasized the federal tax credit provides a key selling point, but only for lease customers. A disproportionately large number of PEV customers choose leasing, since automakers can pass the full credit on to customers in the form of a capital cost reduction. This equates to substantial reductions in monthly payments that can make PEVs a compelling alternative compared to conventional vehicles from a monthly savings or total cost of ownership perspective. The amount of the benefit for purchases involving cash or loan financing, on the other hand, depends upon unknowables such as the customer's tax liability. Hence, dealers typically refer the customer to their accountant for guidance or else steer the customer toward the lease option.

This factor was a major contributor to the popularity of special leases for PEVs. During the first months of the initial roll out of PEVs, lease options were not particularly attractive for many customers, dealers reported. Particular dealers, however, urged automakers to implement an attractive lease option. This could be achieved by leveraging the ability of captive finance companies (automakers own the lender) to capitalize the full value of the federal tax credit into the sales contract, thereby making PEV models affordable to more customers. The automaker responded and others quickly followed suit, implementing similar special lease programs that captured the federal credit and slashed monthly lease payments. Moreover, automakers learned from their dealers to match the minimum down payment amount to the size of the state rebate check. Dealers then had a more powerful ‘no money down’ pitch to prospective PEV buyers.

Several dealers lauded process improvements orchestrated with California’s department of motor vehicles (DMV) that afforded dealers the opportunity to obtain HOV decals upon taking inventory from the manufacturer. This applied to both the white federal sticker for vehicles that operate exclusively on alternative fuels and the green state-issued sticker for plug-in hybrid vehicles. A number of dealers actively marketed the perk to PEV customers (see the *Learning Environment* section), especially commuters near traffic corridors featuring HOV lanes. Techniques included affixing them to PEVs on the lot and featuring them on window stickers and various showroom collateral (Exhibit 6-2).

Exhibit 6-2. Samples of showroom marketing collateral (*Left*: window placard; *Right*: Spark EV Kiosk).

Dealers underscored the need for similar adjustments to other public incentives. Pulling incentive benefits forward to the point of purchase, dealers claimed, confers the certainty needed to actively market public incentives either through local advertisements or by incorporating them on window stickers and in their sales pitch. It also magnifies the impact of the incentive benefit for customers. Said one dealer, "Given the choice between $2,500 as it is now or $1,500 at point of sale… I'd take the point of sale stuff. It would be more valuable at the dealership level." In other words, a bird in the hand is better than two in the bush. To this end, many dealers suggested waiving state sales taxes on PEVs as a potentially powerful tool for convincing customers. In sum, dealers stressed that the elements of immediacy and certainty reinforce efficacy and bolster opportunities for dealers to market public incentives more effectively.

6.5.3 Assure Availability of Public Incentives

Dealers similarly emphasized the need for greater certainty around the availability of public incentives. State programs, for example, such as California's single-occupant HOV lane access decal and CVRP rebate, rely on annual authorizations from the state legislature. Typically, these programs place a cap on outlays or other restrictions that effectively decouple supply with actual consumer demand. In each of the past two years, demand outpaced these allotments. In both cases, the legislature authorized additional green HOV decal allotments and rebate funding. Customers, however, were placed on a wait list that often saw rebate checks taking as long as three months to reach customers.

The prospect of shortfalls in funding for rebates or allocation of HOV decals places dealers at risk of stocking PEV inventory that could prove difficult to move without these supports. Moreover, it increases liability exposure due to increased potential for miscommunication with customers. Consequently, some dealers noted they must reduce their allocation and exercise greater caution when marketing these incentives. While online indicators provided by state agencies aid in monitoring current status and burn-down of state incentive budgets, many voiced a preference for programs with definitive beginning and end dates rather than a floating end date that is difficult to predict. Such a design would give dealers 100% assurance in the availability of public incentives, thereby eliminating liability risk and giving them the confidence to actively market these incentives.

6.5.4 More Charging Infrastructure

Dealers that sell pure EVs (BEVs) often reiterated the need for more public charging infrastructure. More chargers at key destinations and workplaces, dealers argued, can effectively double the range of today's BEVs, many of which are limited to 50 miles of range or less in unfavorable conditions (e.g., freeway speeds, freezing temperatures, poor weather, etc.). Doing so would make BEVs a more attractive commuting option to more customers.

6.5.5 Relax Minimum Ownership Requirements

A few dealers suggested relaxing customer eligibility requirements for the CVRP state rebate program by reducing the minimum ownership term to 24 months from the 36 month requirement in effect at the time. Doing so, these dealers argued, would achieve multiple goals. First, it would effectively increase public exposure to PEVs by putting more "butts in seats". Second, dealers speculated that it would increase the rate of 'sales turns', or the frequency with which customers return to the dealer to purchase a new car. For example, over a six-year period, a customer on consecutive 36-month lease terms would visit the dealer a total of three times. In contrast, over six years a customer on a 24-month term would visit the dealer a total of four times. The incremental increase in transactions translates to more opportunities for the dealer to win customer loyalty and earn a profit. Said one PEV dealer, "What if California offered $1,000 or $1,500 if you had a two-year lease? I think that would even push [PEVs] even more... They don't want to be in it for three years. They come back in another two years, I'm happy." Shorter lease terms may also contribute to more stable valuation of residuals (i.e., a vehicle's estimated wholesale value at the end of the lease term).

6.5.6 Dealers Need Incentives, Too

Some dealers argued for publicly-funded dealer incentives as recompense for added dealer costs and effort associated with PEV sales. Automaker incentives wax and wane, which places the dealer at greater risk of stranded inventory. As one dealer put it, "When the big bonuses stopped, so did the sales." A consistent incentive, these dealers stressed, would properly motivate dealers to stock them and salespeople to sell them. The same dealer explained, "If you make it worth somebody's while, they become an expert on the car overnight". Salespersons in the top selling quartile, however, contended that current incentives are sufficient to sell these vehicles. Rather, these individuals explained, salespeople must learn to adjust their approach and dealers must implement more effective methods for selling PEVs (see the Retail Innovation and Emerging Practices section).

6.5.7 Better Access to PEV Information

A number of dealers expressed frustration with the fragmented nature of information relating to government and utility incentives for PEVs, specifically the availability and accessibility of accurate and timely information appropriate for the retail environment. Automaker websites typically provide only general information about available incentives of little practical use to salespeople. Often, these may be simple mention of federal or possibly state-level incentives. Others provide embedded links to sources for each incentive type (e.g., individual state incentive websites such as driveclean.ca.gov) or to sites that attempt to aggregate the various incentives available (e.g., DOE's fueleconomy.gov or Plug-in America's incentive locator site). Accurate and timely information on regional and local-level PEV incentives and discounts and utility rates require additional investigation elsewhere on the web. No one website, app or other tool, holds the complete picture for just which incentives any given PEV customer may qualify for. Consequently, customers routinely visit the dealership armed with information that dealers themselves lack the means to match.

6.6 Other Challenges

Several automakers lamented that differences in dealer-level processes, and the inability to uniformly affect process changes for advanced alternatives like PEVs and fuel cell vehicles across dealer networks, presents a major barrier to commercialization of these technologies. Some dealers excel in terms of PEV sales volume and retail satisfaction, but many fall short. OEM representatives avoided the subject of franchise laws but nevertheless made clear that strict rules limit the options available to them. Automakers stressed they cannot mandate adoption of PEV-friendly processes by dealers that choose to sell them. Moreover, in most cases they cannot explicitly restrict the set of dealers to those best suited to offer them. Restrictions are sometimes used, but only in the context of small-scale pilot, demonstration, specialty vehicle or other limited volume programs. Though specific terms vary by manufacturer and their franchise contracts, once an automaker introduces a full production vehicle to one dealer it must offer them to all within a set period, typically six months.

Automakers, however, can set 'reasonable' threshold criteria and certain preconditions for dealer participation in full production programs. For special technology, this can include specific training or certification of dealer staff, purchase of special equipment or related facility upgrades. Automakers can also specify that appropriate market conditions exist as a prequalification for dealer sales of PEVs. For example, an automaker could make proximity to certain support infrastructure a condition of participation. In the case of forthcoming fuel cell vehicles, for example, OEMs can specify that dealers selling them must reside within a given distance of a hydrogen fueling station. Such stipulations, however, must pass a legal test of 'reasonableness' or else face possible court challenges by dealer groups. Similar restrictions for PEVs (e.g., requiring dealer proximity to DC fast charge infrastructure), however, may prove more troublesome since the lack of such stations would arguably not impact the customer's ability to use the vehicle. In this case the customer could, for example, charge at home.

6.7 Tesla Motors

Compared to franchise dealers, interviews with Tesla representatives described a distinctly different experience. Tesla exclusively sells PEVs consisting of one flagship vehicle, the Model S (Tesla had discontinued sales of the Roadster which had been produced in very limited serial quantities). Moreover, the company was focused on the build out of retail stores, service centers and charging infrastructure to support the growing but still small numbers of Tesla buyers.

6.7.1 Compatibility of the Franchise System

Tesla's Chairman and CEO, Elon Musk, had publicly stated that dealers selling PEVs alongside conventional ICE offerings suffer from a fundamental conflict of interest. Tesla representatives elaborated, maintaining that the franchise model is incompatible for a number of reasons. First, the franchise model is a poor fit for smaller start-up manufacturers like Tesla. This is because it takes years to achieve sufficient scale to supply dealer networks with adequate inventory and to achieve more affordable pricing by virtue of that scale. Second, Tesla builds its product entirely on an all-electric architecture with much lower part count and little mechanical wear or service requirements. Tesla representatives further described features such as OTA software updates and firmware patches (bug fixes) as significant elements of the value proposition for its customers. These inherently undercut the main pillars of dealer profit, namely service, maintenance and parts.

Many automotive franchise agreements and state laws require that dealers, not the OEM, implement these improvements and fixes. Moreover, as a tenuous start-up in an industry notorious for its entry barriers, Tesla is entirely dependent on the success of its first few models for its very survival. Consequently, Tesla must balance affordability with optimal margins to ensure sufficient consumer demand and to return the capital needed to scale the business.

A competition advocacy paper published by the U.S. Justice Department's Economic Analysis Group supports this contention. The report estimated, based on an earlier study by Goldman Sachs, that direct distribution could lower vehicle prices by approximately 8.6%, or about $2,225 per vehicle (Bodisch 2009). Direct distribution could achieve these savings from greater efficiencies in matching supply with demand, lower inventory, fewer dealerships, lower sales commissions and reduced transport costs (ibid., Crane 2015). From Tesla's perspective, dealers not only add cost due to these inefficiencies but then pocket a portion of the profit the company deems essential to fuel its own growth.

Tesla contends that dealer groups fight accommodations for the company's unique approach out of fear that other entrants, namely emerging Chinese automakers, may similarly pursue direct sales. This, dealer groups fear, would compel other large OEMs to pressure for similar accommodations on the argument of allowing them to compete on a level playing field. Dealer groups have mobilized to, in Tesla's view, protect the franchise model. To address this concern, Tesla has conceded to limiting its requests for exemptions from state franchise laws to US manufacturers. Nevertheless, many dealer groups continue to lobby against accommodations for alternatives to the franchise system (see Crane 2015).

Dealer groups also maintain that the franchise model protects consumers by ensuring that buyers can obtain parts and service should the OEM go out of business. Interviewees contested this argument on a few points. First, most dealerships lack the parts inventory needed to live up to that promise. Second, the majority of vehicle components are sourced from tiered suppliers and therefore remain available to repair and body shops. Lastly, a robust market of independent service mechanics exists for customers to fall back on.

Tesla emphasized the importance of ensuring the highest product quality and customer satisfaction. The success of new technologies, interviewees argued, hinges on winning new customers and ensuring the company keeps the ones they already won over. Generating positive word-of-mouth is the life blood of a new technology and that of any start-up bringing a new technology to market. The direct-to-consumer (D2C) model, Tesla argues, affords the company optimal control over the customer experience, which encompasses not only the retail environment, but the supporting service and charging infrastructure as well. "We've tried to set ourselves up for success as best we can by controlling as many of those elements as possible," said a senior member of Tesla's business development team. As an example, the company's process reduced the time from customer complaint to review and issue of a service bulletin to as little as one week, a remarkably short turnaround period by industry standards.

The D2C model, interviewees claimed, affords Tesla the ability to deliver a level of service that drives WOM with greater impact and much lower cost than traditional marketing techniques like ad campaigns and Superbowl spots, representatives argued. The company's model also keys on efficiencies made possible by Internet commerce. For example, Tesla fully leverages its web interface for both informational and transactional purposes. This means the company can drive traffic to its web portal where it can then transact orders even in states that ban its brick-and-mortar stores. Nevertheless, Tesla envisions that with greater scale it may ultimately shift to a franchise model or some hybrid of direct and franchise outlets. Meanwhile, the company views itself as a positive force for change in the industry.

6.7.2 Retail Stores and Service Centers

A key facet of Tesla's D2C model is its use of retail stores situated in high-traffic shopping destinations. Company representatives cited this technique as pivotal for introducing new technologies to an unfamiliar public and pointed to several benefits of the store approach. First, stores situated in popular shopping destinations achieves maximum exposure to drive greater awareness of the technology and the brand. Second, the technology appeals to customers looking for products, cars included, that appeal to their lifestyle choices and values. The stores reflect themes that resonate with Tesla's target demographic and include environmental benefits and quality high-tech products that integrate the latest in wireless connectivity and touchscreen capabilities. Third, stores incorporate a significant interactive element that, in combination with no commission product specialists, invite customers in to explore, ask questions and learn. Tesla also cited a more pragmatic reason for the use of stores: Lack of resources for the large property and facility acquisitions a traditionally-styled dealer network would require. Retail stores in malls and shopping centers solved that problem. Each store needed only one showroom vehicle, complemented by kiosks and on-wall displays showcasing optional features and trims.

To convince customers to make a switch to electric mobility takes overcoming a number of preconceived notions about not just electric vehicles but about the buying process itself. The stores, and in particular the company's product specialists, help re-frame the conversation around the unique value of electric driving, interviewees explained. For example, product specialists are trained to focus less on the up-front vehicle price, which is much higher for EVs and the Model S in particular, and more on the monthly cost equation. This includes not just gas savings but savings from public incentives, utility rate discounts, and less frequent maintenance and service due to lower wear and tear and fewer moving parts. They also underscore the convenience of home charging, OTA software updates, and the benefits of pairing the vehicle with home solar. The sum total of these attributes positions the product as a competitive alternative to conventional, albeit premium, gas-powered vehicles.

Moreover, direct ownership of retail storefronts, charging infrastructure and service centers speeds troubleshooting and problem resolution by shortening the chain of communication and assuring uniform implementation of fixes throughout its entire service network. A Tesla service manager with decades of prior experience with the dealer service departments touted the "direct line" to corporate as critical for assuring high service quality and customer loyalty.

6.7.3 Policy Insights

Tesla views regulatory and policy intervention as an essential catalyst for the creation of a fair market for alternatives, and new entrants in particular. Tesla lauded the ZEV mandate and credited it with helping the company through a particularly vulnerable period in its history. The credit trading scheme lends manufacturers the flexibility to meet the targets through a variety of pathways, the interviewee explained. "At an early stage, it was very important for us to have the capability to sell excess credits". These funds continue to fund internal R&D focused entirely on advancing electric mobility.

Tesla representatives expressed their hope that ARB hold fast against calls by industry to weaken or delay the mandate's implementation. Said a senior Tesla executive, "We would like to see it [the ZEV mandate] actually get even more strict because we think that the manufacturers have found ways to effectively slow down the entrance of some of these products into the marketplace." As an example, the planned increase in the number of ZEV credits for each FCEV placed in operation (from 7 to 9 credits between 2015 and 2017) would effectively enable automakers to satisfy their requirement more quickly. This could, it was argued, end up pandering to automakers whose intent may be to minimize the cost of compliance rather than commit to growing the market, ultimately resulting in fewer alternatives on the road.

Similarly, Tesla is resisting calls for a MSRP cap or other restrictions that interviewees claimed would unfairly target new entrants. ARB data showed 20% of Model S buyers cited the rebate as a prime factor in their purchase decision, a not insignificant sum from a market where the company derives most of its US sales. Calls to amend the ZEV formula to increase the number of credits earned for PHEVs further rankles the company, since any changes that favor PHEVs would translate into less revenue for Tesla from credits sold to automakers either unable or unwilling to meet current ZEV requirements. Moreover, the company questions the use of public funds for build out of alternative fuel infrastructures (as was proposed by Assembly Bill 8 and later signed into law), something it believes automakers should be doing themselves.

Interviewees acknowledged a greater need to work alongside utilities, national labs and other government agencies. They noted, however, that their pace of operations often doesn't mesh well with Tesla's internal needs for speeding developments to market the firm deems necessary to ensure commercial success. "It's a clash of culture that can make that [partnerships] challenging sometimes."

In sum, Tesla prides itself as a disruptor of the status quo in which the large strides needed to achieve sustainability goals are stymied by large incumbents wedded by virtue of their business model to incremental improvements. As the company sees it, their existence and continued success offers proof that a profitable market for PEVs exists where firms can muster the willingness and ingenuity to pursue it.

7 Results III: Buyer Survey Data Analysis

This chapter is the last of the three chapters in the Results section. It presents findings from the statistical analysis of national survey data on retail satisfaction from new car buyers. This includes descriptive data about conventional ICEV and plug-in vehicle buyers and their unique characteristics, as well as the inferential statistical findings about the relationship between the study variables.

Recall from Chapter 4 that the research design entailed testing initial hypotheses (labeled H1a and H1b in Table 7-1 that follows), which the researcher based on the contingency theory of high-tech marketing. This theory suggests that manufacturers using innovation-specific distribution approaches (i.e., a niche strategy focused on "whole product" end-to-end support of the customer) should witness better performance with early market customers than manufacturers using generic (i.e., mass market) introduction strategies. The researcher considered whether this theory might explain differences in retail quality reported by PEV buyers. These results, in combination with insights gleaned from interviews detailed in the previous two chapters, informed the construct of additional hypotheses related to factors that might explain the H1a and H1b findings from tests of the initial hypotheses. Table 7-1 summarizes these hypotheses and the anticipated findings. Chapter 4 (Research Methods) details the development of these hypotheses from the interview data and literature review.

Table 7-1. Summary of the research hypotheses.

No.	Hypothesis	Make Category	Response Variable	Variable of Interest	Control Variables	Predicted Relationship
H1a	A difference in retail satisfaction with dealers exists between PEV and ICEV buyers.	Non-premium	RS	P	D*i*, ST	PEV buyers rate retail satisfaction from dealers lower than ICEV buyers
H1b	A difference in retail satisfaction exists between customers who bought a PEV through direct distribution and customers who bought an ICEV via established dealers.	Premium	RS	P	D*i*, ST	Buyers purchasing PEVs through direct distribution rate retail satisfaction higher than ICEV buyers purchasing via dealers.
H2a	A difference in total transaction time at the selling dealership exists between PEV and ICEV buyers.	Non-premium	TS	P	ST	PEV buyers report more total time spent at the dealer than ICEV buyers
H2b	A difference in total transaction time exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	TS	P	ST	Buyers purchasing PEVs via direct distribution report shorter purchase transaction times than ICEV buyers via dealers
H3a	A difference in the duration of vehicle delivery at the selling dealership exists between PEV and ICEV customers.	Non-premium	TD	P	D*i*, ST	PEV buyers report a longer vehicle delivery stage via dealers than ICEV buyers
H3b	A difference in duration of the vehicle delivery stage exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	TD	P	D*i*, ST	Buyers purchasing PEVs via direct distribution report a longer delivery stage than ICEV buyers via dealers
H4	A difference in the percentage of buyers representing conquest sales exists between PEV and ICEV customers who bought through established dealers.	Non-premium	CS	P	D*i*, ST	PEV buyers represent more conquest sales than ICEV buyers
H5	A difference in reported intent to return to the selling dealer for paid services exists between PEV and ICEV customers who bought through established dealers.	Non-premium	PS	P	D*i*, ST	Fewer PEV buyers intend to return to the selling dealer for paid services
H6	A difference in the percentage of reported cross-selling by dealers exists between PEV and ICEV customers who bought through established dealers.	Non-premium	XS	P	D*i*, ST	A greater percentage of PEV buyers report cross-selling by dealers
H7a	A difference in intended make loyalty exists between between PEV and ICEV customers who bought through established dealers.	Non-premium	L	P	D*i*, ST	PEV buyers using dealers report lower intended make loyalty than ICEV buyers
H7b	A difference in intended make loyalty exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	L	P	D*i*, ST	Buyers purchasing PEVs via direct distribution report higher intended make loyalty than ICEV buyers purchasing via dealers

RS = Retail Satisfaction; TS = Total purchase transaction time; TD = Duration of the vehicle delivery stage; CS = Percentage of buyers that switched from competing makes; PS = Buyer intent to the return to the dealer for paid services; XS = Incidence attempts by dealers to sell a buyer a car they did not want; L = Intended buyer loyalty to the make; P = Powertrain Choice; D*i* = Demographic variables; ST = Buyer's state of residence (random effect)

7.1 Data Overview

The data consisted of 29,040 total respondents. The data file required cleaning to include only buyers with no incomplete responses to key demographic variables and other variables of interest to the researcher. This resulted in a sample of 13,526 responses for the non-premium category and 5,748 for the premium category (19,274 total responses).

Data from the total *non-premium* buyer population (ICE and PEV buyers) included respondents between 18 and 94 years of age (median age = 51). Nearly 40% of new vehicle buyers were a member of the baby boom generation (born between 1946 and 1964) (November 2011). A substantial majority of buyers were white (85.1%), male (63.0%), married (70.0%), and earned at least a college degree (57.8%). Nearly one in four buyers (24.2%) possessed an advanced degree.

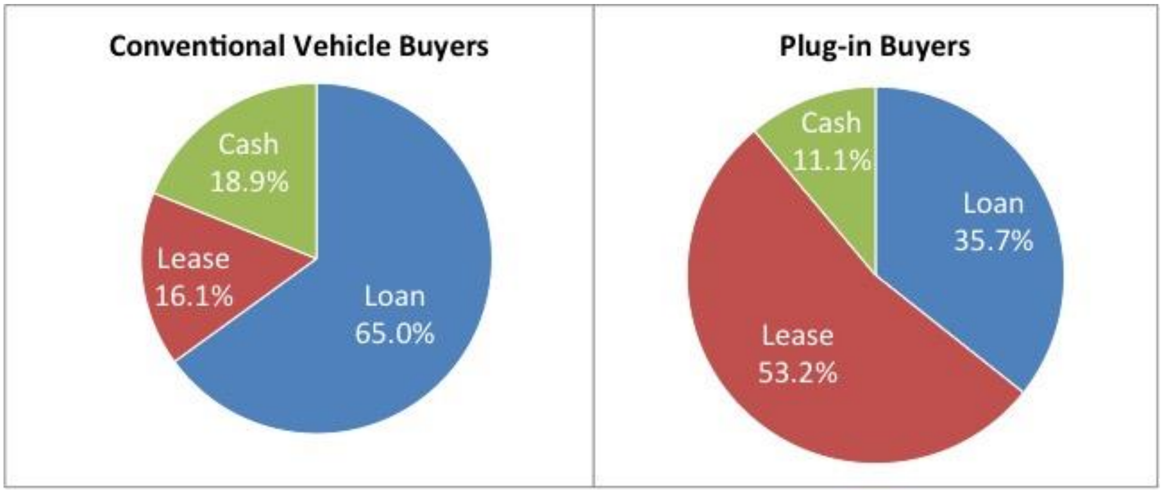
Data from the total *premium* buyer population (ICEV and PEV buyers) included respondents between 18 and 95 years of age (median age = 54). Boomers comprised 47.2% of new vehicle buyers. A substantial majority of buyers were white (82.0%), male (70.0%$), married (76.4%) and earned at least a college degree (77.2%). 39.0% held an advanced degree. Table 7-2 further parses the demographic composition of the sample by market category (non-premium and premium) and powertrain choice.

Table 7-2. Summary of sample demographic composition by market category and powertrain choice.

		Non-Premium		Premium	
		PEV	ICE	PEV	ICE
Variable	**Category**	N=545	N=12,981	N=100	N=5,648
Age Group (Generation)	Gen Y	12.7%	20.4%	8.0%	11.2%
	Gen X	22.0%	22.6%	35.0%	24.5%
	Boomer	52.5%	43.7%	47.0%	47.2%
	Pre-Boomer	12.8%	13.3%	10.0%	17.2%
Gender	Male	78.2%	62.3%	90.0%	69.7%
	Female	21.8%	37.7%	10.0%	30.3%
Marital Status	Married	80.0%	69.7%	88.0%	76.2%
	Not Married	20.0%	30.3%	12.0%	23.8%
Education Level	Adv. Degree	45.9%	23.3%	57.0%	38.7%
	College Degree	80.6%	56.9%	85.0%	77.1%
	No Degree	19.4%	43.1%	15.0%	22.9%
Household Income	< $40K	2.8%	11.3%	1.0%	1.3%
	$40K - $124,999	30.0%	45.2%	10.0%	17.8%
	$125K - $249,99	55.0%	38.4%	19.0%	49.0%
	$250K or more	15.2%	5.1%	70.0%	31.9%
Race	White	85.3%	85.1%	86.0%	81.9%
	Non-white	14.7%	14.9%	14.0%	18.1%

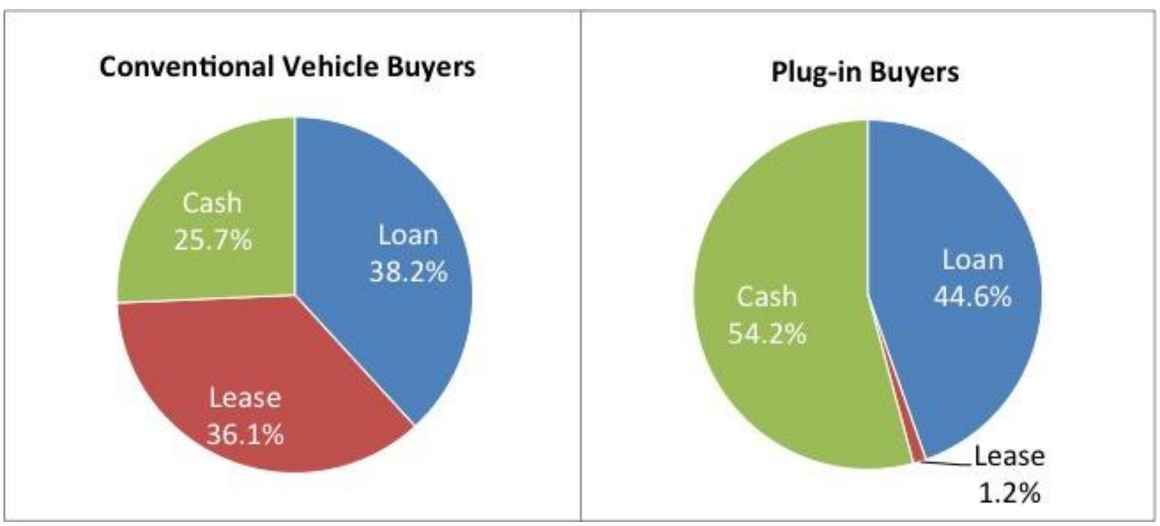
Source: *2013 Sales Satisfaction Index (SSI) Study,* J.D. Power & Associates

The researcher further examined how buyers paid for their new vehicle purchase. Figure 7-1 and Figure 7-2 present the breakdown of payment method by powertrain choice and market category. Leasing comprised a much larger percentage of non-premium PEV buyers. Note that this data predates Tesla's leasing program. Hence, as the sole option for premium buyers leasing represented a near negligible fraction of the total (Figure 7-2).



Source: *2013 SSI Study*, J.D. Power & Associates

Figure 7-1. Payment method for non-premium makes by powertrain choice.



Source: *2013 SSI Study*, J.D. Power & Associates

Figure 7-2. Payment method for premium makes by powertrain source.

7.2 Statistical Analysis

The researcher analyzed the *2013 SSI Study* data to explore the effect of powertrain choice (i.e., PEV versus ICEV) while controlling for demographic factors (and their interaction) on several response variables. Response variables included retail satisfaction, time spent at the retail facility by buyers and other characteristics of interest. These are grouped accordingly:

7.2.1 Analysis 1a: Modeling Buyer Retail Satisfaction

Group 1 consists of questions that investigate the effect of powertrain choice while accounting for demographic factors (and their interaction) that may explain sources of variation in retail satisfaction reported by new car buyers. Recall from Chapter 4 (Research Methods):

> H1a: *For* ***non-premium*** *makes, a difference in retail satisfaction with dealers exists between PEV and ICEV buyers.*

Prediction: PEV buyers rate retail satisfaction from dealers lower than ICEV buyers.

> H1b: For **premium** makes, a difference in retail satisfaction exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.

Prediction: PEV buyers rate retail satisfaction from innovation-specific distribution channels higher than ICEV buyers purchasing from established dealer channels.

Analysis: For both H1a and H1b, the researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for retail satisfaction while accounting for demographic effects using a linear mixed effects (LME) approach.

The study initially addresses the following question: *Accounting for demographic sources of variation, does powertrain choice explain variation in retail satisfaction?* The research considers this question for both non-premium and premium makes using the two-step information theoretic (IC) approach detailed in Chapter 4 Research Methods.

Recall from Chapter 4, that in the first step the researcher fits demographic effects to account for variation in the response that might otherwise confound the predictor variables of interest (e.g., powertrain choice). The demographic model took the form:

$$RS = \beta_0 + \beta_1 \text{ E} + \beta_2 \text{ G} + \beta_3 \text{ I} + \beta_4 \text{ N} + Z_1 \text{ ST} + \varepsilon$$

where βs represent coefficients for intercept (0), education level (E), gender (G), household income level (I), age group (N), and Z_1 represents the random effect for buyer's state of residence (ST). Briefly, retail satisfaction can be evaluated robustly by first fitting demographic effects to the response and treating these terms as additive fixed effects. Thus, the researcher initially posited over thirty models in which various potential interactions among demographic terms were explored (e.g., Step I, Table 7-3 and Table 7-4). A parsimonious demographic model was identified using the model selection process described in Chapter 4 (Research Method). A parsimonious model is the simplest model that represents the most amount of variation in the response (i.e., it is the best-approximating model). Recall from Chapter 4 Research Methods that log likelihood (LL) is a measure of goodness of fit; AIC*c* is the Akaike's Information Criteria with a second-order bias correction for sample size that provides a measure of fit with an added penalty for complexity (number of parameters); *w* represents the Akaike's weight, which is the conditional probability that the corresponding model represents the best-approximating model;

and C*w* represents the probability of that model, or any model ranked higher (i.e., lower AIC*c*), being the best model within the consideration set.

Referring to Table 7-3 as an example, model Ia was the best-approximating demographic model of those considered (alternative models yielded ΔAIC*c* $\geq$ 2.0 relative to the best-approximating demographic model). Stated another way, there are no other combinations of variables that compete with this model. Variables that were not supported as covariates for retail satisfaction in this example consisted of race (R) and marital status (M).

Note that Akaike's weight, *w*, is useful for determining a superior model in situations where multiple models are strongly supported by the data (ΔAIC*c* < 2.0). For example, suppose a hypothetical model, "model 1", has an Akaike's weight equal to 0.4 and another competing model, "model 2", has an Akaike's weight equal to 0.2. This means that model 1 has a conditional probability of being the best-approximated model of 40% compared to 20% for model 2. The researcher can compare the ratio of Akaike's weights between the candidate best-approximating model and the competing model and conclude that model 1 is twice as likely to be the best-approximating model than model 2 in this example.

The second step examined evidence for variation in retail satisfaction explained by powertrain choice and compared that evidence to the best-approximating model comprised of entirely of demographic factors from the first step using the same IC technique as Step I. The powertrain choice model took the form:

$$RS = [\mathrm{DF}_R] + \beta_P\,\mathrm{P} + Z_1\,\mathrm{ST} + \varepsilon$$

where DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intra-class correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

Retail Satisfaction: Analysis of Non-Premium Makes

For non-premium makes, the best-approximating demographic model (identified by the lowest AIC*c* value) for overall retail satisfaction included household income (I), education level (E), gender (G), and generational affiliation (N). Two main factor effect terms including race and marital status and all interaction terms were eliminated. Recall from Chapter 4 that a ΔAIC*c* ≥ 2.0 indicates significant difference in variation explained between the model of interest and the best-approximating model. For example, if ΔAIC*c* ≥ 2.0, than it lacks fit compared to the best-approximating model. A ΔAIC*c* ≥ 7.0 indicates a strong significant difference.

Model Ia (Table 7-3) was 67.21 AIC*c* units less than the null model (model Ii, random-effect only). Removing additional variables resulted in higher AIC*c* values. A likelihood ratio test (also described in detail in Chapter 4 Research Methods) yielded a model that fit the data substantially better than the null model (LRT χ^2 (8) = 83.2, p = < 0.001).

In Step II of the analysis, the researcher compared evidence between the best model of demographic factors from the previous step to a model in which powertrain choice (P) was included as an explanatory variable. Models were developed to consider both an additive effect and potential interaction effects between powertrain choice and key demographic variables (i.e., income, education, and gender) from the previous step (Step II, Table 7-3). The analysis revealed that the best-approximating model included only an additive effect for P (model IIa, Table 7-3), although competitive models included interactions between powertrain choice and education (ΔAIC*c* = 0.77) and between P and the education (E) and gender (G) variables (ΔAIC*c* = 0.89). A comparison of the ratios of Akaike's weights ($w_{\text{model IIa}}$ / $w_{\text{model IIb}}$) and ($w_{\text{model IIa}}$ / $w_{\text{model IIc}}$), however, indicates model Ia ($w_{\text{model IIa}}$ = 0.33) is at least 1.5 times more likely to be the best-approximating model relative to model Ib ($w_{\text{model IIb}}$ = 0.22) and model Ic ($w_{\text{model IIc}}$ = 0.21). Model IIa was 25.3 AIC*c* units less than the demographic factor only model (model IIf) and 92.5 AIC*c* units less than the null model (model IIg, random effects-only model; LRT χ^2 (9) = 110.5, p = < 0.001). **This indicates a strong significant difference in retail satisfaction between PEV and ICEV buyers**. PEV buyers reported significantly lower retail satisfaction scores than ICEV buyers.

Based on the β coefficient in the best-approximating model for powertrain choice, predicted outcomes revealed plug-in vehicle buyers rated dealers substantially lower (-0.51 points, SE = 0.09) than conventional buyers with strong evidence of support (LRT χ^2 (1) = 27.3, $p < 0.001$) when accounting for variation stemming from demographic factors (see Figure 7-3). **This finding confirms the researcher's hypothesis that, for non-premium makes, PEV buyers rate dealers lower in retail satisfaction than ICEV buyers**.

Other significant factors affecting retail satisfaction were noted. Female buyers rate dealers 0.13 points (SE = 0.038) higher than male buyers when accounting for powertrain choice as a source of variation in retail satisfaction with significant support from the model

(LRT $\chi^2(1) = 11.2$, $p < 0.001$). Similarly, significant differences in retail satisfaction were predicted based on generational affiliation (age group). Generation Y ("Gen Y") buyers scored retailers 0.29 points (SE = 0.07) lower than baby-boomers. Generation X ("Gen X") buyers similarly rated retailers lower (-0.27, SE = 0.06). Also, college-educated buyers rated retailers 0.23 points (SE = 0.04) lower than buyers without a college degree. All had significant support from the data ($p < 0.001$). Figure 7-3 illustrates the difference in retail satisfaction scores between plug-in and conventional vehicle buyers.

Table 7-3. Evaluation of linear mixed effects models comprised of factors influencing new vehicle buyer satisfaction with the selling dealership (non-premium makes).

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood;

ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**I + E + G + N**	**11**	**58553.0**	**-29265.5**	**0.00**	**0.46**	**0.46**
	b	I + E + G + N + M	12	58555.0	-29265.5	2.00	0.17	0.63
	c	I*E + G + N	14	58555.5	-29263.7	2.43	0.14	0.76
	d	N + G*E	9	58556.8	-29269.4	3.75	0.07	0.84
	e	E + G + N + R	9	58556.8	-29269.4	3.80	0.07	0.90
	f	I + E + G + N + M + R	13	58557.0	-29265.5	3.92	0.06	0.97
	g	I + E + G + N + M + R + I*E	16	58559.4	-29263.7	6.34	0.02	0.99
	h	I + E + G + N + M + R + I*E + G*E	17	58561.3	-29263.6	8.26	0.01	1.00
	i	**null (random effect only)**	**3**	**58620.3**	**-29307.1**	**67.21**	**0.00**	**1.00**
II	**a**	**I + E + G + N + P**	**12**	**58527.7**	**-29251.9**	**0.00**	**0.33**	**0.33**
	b	I + E*P + G + N	13	58528.5	-29251.2	0.77	0.22	0.55
	c	I + E*G*P + N	16	58528.6	-29248.3	0.89	0.21	0.76
	d	I + E + G*P + N	13	58529.2	-29251.6	1.47	0.16	0.92
	e	I*P + E + G + N	15	58530.6	-29250.3	2.81	0.08	1.00

f	**I + E + G + N**	**11**	**58553.0**	**-29265.5**	**25.29**	**0.00**	**1.00**
g	**null (random effect only)**	**3**	**58620.3**	**-29307.1**	**92.50**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg package in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included powertrain choice (P).

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

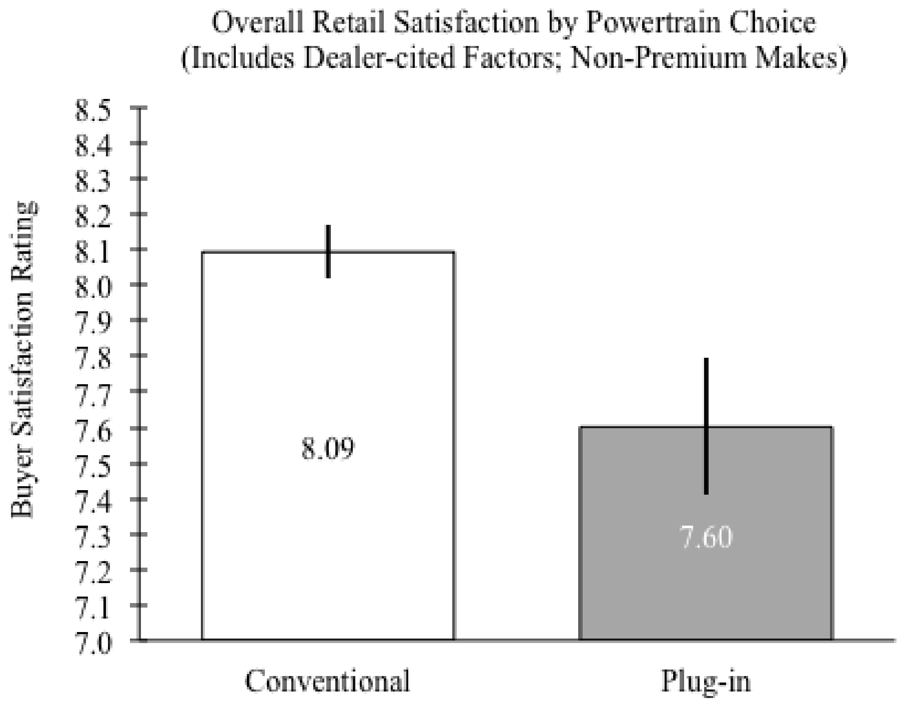


Figure 7-3. Predicted mean retail satisfaction based on linear mixed effect models.

Differences in overall ratings of the purchase experience between buyers of conventional and plug-in vehicles from dealers of non-premium makes. Estimates were derived from the best-approximating model and account for variation associated with demographic factors, including a random effect for intra-class correlation by state of residence. Bars represent 95% confidence intervals (N = 13,526).

Retail Satisfaction: Analysis of Premium Makes

For premium makes, the best-approximating demographic model (i.e. lowest AIC*c* value) for overall retail satisfaction included education level (E), gender (G), and race (R). Three main factor effect terms were eliminated, including income, marital status, generational affiliation and all interaction terms. The best demographic model (Model Ia) was 5.4 AIC*c* units lower than the null model (Table 7-4).

Removing additional variables resulted in higher AIC*c* values. Two competing models, identified as having an AIC*c* differential less than two (2.0) points involved a model with education as the sole predictor and a model that included both income and education variables. A likelihood ratio test yielded a model (model Ia, Table 7-4) that fit the data better than the null model (null = random-effect only; LRT χ^2 (3) = 11.4, p = < 0.01).

Based on the best demographic model for retail satisfaction, buyers holding at least a college degree scored premium retailers lower (8.58; 95% CI 8.50 – 8.66) compared to those without a degree (8.73; 95% CI 8.61 – 8.84). Non-white buyers gave retailers lower marks as well (8.59; 95% CI 8.46 – 8.71) compared to white buyers (8.72; 95% CI 8.61– 8.84).

Step II compared the best model of demographic factors from the previous step to models in which powertrain choice (P) was included as an explanatory variable. Models were developed to consider both an additive effect and potential interaction effects between powertrain choice and key demographic variables in the best model from Step I (model Ia, Table 7-4). The analysis revealed the best model (model IIa in bold, Table 7-4), which included both an additive effect for powertrain choice and an interaction effect between powertrain choice (P) and gender (G).

Although the additive effect of P showed strong support from the data (model IIc was 8.94 AIC units lower than the best-approximated demographic model (model IIe), the data showed stronger support for a model that consisted of an interaction between powertrain and gender (model IIa; LRT χ^2 (1) = 5.0, p = 0.026). This means the effect of powertrain choice (P) was strengthened when considering differences in gender. For example, male buyers of premium PEVs demonstrated higher satisfaction than all three other groups (Figure 7-4). Model IIa was substantially better than the best-approximating demographic-only model found in Step I (ΔAIC_c $_{\text{model Ia}}$ = 11.9; Table 7-4).

Based on the β coefficient in the final model for buyer satisfaction, predicted outcomes revealed that male plug-in vehicle buyers rated the retail experience significantly higher (9.41, SE = 0.21) than both male conventional buyers (8.62, SE = 0.04) and female conventional buyers (8.68 SE = 0.05, Figure 7-4) with strong evidence of support (LRT χ^2 = 15.92). Although female plug-in buyers scored premium retailers substantially lower (8.06), the data lacked sufficient evidence to confirm this finding (SE = 0.60, Figure 7-4). Figure 7-5 depicts the contrast in dispersion and skewness in the underlying data for buyers of premium conventional and plug-in vehicles. Note the much lower dispersion and higher median associated with the data for premium plug-in buyers.

Table 7-4. Evaluation of linear mixed effects models comprised of factors influencing new car buyer satisfaction with the selling dealership (premium makes).

k = number of parameters; AICc = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAICc = difference in AICc between model of interest and best-approximating model; w = Akaike's weight; Cw = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**E + G + R**	**6**	**22094.7**	**-11041.3**	**0.00**	**0.26**	**0.26**
	b	E	4	22095.6	-11043.8	0.88	0.17	0.43
	c	I + E	7	22096.7	-11041.3	1.97	0.10	0.52
	d	G*R*E	10	22097.0	-11038.5	2.26	0.08	0.61
	e	E + G	5	22097.0	-11043.5	2.36	0.08	0.69
	f	E + G + N + R	9	22097.6	-11039.8	2.90	0.06	0.75
	g	G*E	6	22097.8	-11042.9	3.07	0.06	0.80
	h	I + E + G	8	22097.8	-11040.9	3.12	0.05	0.86
	i	E + N	7	22098.6	-11042.3	3.93	0.04	0.90
	j	N + G*R*E	13	22099.7	-11036.8	5.04	0.02	0.92
	k	**null (random effect only)**	**3**	**22100.1**	**-11047.0**	**5.39**	**0.02**	**0.93**
II	**a**	**E + G*P + R**	**8**	**22082.8**	**-11033.4**	**0.00**	**0.54**	**0.54**

b	E*P + G*P + R	9	22084.4	-11033.2	1.62	0.24	0.78
c	E + G + R + P	7	22085.8	-11035.9	2.97	0.12	0.90
d	E*P + G + R	8	22086.3	-11035.1	3.49	0.09	1.00
e	**E + G + R**	**6**	**22094.7**	**-11041.3**	**11.91**	**0.00**	**1.00**
f	**null (random effect only)**	**3**	**22100.1**	**-11047.0**	**17.29**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg package in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

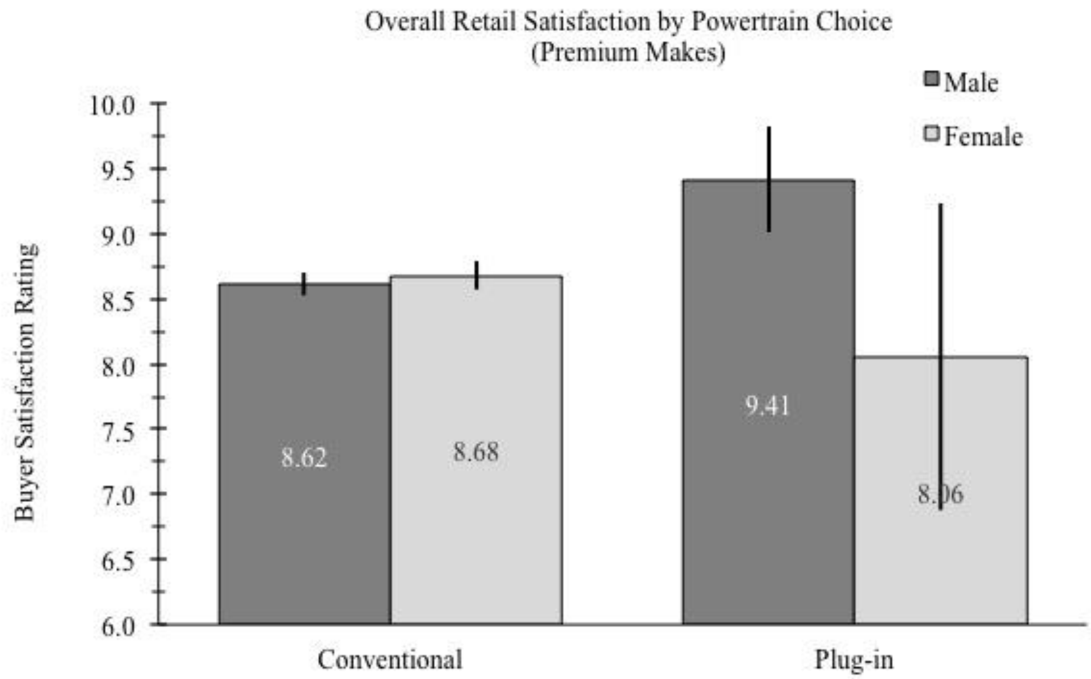


Figure 7-4. Predicted mean buyer satisfaction with the overall retail experience based on linear mixed effect models.

Differences in scores of retail satisfaction between buyers of premium conventional and plug-in electric vehicles. Estimates were derived from best-approximating model and accounts for variation arising from demographic factors and a random effect for intraclass correlation by state of residence. Bars represent 95% confidence intervals (N=5,504).

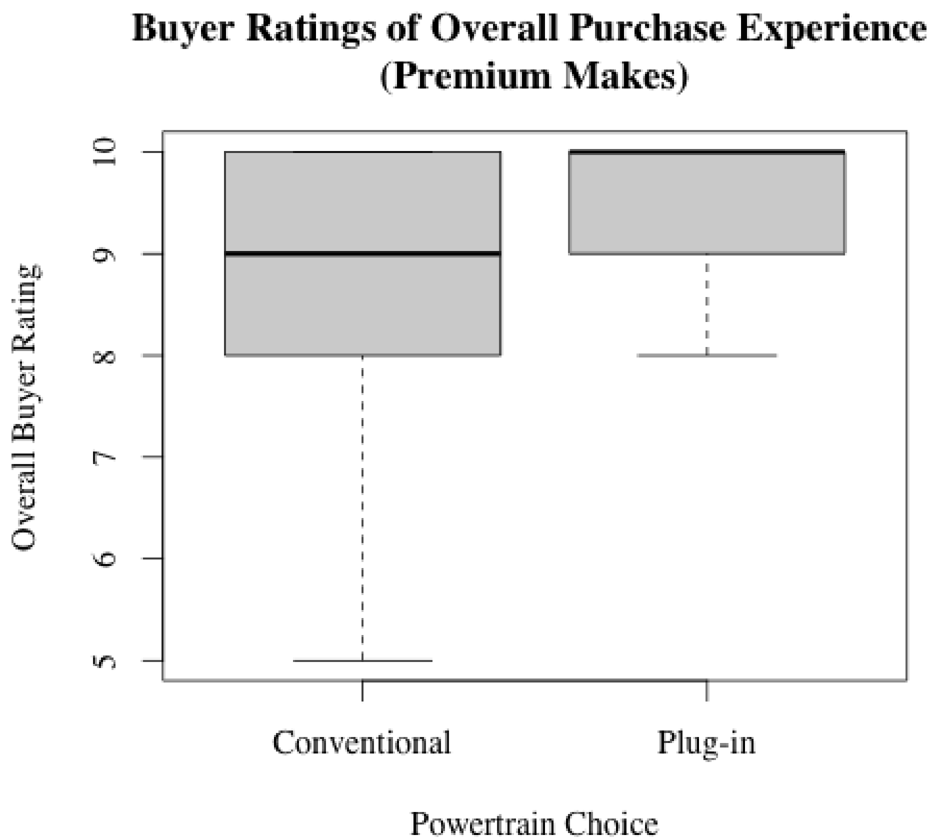


Figure 7-5. Box and whisker plot comparing non-parametric variation in buyer ratings of overall retail satisfaction between premium conventional and plug-in vehicles.

Bolded bands indicate the second quartile (median). Box tops and bottoms depict the first and third quartiles. Spacing between diagram elements represent the degree of dispersion and skewness in the data.

7.2.2 Analysis 2a: Modeling Time Spent by Buyers at the Retail Facility

The second group of research questions (Group 2) examined the amount of <u>time spent</u> at the retail facility.

Recall the following hypotheses from Chapter 4:

> H2a: *For buyers of* ***non-premium*** *makes, a difference in total (and by stage) transaction time at the selling dealership exists between PEV and ICEV buyers.*

Prediction: PEV buyers report longer transaction times (total and by stage) at the selling dealer than ICEV buyers.

> H2b: For buyers of **premium** makes, *a difference in total (and by stage) transaction time exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.*

Prediction: PEV buyers report shorter total transaction times than ICEV buyers (see Chapter 4 for details).

Analysis: For H2a and H2b, the researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for time spent at the dealership using a simple linear model and no control variables.

Recall from Chapter 4 that the purpose of this analysis was to explore the data relating to this response variable. To do so, the researcher temporarily suspended use of LME and the two-step information theoretic (IC) approach in favor of a simple linear model in which powertrain choice was regressed against the time reported spent in total and by phase of the vehicle purchase transaction (control variables were omitted). Thus, the model took the form:

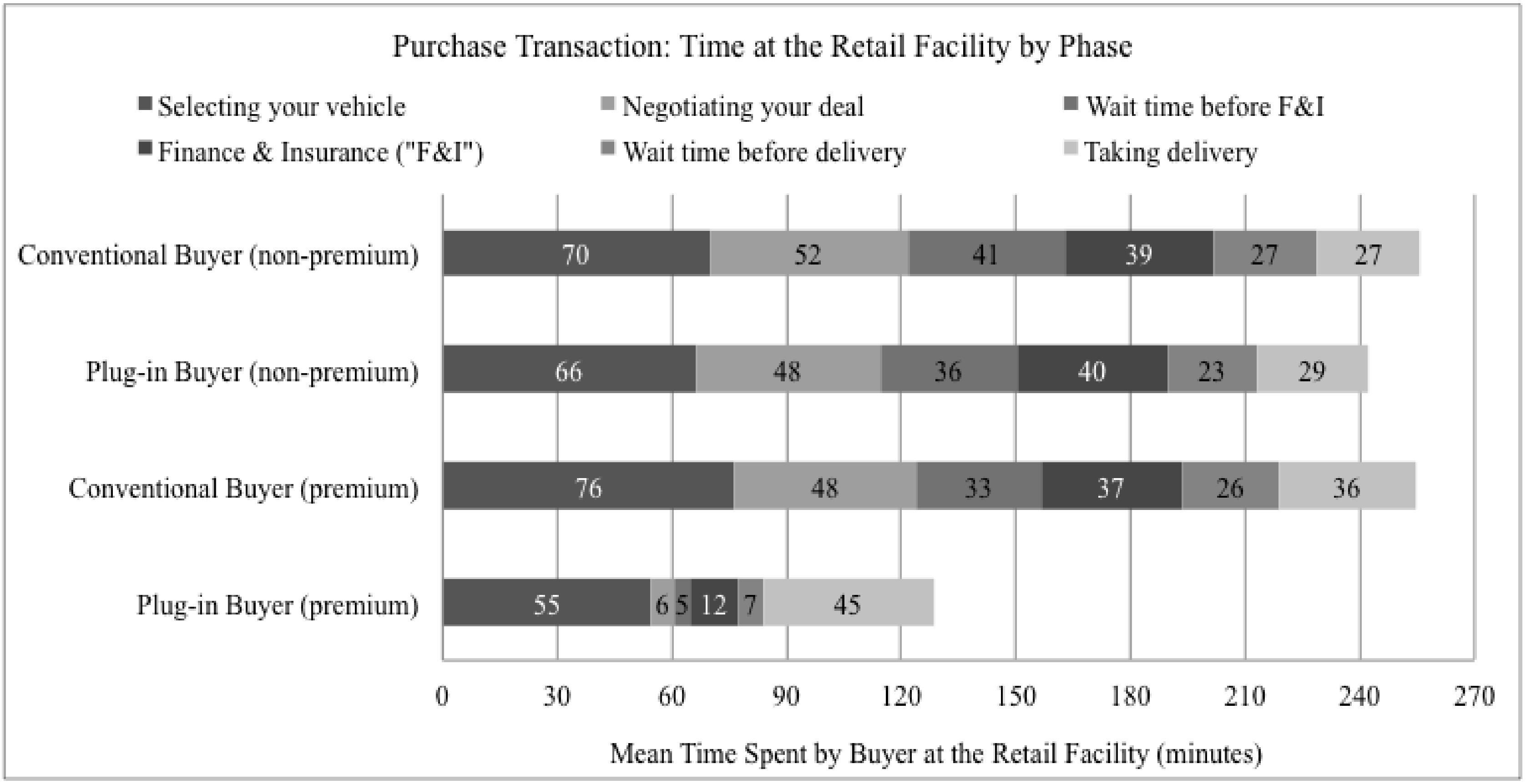
$$Time_{phase} = \beta_1 \mathrm{P} + \varepsilon$$

where $Time_{phase}$ = time spent by the buyer at the retail facility by phase of the purchase transaction; β_1 = coefficient for powertrain choice (P)*;* and ε = normally distributed residual error. The researcher re-introduced LME and the two-step IC procedure to investigate in more detail specific findings of interest from this first pass analysis. Powertrain choice (P) represented the sole independent variable used to approximate the durations of each transaction phase (and the total) for both non-premium and premium buyer populations.

Figure 7-6 revealed that *for non-premium makes*, conventional and plug-in vehicle buyers spent on average a total of over four hours to transact a vehicle purchase. Notably, *plug-in buyers spent less overall time* (4:02) then conventional vehicle buyers (4:16). This finding refutes the researcher's hypothesis.

For premium makes, with the exception of vehicle delivery, total transaction time and transaction times by phase were similar to conventional buyers of non-premium makes. Notably, the delivery phase for buyers of premium conventional makes averaged 9 minutes (33%) longer than buyers of non-premium conventional makes.

Contrast these findings with those for PEV buyers from premium makes (i.e., Tesla). Here, customers reported spending an average of 2 hours and 10 minutes at the retail facility, 49.2% less time than buyers of conventional models from premium makes (4:16). This finding confirms the researcher's hypothesis that PEV buyers who purchase their vehicles from manufacturers using an innovation-specific distribution channel report less total time spent at the retail facility to transact a purchase. Also of note, for premium plug-in vehicle buyers, the delivery phase of the purchase transaction averaged 45 minutes, 9 minutes (25%) longer than buyers of conventional vehicles from dealers of premium makes (36 minutes).



Source: 2013 Sales Satisfaction Index (SSI) Study by J.D. Power & Associates

Figure 7-6. Predicted mean time spent by the buyer at the retail facility (total and by phase of the purchase transaction) based on simple linear regression models.

7.2.3 Analysis 2b: Modeling Time Spent at Vehicle Delivery

Given the disparities noted in the simple exploratory investigation conducted in Analysis 2a, the study examined the vehicle delivery phase of the buying process in greater detail. Specifically, the research asks: *Does powertrain choice explain sources of variation in the duration of the vehicle delivery phase (after accounting for demographic factors)?* The research examines this question for both non-premium and premium makes using the two-part information theoretic approach detailed in Chapter 4 (Research Methods). Recall the following hypotheses from Chapter 4:

> H3a: For buyers of **non-premium** makes, *A difference in the duration of vehicle delivery at the selling dealership exists between PEV and ICEV customers*.

Prediction: PEV buyers report a longer vehicle delivery stage via dealers than ICEV buyers.

> H3b: For buyers of **premium** makes, a difference in duration of the vehicle delivery stage exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.

Prediction: Buyers of PEVs from premium makes (i.e., Tesla) report a longer vehicle delivery stage than buyers of ICEVs from dealers.

Analysis: For both H3a and H3b, the researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for the duration of the vehicle delivery stage while accounting for demographic effects using a linear mixed effects (LME) and two-step IC approach described in Chapter 4 (Research Methods).

Duration of Vehicle Delivery: Analysis of Non-Premium Makes

For non-premium makes, all interaction terms were eliminated. The best-approximating demographic model for time spent at the retail facility during the vehicle delivery phase consisted of household income (I), education (E), gender (G), generational affiliation (N), marital status (M) and race (R). This model was 155.7 AIC*c* units less than the null model. Removing additional variables resulted in higher AIC*c* values. A likelihood ratio test yielded a model that fit the data substantially better than the null model (null = random-effect only; LRT χ^2 (10) = 175.7, p = <0.001).

In Step II of the analysis, the researcher compared evidence between the best model from Step I (consisting of demographic variables) to a model in which powertrain choice (P) was included as an explanatory variable. Models were developed to consider both an additive effect and potential interaction effects between powertrain choice and key demographic variables (i.e. income, education, and gender) from the previous step (see Step II, Table 7-5). The analysis revealed best-approximating model containing an additive effect for P (model IIa, Table 7-4), although competitive models included interaction effects between gender (G) and P (ΔAIC*c* = 1.34; $w_{\text{model IIb}}$ = 0.18) and between education (E) and P (ΔAIC*c* = 1.57; $w_{\text{model IIc}}$ = 1.57). Model IIa was 158.8 AIC units less than the null model (random effects-only model; LRT χ^2 (11) = 111.4, p = <0.001).

Based on the β coefficient in the best-approximating model for powertrain choice, predicted outcomes revealed plug-in vehicle buyers spending 2.7 minutes longer (30.4 minutes, SE = 1.3) than conventional vehicle buyers (27.7 minutes, SE = 0.5). Figure 7-7 depicts these results. This finding has strong evidence of support from the data (LRT $\chi^2(1) = 5.1$, $p = 0.024$) when accounting for variation stemming from gender, income, education, generational affiliation, marital status, and racial factors. This finding confirms the researcher's hypothesis of a positive relationship between choice of a PEV and time reported spent at the retail facility during delivery.

Table 7-5. Evaluation of linear mixed effects models comprised of factors influencing time spent by the buyer at the selling dealership during the vehicle delivery phase (non-premium makes).

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood;

ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**I + E + G + N + M + R**	**13**	**126791.8**	**-63382.9**	**0.00**	**0.77**	**0.77**
	b	I + E + G + N + M + R + I*E	16	126796.2	-63382.1	4.32	0.09	0.86
	c	I + E + G + N + M + R + I*E + G*E	17	126797	-63381.5	5.17	0.06	0.92
	d	E + G + N + R	9	126797.1	-63389.5	5.23	0.06	0.98
	e	I + E + G + N + M + R + I*E + G*E + G*I	20	126801.3	-63380.6	9.43	0.01	0.98
	f	N + G*R*E	13	126802.1	-63388.0	10.27	0.00	0.99
	g	I + E + G + N + M	12	126802.4	-63389.2	10.59	0.00	0.99
	h	**null (random effect only)**	**3**	**126947.5**	**-63470.8**	**155.70**	**0.00**	**1.00**
II	**a**	**I + E + G + N + M + R + P**	**14**	**126788.7**	**-63380.4**	**0.00**	**0.35**	**0.35**
	b	I + E + G*P + N + M + R	15	126790.1	-63380.0	1.34	0.18	0.54
	c	I + E*P + G + N + M + R	15	126790.3	-63380.1	1.57	0.16	0.70
	d	I + E*P + G*P + N + M + R	16	126791.7	-63379.8	2.93	0.08	0.78
	e	**I + E + G + N + M + R**	**13**	**126791.8**	**-63382.9**	**3.11**	**0.07**	**0.85**
	f	I*P + E + G + N + M + R	17	126792.3	-63379.1	3.56	0.06	0.91

g	I*P + E*P + G + N + M + R	18	126793.1	-63378.6	4.42	0.04	0.95
h	I*P + E + G*P + N + M + R	18	126793.7	-63378.8	5.01	0.03	0.98
i	I*P + E*P + G*P + N + M + R	19	126794.7	-63378.3	5.93	0.02	1.00
j	**null (random effect only)**	**3**	**126947.5**	**-63470.8**	**158.81**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included powertrain choice (P).

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

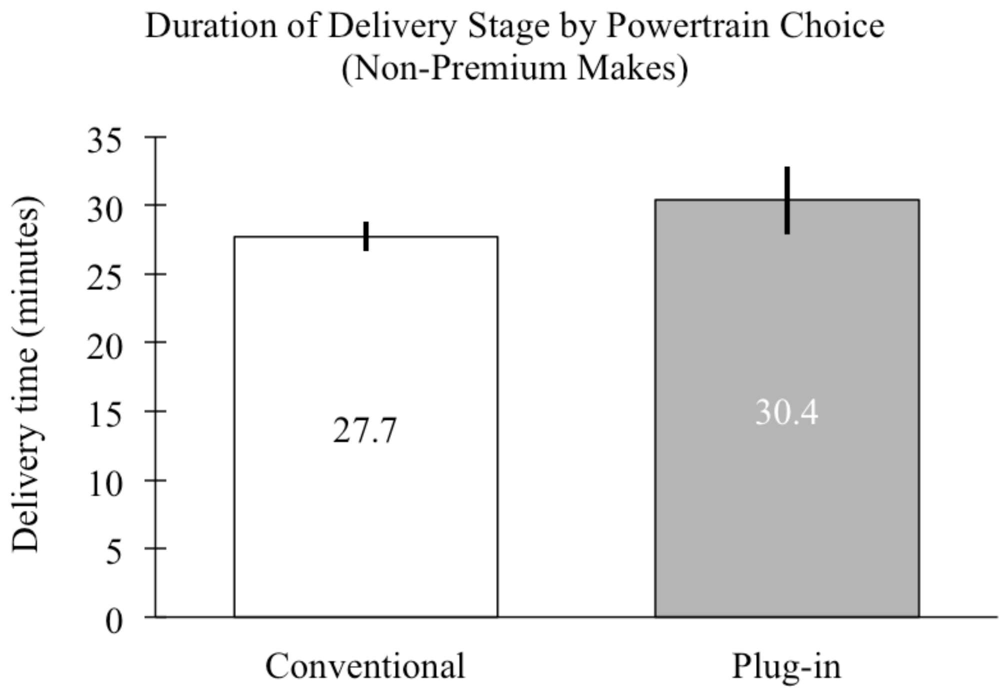


Figure 7-7. Predicted mean time spent at the selling dealer during the vehicle delivery phase based on linear mixed effect models.

Differences in time reported by buyers of conventional and plug-in vehicles from dealers of non-premium makes. Estimates were derived from the best-approximating model and account for variation from demographic factors, including a random effect for intraclass correlation by state of residence. Bars represent 95% confidence intervals (N = 13,526).

Duration of Vehicle Delivery: Analysis of Premium Makes

For premium makes, four main effects and all interaction terms were eliminated. The best-approximating demographic model for time spent at the retail facility during delivery included gender (G) and age group (N). This model was 67.2 AIC*c* units less than the null model. Removing additional variables resulted in higher AIC*c* values. A likelihood ratio test (LRT) yielded a model that fit the data substantially better than the null model (null = random-effect only; LRT χ^2 (4) = 75.2, p = <0.001).

In Part II of the analysis of factors influencing duration of the vehicle delivery phase, the researcher compared evidence between the best model of demographic factors from the previous step to a model in which powertrain choice (P) was included as an explanatory variable. Models were developed to consider both an additive effect and potential interaction effects between powertrain choice and key demographic variables (i.e., gender or generational affiliation) from the previous step (see Step II, Table 7-6).

The analysis revealed that the best-approximating model involved a main effect for gender (G) and both a main effect for P as well as an interaction effect between age group (N) and P (model IIa, Table 7-6). A competitive model included interaction effects between gender (G) and P as well (ΔAIC*c* = 1.95; $w_{\text{model IIb}}$ = 0.22). Model IIa, however, was 2.7 times more likely to be a better model than model IIb. Model IIa was also 71.0 AIC*c* units less than the null model (random effects-only model; LRT χ^2 (8) = 87.1, p = <0.001). Though the main effect of P was relatively weak (LRT χ^2 (1) = 3.0, p = 0.085), the interaction effect between P and N is strongly supported by the data (LRT χ^2 (3) = 8.9, p = 0.031). The gender (G) main effect was found to be insignificant (p = 0.120).

Based on the β coefficient in the best-approximating model for powertrain choice, predicted outcomes revealed that buyers of plug-ins from premium makes spend on average 4.5 minutes longer (40.0 minutes, SE = 4.4) than buyers of premium conventional makes (35.5 minutes, SE = 0.7) when accounting for variation from demographic factors (Figure 7-8). Notably, Gen X plug-in buyers reported spending 12.5 minutes longer (44.9 minutes, SE = 5.6) than their conventional buyer counterparts (32.4 minutes, SE = 1.0) and 14.6 minutes longer (51.5 minutes, SE = 11.8) than conventional buyers from Gen Y (30.3 minutes, SE = 1.4). These findings confirm the researcher's hypothesis of a positive relationship between choice of a PEV and time spent by the buyer at the retail facility during delivery.

Figure 7-8 shows what appears to be an inverse relationship between time spent during the vehicle delivery phase and age group, with older generation PEV buyers reporting less time spent at delivery than younger generations. This is exactly the reverse of the trend observed for conventional vehicle buyers. However, with the exception of Gen X (p = 0.008) and Gen Y (p = 0.011) buyers, there is no additional evidence from the data to confirm this observation.

Table 7-6. Evaluation of linear mixed effects models comprised of factors influencing time spent by the buyer at the selling dealership during the vehicle delivery phase (premium brands).

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood;

ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**G + N**	**7**	**53531.43**	**-26758.7**	**0.00**	**0.54**	**0.54**
	b	E + N	7	53533.38	-26759.7	1.95	0.20	0.75
	c	N + G*E	9	53534.58	-26758.3	3.16	0.11	0.86
	d	E + G + N + R	9	53534.68	-26758.3	3.26	0.11	0.97
	e	I + E + G + N	11	53538.38	-26758.2	6.96	0.02	0.98
	f	I + E + G + N + M	12	53540.31	-26758.1	8.89	0.01	0.99
	g	N + G*R*E	13	53540.71	-26757.3	9.28	0.01	0.99
	h	I + E + G + N + M + R	13	53542.31	-26758.1	10.88	0.00	1.00
	i	**null (random effect only)**	**3**	**53598.6**	**-26796.3**	**67.18**	**0.00**	**1.00**
II	**a**	**G + N*P**	**11**	**53527.56**	**-26752.8**	**0.00**	**0.59**	**0.59**
	b	G*P + N*P	12	53529.51	-26752.7	1.95	0.22	0.81
	c	G + N + P	8	53530.46	-26757.2	2.90	0.14	0.94
	d	**G + P**	**7**	**53531.43**	**-26758.7**	**3.86**	**0.08**	**0.95**
	e	G*P + N	9	53532.28	-26757.1	4.72	0.06	1.00

f	**null (random effect only)**	**3**	**53598.6**	**-26796.3**	**71.04**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg package in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included powertrain choice (P).

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

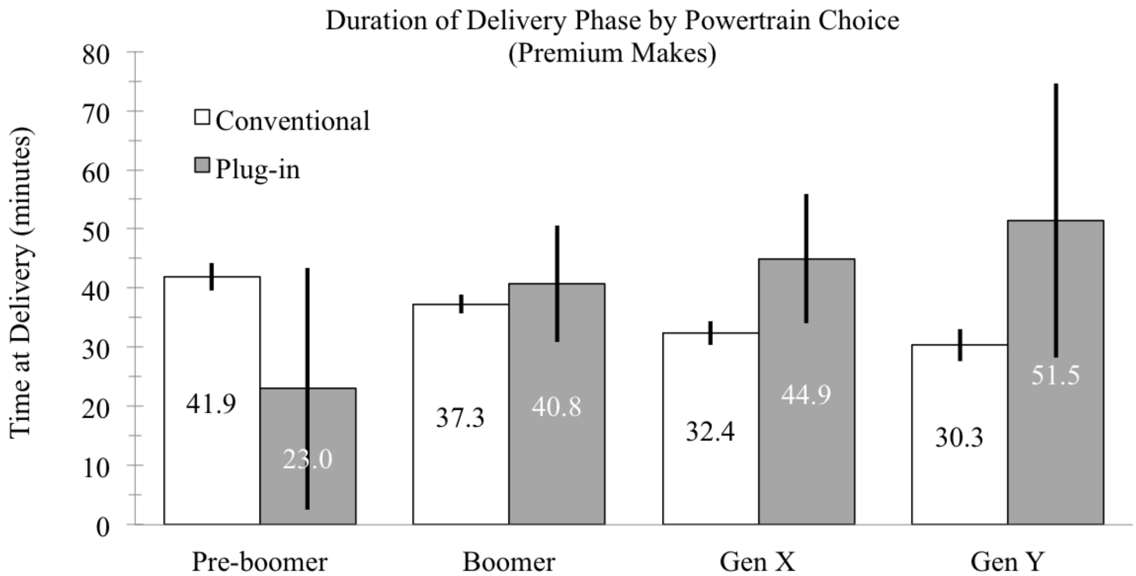


Figure 7-8. Predicted mean time spent at the selling dealer during the vehicle delivery phase based on linear mixed effect models.

Differences in time reported by buyers of conventional and plug-in vehicles from dealers and retailers of premium makes. Estimates were derived from the best-approximating model and account for variation demographic factors, as well as a random effect for intraclass correlation by state of residence. Bars represent 95% confidence intervals (N = 5,504).

7.2.4 Analysis 3a: Modeling Conquest Buyers

The final group of research questions (Group 3) examined several other response variables of interest to the researcher. The study considers whether PEVs present an opportunity for automakers to win new customers from competing non-premium makes (a.k.a. “conquest” buyers). Recall the following hypotheses from Chapter 4 (Research Methods):

> H4: For buyers of **non-premium** makes, a difference in the percentage of buyers representing conquest sales exists between PEV and ICEV customers who bought through established dealers.

Prediction: Based on interview findings, the researcher predicts the percentage of buyers representing conquest sales will be greater for PEVs than for ICEVs.

Analysis: The researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for the percentage of buyers representing conquest sales while accounting for demographic effects using GLMM (binomial error distribution) and the two-step IC approach detailed in Chapter 4 (Research Methods).

For Step I, the researcher initially constructed over twenty models comprised of demographic variables as main factor effects in which various potential (two-way) interactions were explored (Step I, Table 7-7). These present the same model form as used for Group 1 models:

Step I: $CS = \beta_0 + \beta_1 \text{E} + \beta_2 \text{R} + \beta_3 \text{G} + \beta_4 \text{I} + \beta_5 \text{M} + \beta_6 \text{N} + Z_1 \text{ST} + \varepsilon$

Step II: $CS = [\text{DF}_R] + \beta_P \text{P} + Z_1 \text{ST} + \varepsilon$

where βs represent coefficients of the y-intercept and the demographic factors; CS = Conquest sales; DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intraclass correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

Using the model selection process described in Chapter 4, the analysis identified a best-approximating model (model Ia, Table 7-7) comprised of main effects for income (I), education (E), and age group (N) that fit the data substantially better than the null model (random effects-only model, $\Delta AICc = 176.64$). A LRT further indicates strong support from the data for this model relative to the null (LRT χ^2 (7) = 190.7, $p < 0.001$).

Step II of the analysis examined evidence for variation in conquests explained by powertrain choice (P) and compared that evidence to the best-approximating model of demographic factors. Models were developed to include a main effect for powertrain choice (P) while testing different potential interaction effects between P and each of the demographic factors. The researcher then repeated the model selection technique from Step I. A likelihood ratio test found four competitive models (models IIa, IIb, IIc, and IId, $\Delta AICc < 2.0$) that fit the data substantially better than both the null model and the demographic factor-only model (model Ia, Table 7-7). The data strongly supported model IIb ($\Delta AICc = 0.14$, $w_{\text{model IIb}} = 0.25$), which involved only a single interaction term (between education level and gender). Hence, the researcher chose model IIb as the best-approximating model for analysis.

The model evidence indicated a strong additive effect for powertrain choice (LRT χ^2 (2) = 29.6, p = <0.001). Predicted conquests from competing makes were 7.6 (67.2%, SE = 3.0) percentage points higher for all plug-in buyers versus all conventional vehicle buyers (59.6%, SE = 0.9), regardless of whether the buyer held a college degree or not (see Figure 7-9). These findings confirm the researcher's hypothesis of a positive relationship between choice of a PEV and conquest sales from competing non-premium makes.

The β estimate for the interaction in this model also had strong evidence of support (χ^2 (1) = 7.23, p = 0.0072). Based on the final model of conquest customers, 75.0% of college-educated buyers of plug-in vehicles (95% CI: 72.5% - 77.4%) switched from a competing brand, substantially more so than other categories of P and E. In particular, this model interaction supported significant differences in college-educated plug-in buyers and college-educated conventional vehicle buyers (60.3%; 95% CI: 59.3% - 61.3%), plug-in buyers without a college degree (58.2%; 95% CI: 52.6% - 63.6%), and conventional buyers without a college degree (58.8%; 95% CI: 57.7% - 59.9%).

Table 7-7. Evaluation of generalized linear mixed effects models consisting of demographic factors affecting the buyer decision to switch from a competing non-premium make.

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**I + E + N**	**9**	**15894.7**	**-7938.4**	**0.00**	**0.38**	**0.38**
	b	I + E + G +N + M + R	12	15895.4	-7935.7	0.61	0.28	0.66
	c	I + E + G + N	10	15896.6	-7938.3	1.84	0.15	0.82
	d	I + E + G + N + M	11	15897.9	-7937.9	3.16	0.08	0.89
	e	E + G + N + R	8	15900.3	-7942.1	5.52	0.02	0.92
	f	I + E + G + N + M + R + I*E	15	15900.4	-7935.2	5.71	0.02	0.94
	g	E + N	6	15900.7	-7944.3	5.96	0.02	0.96
	h	I*E + G + N	13	15901.6	-7937.8	6.89	0.01	0.97
	i	I + E + G + N + M + R + I*E + G*E	16	15902.0	-7935.0	7.25	0.01	0.98
	j	N + G*I	12	15902.9	-7939.4	8.14	0.01	0.99
	k	N + G*E	8	15903.3	-7943.7	8.59	0.01	0.99

	l	G + N	6	15903.5	-7945.8	8.80	0.00	1.00
	m	**null (random effect only)**	**2**	**16071.4**	**-8033.7**	**176.64**	**0.00**	**1.00**
II	**a**	**I + E*P + N*P**	**14**	**15869.0**	**-7920.5**	**0.00**	**0.26**	**0.26**
	b	I + E*P + N	11	15869.1	-7923.6	0.14	0.25	0.51
	c	I*P + E*P + N	14	15869.7	-7920.9	0.75	0.18	0.69
	d	I*P + E*P + N*P	17	15870.0	-7918.0	1.04	0.16	0.85
	e	I*P + E + N*P	16	15871.9	-7919.9	2.91	0.06	0.91
	f	I*P + E + N	13	15872.5	-7923.2	3.51	0.05	0.95
	g	I + E + N*P	13	15873.4	-7923.7	4.44	0.03	0.98
	h	I + E + N + P	10	15874.4	-7927.2	5.36	0.02	1.00
	i	**I + E + N**	**9**	**15894.7**	**-7938.4**	**25.74**	**0.00**	**1.00**
	j	**null (random effect only)**	**2**	**16071.4**	**-8033.7**	**202.38**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg package in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

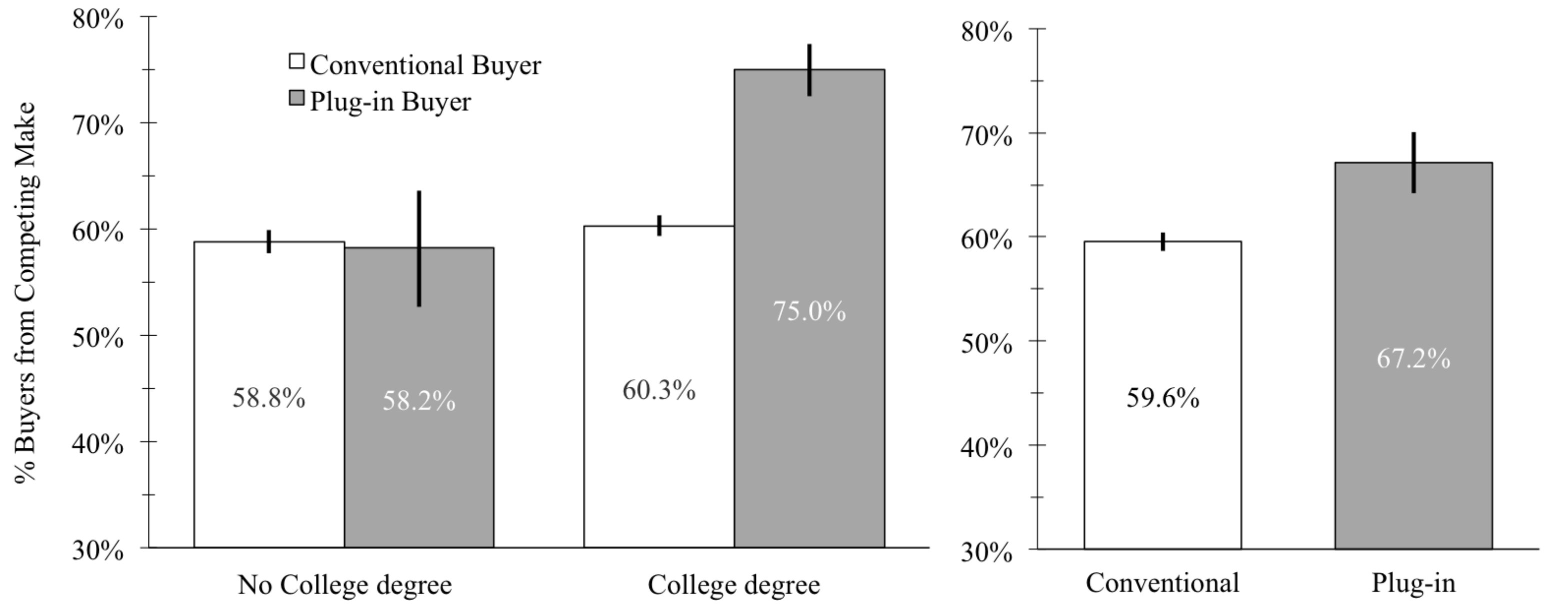


Figure 7-9. Predicted percent of conquests (buyers that switched from a competing make) based on general linear mixed effect models.

Differences in percent between buyers of non-premium conventional and plug-in electric vehicles (A: interaction between education and powertrain choice; B: additive effect of powertrain choice only). Estimates were derived from the best-approximating model and controls for demographic factors, including a random effect for variation by state of residence. Bars represent 95% confidence intervals (N = 11,933).

7.2.5 Analysis 3b: Modeling Intent to Return for Paid Services

The research considered whether plug-in vehicle buyers were more or less likely to return to the selling dealer for paid services (e.g., routine maintenance, warranty, parts, repair). Recall hypothesis H5 from Chapter 4 (Research Methods):

> H5: For buyers of **non-premium** makes, a difference in the customer's likelihood of returning to the selling dealer for paid services exists between PEV and ICEV customers who bought through established dealers.

Prediction: Fewer PEV buyers intend to return to the selling dealer for paid services.

Analysis: The researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for the percentage of buyers who reported they intend to return to the selling dealer for paid services while accounting for demographic effects using GLMM (binomial error distribution) and the two-step IC approach detailed in Chapter 4 (Research Methods).

The survey question involved an ordinal response variable in which the buyer selected the most appropriate response from four categories: (1) Definitely will not, (2) probably will not, (3) probably will, or (4) definitely will return to the dealer for paid service work. The researcher converted the response to a binary variable based on whether or not the buyer selected "definitely will return". To prepare the data for analysis, the researcher omitted all responses with missing values and subset the data to include only responses for purchases/leases of non-premium makes. These present the same model form as used for Group 1 models:

Step I: $PS = \beta_0 + \beta_1 \text{E} + \beta_2 \text{R} + \beta_3 \text{G} + \beta_4 \text{I} + \beta_5 \text{M} + \beta_6 \text{N} + Z_1 \text{ST} + \varepsilon$

Step II: $PS = [DF_R] + \beta_P \text{P} + Z_I \text{ST} + \varepsilon$

where βs represent coefficients of the y-intercept and the demographic factors; *PS* = Percentage of buyers intending to return to the selling dealer for paid services; DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intraclass correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

Step I identified the best generalized linear mixed effect model (GLMM) that explained variation in buyer intent to return for paid dealer services as a function of demographic factors. Over twenty different GLMM models were evaluated consisting of both main effects for P as well as interaction (two-way) effects between P and key demographic variables. Table 7-8 provides a partial list of models determined by most evidentiary support from the data. Step I of the analysis revealed a best-approximating demographic model consisting of education (E), gender (G), race (R), and age group (N) (see model Ia, Table 7-8). This model fit the data better than competing models (models Ib and Ic) based on $\Delta AICc$ as well as the intercept-only model as determined by a likelihood ratio test (LRT $\chi^2(6) = 234.4$, $p < 0.001$).

Step II examined evidence of variation in the response explained by powertrain choice. Several models consisting of a main effect for powertrain choice (P) as well as interaction effects between P and significant demographic factors from model Ia were evaluated using the same model selection process. The analysis revealed a best-approximating model consisting of a main effect for P (model IIa, Table 7-8). The analysis revealed several competing models ($\Delta AICc$ <

2.0) in which an interaction effect with P was present. Further analysis determined that model IIa had more support from the data than the models containing interaction effects and was almost twice as likely to yield a better model than modeled IIb, IIc, or IId ($w_{\text{model IIa}}/w_{\text{model IIb}}$). Model IIa also fit the data better than the null model ($\Delta \text{AIC}c_{\text{ model I1j}} = 235.3$).

Based on the β coefficient, the log odds probability that a plug-in buyer "definitely will" return to the selling dealer for paid services was 8.5 percentage points lower (48.1%, asymptotic LCL/UCL = 2.3%) than the probability for a conventional vehicle buyer (56.6%, asymptotic LCL/UCL = 0.8%). The data revealed strong evidence of support for this finding (LRT χ^2 (1) = 7.8, p = 0.005). Figure 7-10 plots these results. These findings confirm the researcher's hypothesis that fewer PEV buyers intend to return to the selling dealer for paid services than ICEV buyers.

Table 7-8. Evaluation of generalized linear mixed effects models for whether a buyer selected "definitely will" plan to return to the selling dealer for paid services (non-premium makes).

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**E + G + N + R**	**8**	**19454.8**	**-9719.4**	**0.00**	**0.34**	**0.34**
	b	I + E + G + N + M + R + I*E	15	19455.1	-9712.5	0.23	0.30	0.64
	c	I + E + G + N + M + R	12	19455.7	-9715.8	0.87	0.22	0.86
	d	I + E + G + N + M + R + I*E + G*E	16	19457.0	-9712.5	2.18	0.11	0.97
	e	I + E + G + N + M + R + I*E + G*E + G*I	19	19460.7	-9711.3	5.86	0.02	0.99
	f	I*E + G + N	13	19465.0	-9719.5	10.18	0.00	1.00
	g	I + E + G + N	10	19465.4	-9722.7	10.53	0.00	1.00
	h	N + G*E	8	19465.5	-9724.8	10.69	0.00	1.00
	i	I + E + G + N + M	11	19465.5	-9721.8	10.70	0.00	1.00
	j	**null (random effect only)**	**2**	**19677.2**	**-9836.6**	**222.41**	**0.00**	**1.00**
II	**a**	**E + G + N + R + P**	**9**	**19442.0**	**-9712.0**	**0.00**	**0.38**	**0.38**
	b	E + G + N + R*P	10	19443.3	-9711.6	1.29	0.20	0.58

c	E + G*P + N + R	10	19443.8	-9711.9	1.76	0.16	0.74
d	E*P + G + N + R	10	19443.8	-9711.9	1.84	0.15	0.89
e	E*P + G*P + N + R	11	19445.6	-9711.8	3.60	0.06	0.95
f	E + G + N*P + R	12	19447.4	-9711.7	5.38	0.03	0.98
g	E + G*P + N*P + R	13	19449.2	-9711.6	7.18	0.01	0.99
h	E*P + G + N*P + R	13	19449.2	-9711.6	7.22	0.01	1.00
i	**E + G + N + R**	**8**	**19454.8**	**-9719.4**	**12.85**	**0.00**	**1.00**
j	**null (random effect only)**	**2**	**19677.2**	**-9836.6**	**235.26**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (package AICcmodavg in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

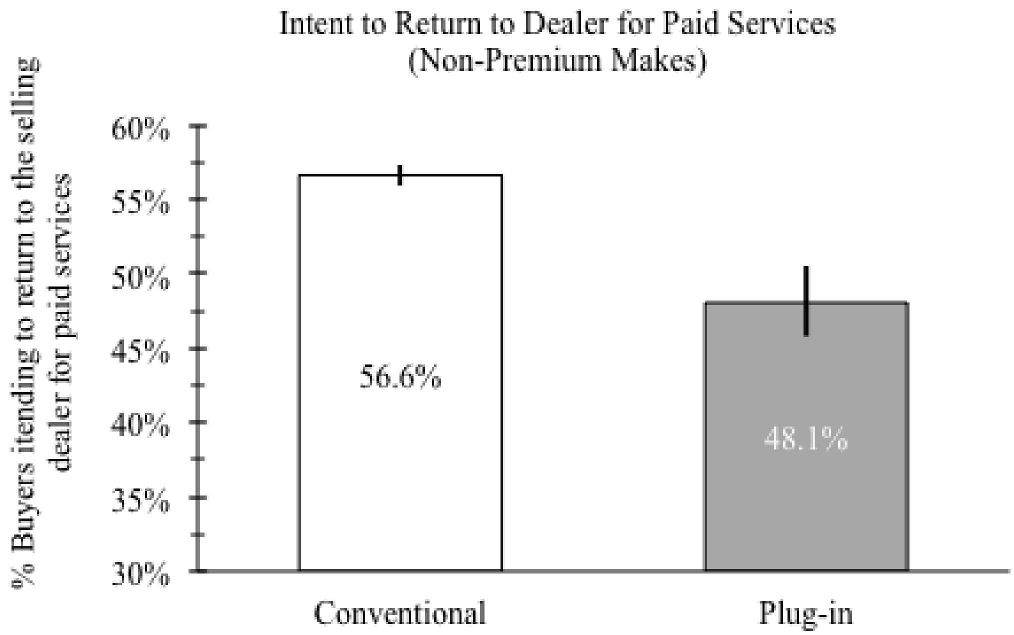


Figure 7-10. Percent of buyers intending to return to the selling dealer for paid services based on generalized linear mixed effects models (predicted mean).

Results based on whether a buyer selected "definitely will" among four response choices. Estimates were derived from the best-approximating model and accounted for variation associated with demographic factors, including a random effect for intraclass correlation by state of residence. Bars represent 95% confidence intervals (N = 14,238).

7.2.6 Analysis 3c: Modeling Cross-Selling

The study investigates whether more plug-in buyers reported that the dealer tried to sell them a vehicle they did not want as compared to conventional vehicle buyers. Automakers refer to this practice as "cross-selling." Recall the following hypothesis from Chapter 4 (Research Methods):

> H6: For buyers of **non-premium** makes, *a difference in the percentage of reported cross-selling by dealers exists between PEV and ICEV customers who bought through established dealers*.

Prediction: A greater percentage of PEV buyers report cross-selling by dealers.

Analysis: The researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for the percentage of buyers who reported the selling dealer attempted to cross-sell them into a vehicle they did not want while accounting for demographic effects. The researcher used a GLMM and the two-step IC approach detailed in Chapter 4 (Research Methods).

In Step I, the researcher initially posited over twenty generalized linear mixed effect models (GLMMs) involving a binary response. Models consisted of six independent demographic variables as main factor effects in which the researcher explored various potential (two-way) interactions amongst these terms (see Step I, Table 7-9). These present the same model form as used for Group 1 models:

Step I: $XS = \beta_0 + \beta_1 \text{ E} + \beta_2 \text{ R} + \beta_3 \text{ G} + \beta_4 \text{ I} + \beta_5 \text{ M} + \beta_6 \text{ N} + Z_1 \text{ ST} + \varepsilon$

Step II: $XS = [\text{DF}_R] + \beta_P \text{ P} + Z_1 \text{ ST} + \varepsilon$

where βs represent coefficients of the y-intercept and the demographic factors; XS = Percentage of buyers who reported the dealer attempted to sell them a vehicle they did not want; DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intraclass correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

The researcher identified a best-approximating model (model Ia, Table 7-9) using the IC model selection procedure detailed in Chapter 4 (Research Methods). Note that $\Delta AICc$ is 202.17 units better than the null model, indicating strong support from the data.

Step II examined evidence for variation in cross-selling by dealers explained by powertrain choice and compared that evidence to the best-approximating demographic model from Step I (model IIb, Table 7-9). Model IIb, however, was highly competitive with the best-approximating model that included powertrain choice as a factor (see model IIa, $\Delta AICc_{\text{model 1a}}$ = 0.7, Table 7-9). This suggests weak support for powertrain choice as an explanatory factor in the cross-selling behavior of dealers. However, an examination of the Akaike's weights for these models revealed that model IIa had 1.5 times the evidence of support from the data than model IIb ($w_{\text{model IIa}}/w_{\text{model IIb}}$). Model IIa also fit the data better than the null model ($\Delta AICc_{\text{model I1f}}$ = 202.9).

In interviews, some dealers suggested that PEV buyers were more likely than their conventional counterparts to know the exact vehicle they intended to buy from the outset.

Dealers maintained that because of this, greater incidence of cross-selling might result. To account for this potential dynamic, the researcher added a third step to the analysis.

In Step III, the researcher incorporated initial buyer intent (X) as a factor to the model and repeated the process in which models containing both main effects for X and interaction effects between X and powertrain choice (P) were evaluated. The analysis identified Model IIIa as having greater support from the data than the best-approximating demographic model (model IIIc, $\Delta AICc_{\text{model IIIa}} = 21.8$) as well as the null model (model IIId, $\Delta AICc_{\text{model IIId}} = 224.7$).

Based on the β coefficient, the log odds probability that a dealer of non-premium makes attempted to cross-sell a plug-in buyer was 2.1 percentage points higher (7.3%, LCL = 1.3%, UCL = 1.5%) than conventional vehicle buyers (5.2%, LCL = 0.4%, UCL = 0.5%). However, the data revealed weak support for this finding (LRT χ^2 (1) = 3.3, p = 0.070). Figure 7-11 depicts these results. This confirms the researcher's hypothesis that a greater percentage of non-premium PEV buyers reported attempted cross-selling by dealers, though there is weak support from the data for this finding.

Table 7-9. Evaluation of generalized linear mixed effects models for whether a dealer attempted to sell the buyer a vehicle they did not want (non-premium makes).

k = number of parameters; AIC*c* = Akaike's Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike's weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**I + N + M + R**	**10**	**5258.1**	**-2619.0**	**0.00**	**0.70**	**0.70**
	b	I + E + G + N + M + R	12	5261.5	-2618.7	3.38	0.13	0.83
	c	I + E + G + N + M + R + I*E	15	5262.3	-2616.1	4.24	0.08	0.91
	d	I + E + G + N + M + R + I*E + G*E	16	5263.3	-2615.6	5.21	0.05	0.96
	e	I + E + G + N + M + R + I*E + G*E + G*I	19	5264.0	-2613.0	5.94	0.04	1.00
	f	E + G + N + R	8	5286.1	-2635.1	28.05	0.00	1.00
	g	I + N + M	9	5293.6	-2637.8	35.49	0.00	1.00
	h	**null (random effect only)**	**2**	**5460.2**	**-2728.1**	**202.17**	**0.00**	**1.00**
II	**a**	**I + N + M + R + P**	**11**	**5257.3**	**-2617.7**	**0.00**	**0.54**	**0.54**
	b	**I + N + M + R**	**10**	**5258.1**	**-2619.0**	**0.73**	**0.37**	**0.91**
	c	I*P + N + M + R	14	5262.3	-2617.1	4.92	0.05	0.96
	d	I + N*P + M + R	14	5262.6	-2617.3	5.28	0.04	1.00

	e	I*P + N*P + M + R	17	5267.5	-2616.7	10.18	0.00	1.00
	f	**null (random effect only)**	**2**	**5460.2**	**-2728.1**	**202.89**	**0.00**	**1.00**
III	**a**	**I + N + M + R + P + X**	**12**	**5235.6**	**-2605.8**	**0.00**	**0.70**	**0.70**
	b	I + N + M + R + P*X	13	5237.2	-2605.6	1.65	0.30	1.00
	c	**I + N + M + R + P**	**11**	**5257.3**	**-2617.7**	**21.79**	**0.00**	**1.00**
	d	**null (random effect only)**	**2**	**5460.2**	**-2728.1**	**224.68**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (AICcmodavg package in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles. Step III compared the best models from the previous steps with models that incuded initial buyer intent, as well as the null model.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Fixed effect factor X = buyer bought exact vehicle intended from outset (aka "initial buyer intent"). Null represents the random effect only. Unweighted for U.S. sales mix.

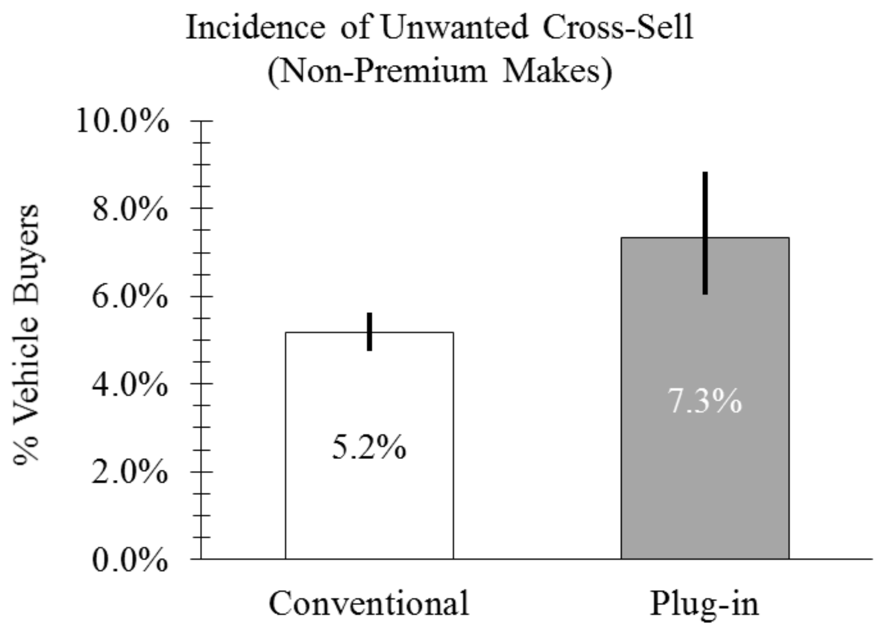


Figure 7-11. Predicted mean incidence of dealer cross-sell to a vehicle the buyer did not want based on generalized linear mixed effects models.

Cross-selling refers to incidents in which the buyer reported that the dealer attempted to sell them a vehicle they did not want. Estimates were derived from the best-approximating model and accounted for variation associated with demographic factors, initial buyer intent, as well as a random effect for intra-class correlation by state of residence. Bars represent 95% confidence intervals (N = 14,127).

7.2.7 Analysis 3d: Modeling Intended Make Loyalty of New Car Buyers

The researcher examined evidence of differences in the intended loyalty of plug-in and conventional vehicle buyers based on the retail experience involving dealers selling non-premium makes. Recall the following hypotheses from Chapter 4 (Research Methods):

> H7a: For buyers of **non-premium** makes through established dealers, *a difference in intended make loyalty exists between between PEV and ICEV buyers.*

Prediction: PEV buyers using dealers report lower intended make loyalty than ICEV buyers.

> H7b: For buyers of **premium** makes, a difference in intended make loyalty exists between PEV buyers who bought through direct distribution and customers who bought an ICEV through established dealers.

Prediction: PEV buyers using an innovation-specific distribution channel report higher intended make loyalty than ICEV buyers who purchased through dealers.

Analysis: The researcher modeled powertrain choice, P (PEV v. ICEV), as a predictor variable for intended make loyalty reported by new car buyers while accounting for demographic effects. The researcher used a GLMM (binomial error distribution) and the two-step IC approach detailed in Chapter 4 (Research Methods).

The survey question entailed an ordinal response variable in which the buyer selected the most appropriate response of four options: (1) Definitely will not, (2) probably will not, (3) probably will, or (4) definitely will purchase the same make next time the buyer is in the market for a vehicle. The researcher converted the response to a binary variable based on whether the buyer chose "definitely will" purchase the same make next time. These present the same model form as used for Group 1 models:

Step I: $L = \beta_0 + \beta_1 \text{E} + \beta_2 \text{R} + \beta_3 \text{G} + \beta_4 \text{I} + \beta_5 \text{M} + \beta_6 \text{N} + Z_1 \text{ST} + \varepsilon$

Step II: $L = [\text{DF}_R] + \beta_P \text{P} + Z_1 \text{ST} + \varepsilon$

where βs represent coefficients of the y-intercept and the demographic factors; L = Percentage of buyers intending to purchase the same make next time; DF_R = the set of demographic factors affecting the response variable from the best-approximating model determined in step one; β_P = coefficient for powertrain choice (P); Z_I represents the random intercept to account for intraclass correlation associated with the buyer's state of residence; and ε = normally distributed residual error.

The first step identified the best GLMM that explained variation in buyer intent to purchase a vehicle of the same make next time (based on the buyer's purchase experience) as a function of demographic factors. The researcher evaluated over twenty different GLMMs consisting of both main effects as well as interaction (two-way) effects between key demographic variables.

Step II of the analysis incorporated powertrain choice (P) as an explanatory variable into the best-approximating model of demographic factors from the previous step. The researcher developed models consisting of a main effect for P and interaction (two-way) effects between P and demographic variables from the best-approximating model in Step I. It then compared the best-approximating model containing powertrain choice to the best-approximating demographic model and the null model (random effects-only).

Customer Loyalty: Analysis of Non-Premium Makes

Step I of the analysis revealed a best-approximating demographic model consisting of income (I), education (E), gender (G), and generational affiliation (N) (see model Ia, Table 7-10). This model fit the data better than competing models (ΔAICc < 2.0; models Ib, Ic and Id) as well as the intercept-only model (null; random effect-only) based on a likelihood ratio test (LRT χ^2 (8) = 152.9, p < 0.001).

Step II of the analysis identified a best-approximating model consisting of a main effect for P (model IIa, Table 7-10). The analysis also revealed several competing models (ΔAICc < 2.0) that included an interaction effect with P. The researcher found that model IIa, however, had more support from the data than the models containing interaction effects. Examination of the ratio of Akaike weights ($w_{\text{model IIa}}/w_{\text{model IIb}}$) indicated model IIa was nearly twice as likely to be a better model than models IIb, IIc, or IId. Model IIa also fit the data better than the null model (ΔAIC$c_{\text{model I1j}}$ = 142.7).

Based on the β coefficient, the log odds probability that a plug-in buyer intended to remain loyal to the same non-premium make next time (based on purchase experience) was 5.9 percentage points lower (25.1%, asymptotic LCL = 2.0%, UCL = 2.1%) than a conventional vehicle buyer (31.0%, asymptotic LCL/UCL = 0.8%). The data provided strong evidence of support for this finding (LRT χ^2 (1) = 14.8, p < 0.001). Figure 7-12 plots these results. These findings confirm the researcher's hypothesis.

Table 7-10. Evaluation of generalized linear mixed effects models for intended buyer loyalty to the same make (non-premium makes).

Based on whether buyer selected, based on the purchase experience, they “definitely will” purchase a vehicle of the same make next time. k = number of parameters; AIC*c* = Akaike’s Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAIC*c* = difference in AICc between model of interest and best-approximating model; w = Akaike’s weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**I + E + G + N**	**10**	**17158.5**	**-8569.2**	**0.00**	**0.33**	**0.33**
	b	E + G + N + R	8	17159.0	-8571.5	0.54	0.25	0.58
	c	I + E + G + N + M + R	12	17160.1	-8568.0	1.56	0.15	0.73
	d	I + E + G + N + M	11	17160.2	-8569.1	1.70	0.14	0.87
	e	N + G*E	8	17161.3	-8572.6	2.78	0.08	0.95
	f	I*E + G + N	13	17163.4	-8568.7	4.91	0.03	0.98
	g	I + E + G + N + M + R + I*E	15	17165.0	-8567.5	6.47	0.01	0.99
	h	I + E + G + N + M + R + I*E + G*E	16	17167.0	-8567.5	8.47	0.00	0.99
	i	I + E + G	7	17167.9	-8577.0	9.42	0.00	1.00
	j	**null (random effect only)**	**2**	**17295.4**	**-8645.7**	**136.85**	**0.00**	**1.00**

II	**a**	**I + E + G + N + P**	**11**	**17152.6**	**-8565.3**	**0.00**	**0.30**	**0.30**
	b	I + E*P + G + N	12	17153.7	-8564.8	1.07	0.18	0.48
	c	I + E + G + N*P	14	17154.3	-8563.1	1.65	0.13	0.61
	d	I + E + G*P + N	12	17154.5	-8565.2	1.89	0.12	0.73
	e	I + E*P + G + N*P	15	17154.9	-8562.4	2.31	0.10	0.82
	f	I + E*P + G*P + N	13	17155.6	-8564.8	2.97	0.07	0.89
	g	I + E + G*P + N*P	15	17156.3	-8563.1	3.65	0.05	0.94
	h	I*P + E + G + N	14	17156.5	-8564.3	3.92	0.04	0.98
	i	**I + E + G + N**	**10**	**17158.5**	**-8569.2**	**5.88**	**0.02**	**1.00**
	j	**null (random effect only)**	**2**	**17295.4**	**-8645.7**	**142.74**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (package AICcmodavg in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

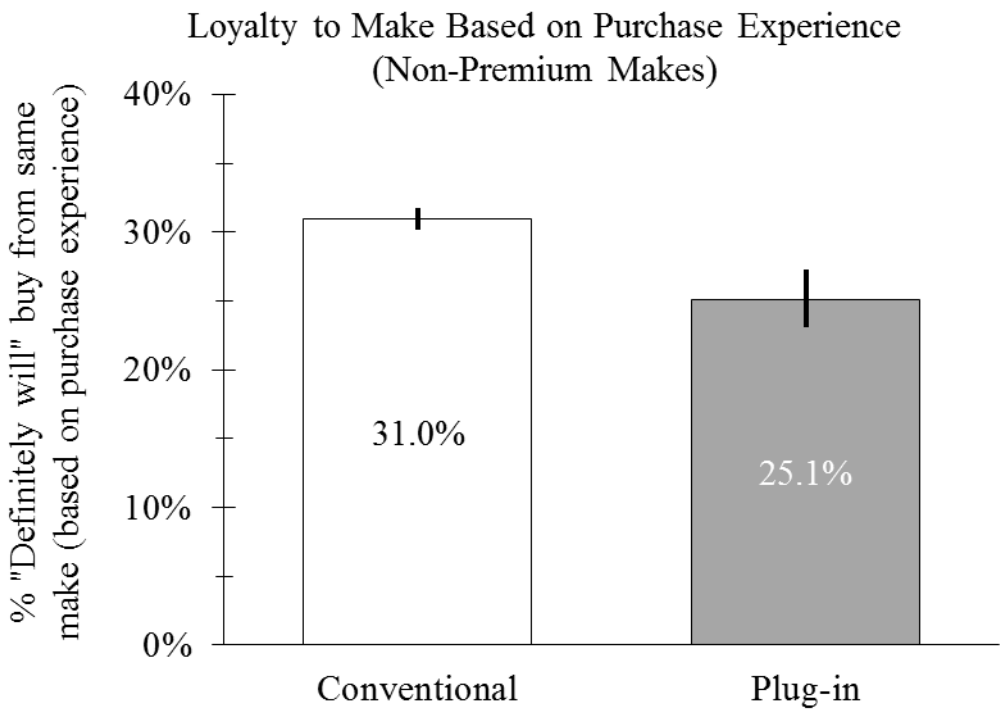


Figure 7-12. Intended customer loyalty to non-premium makes based on generalized linear mixed effects models (predicted mean).

Results based on whether a buyer selected "definitely will" when asked about the likelihood of purchasing/leasing from the same make next time. Estimates were derived from the best-approximating model and accounted for variation associated with demographic factors, as well as a random effect for intraclass correlation by the buyer's state of residence. Bars represent 95% confidence intervals (N = 14,060).

Customer Loyalty: Analysis of Premium Makes

Step I of the analysis revealed a best-approximating demographic model consisting of the buyer's education level, E (see model Ia, Table 7-11). This model fit the data better than competing models (ΔAIC*c* < 2.0; models Ib and Ic) as well as the intercept-only model (null; random effect-only) based on a likelihood ratio test (LRT χ^2 (1) = 15.6, p < 0.001).

Step II of the analysis examined evidence of variation in intended loyalty, based on purchase experience, explained by powertrain choice. The researcher constructed several models consisting of a main effect for powertrain choice (P) as well as an interaction effect between P and education level (E) from model Ia. Using the same model selection process as Step I, the researcher identified a parsimonious (best-approximating) model consisting of a main effect for P (model IIa, Table 7-11). The analysis also identified a competing model (ΔAIC*c* < 2.0), consisting of both a main effect for P and an interaction effect between P and E (model IIb, Table 7-11). The researcher found that model IIa had more support from the data than model IIb, however. Examination of the ratio of Akaike weights indicated model Ia was more than twice as likely to offer better model fit than model IIb ($w_{\text{model IIa}}/w_{\text{model IIb}}$). Model IIa also fit the data better than the null model ($\Delta AICc_{\text{ model I1j}}$ = 28.0).

Based on the β coefficient, the log odds probability that a plug-in buyer intended to remain loyal to the same premium make next time (based on purchase experience) was 22.1 percentage points higher (61.8%, asymptotic LCL = 5.4%, UCL = 5.2%) than a conventional vehicle buyer (39.7%, asymptotic LCL/UCL = 0.9%). The data indicated strong evidence of support for this finding (LRT χ^2 (1) = 16.4, p < 0.001). Figure 7-13 plots these results. The findings confirm the researcher's hypothesis that buyers who purchased a PEV through innovation-specific channels would report higher intended make loyalty than ICEV buyers purchasing via dealers. The chapter concludes with a summary of the statistical findings in Table 7-12..

Table 7-11. Evaluation of generalized linear mixed effects models for intended buyer loyalty to the same make (premium makes).

Based on whether buyer selected, based on the purchase experience, they “definitely will” purchase a vehicle of the same make next time. k = number of parameters; AIC*c* = Akaike’s Information Criterion with second order sample size correction (c); LL = Log Likelihood; ΔAIC*c* = difference in AIC*c* between model of interest and best-approximating model; w = Akaike’s weight; C*w* = cumulative weight.

Step [a]	Model	Model Specification [b]	k	AIC*c*	LL	ΔAIC*c*	w	C*w*
I	**a**	**E**	**3**	**7205.2**	**-3599.6**	**0.00**	**0.31**	**0.31**
	b	G*E	5	7206.2	-3598.1	0.94	0.19	0.50
	c	E + G	4	7206.5	-3599.2	1.26	0.16	0.67
	d	E + N	6	7207.8	-3597.9	2.57	0.09	0.75
	e	E + G + R	5	7208.1	-3599.1	2.91	0.07	0.82
	f	N + G*E	8	7208.5	-3596.2	3.30	0.06	0.88
	g	E + G + N + R	8	7209.6	-3596.8	4.34	0.04	0.92
	h	I + E	6	7210.1	-3599.1	4.93	0.03	0.94
	i	I + E + G + N + M	11	7211.2	-3594.6	5.94	0.02	0.96
	j	**null (random effect only)**	**2**	**7218.9**	**-3607.4**	**13.64**	**0.00**	**1.00**

II	**a**	**E + P**	**4**	**7190.9**	**-3591.4**	**0.00**	**0.70**	**0.70**
	b	E*P	5	7192.5	-3591.3	1.66	0.30	1.00
	c	**E**	**3**	**7205.2**	**-3599.6**	**14.35**	**0.00**	**1.00**
	d	**null (random effect only)**	**2**	**7218.9**	**-3607.4**	**27.99**	**0.00**	**1.00**

Source: *2013 Sales Satisfaction Index (SSI) study* data provided by JD Power & Associates.

[a] Step I compared candidate models consisting of demographic factors and used a best model selection procedure (package AICcmodavg in *R*) to eliminate models that lacked evidence from the data. Step II compared the best model from the previous step with a model that included performance for plug-in electric vehicles.

[b] All model structures consisted of a random intercept for the buyer's state of residence to account for spatial autocorrelation and unbalanced sampling design. Null represents the random effect only. Unweighted for U.S. sales mix.

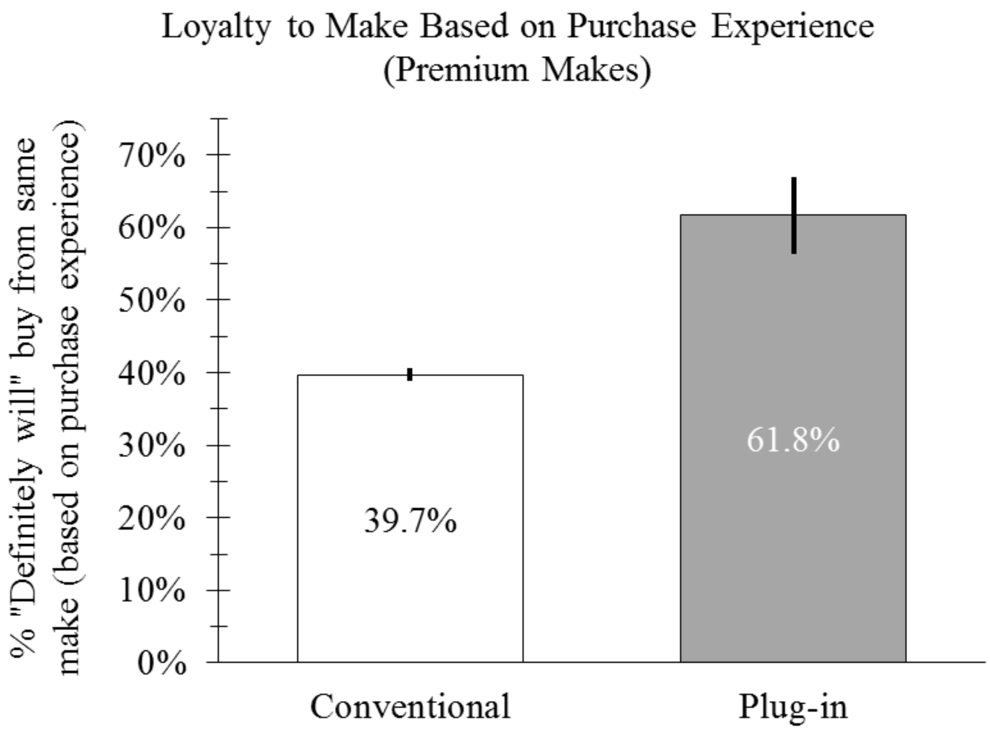


Figure 7-13. Intended customer loyalty to premium makes based on generalized linear mixed effects models (predicted mean).

Results based on whether a buyer selected “definitely will” when asked about the likelihood of purchasing/leasing from the same make next time. Estimates were derived from the best-approximating model and accounted for variation associated with demographic factors, including a random effect for intraclass correlation by the buyer’s state of residence. Bars represent 95% confidence intervals (N = 5,417).

Table 7-12. Summary of statistical findings from Chapter 7.

No.	Hypothesis	Make Category	Predicted Relationship	Result
H1a	A difference in retail satisfaction with dealers exists between PEV and ICEV buyers.	Non-premium	PEV buyers rate retail satisfaction from dealers lower than ICEV buyers	Confirmed
H1b	A difference in retail satisfaction exists between customers who bought a PEV through direct distribution and customers who bought an ICEV via established dealers.	Premium	Buyers purchasing PEVs through direct distribution rate retail satisfaction higher than ICEV buyers purchasing via dealers.	Confirmed
H2a	A difference in total transaction time at the selling dealership exists between PEV and ICEV buyers.	Non-premium	PEV buyers report more total time spent at the dealer than ICEV buyers	Rejected
H2b	A difference in total transaction time exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	Buyers purchasing PEVs via direct distribution report shorter purchase transaction times than ICEV buyers via dealers	Confirmed
H3a	A difference in the duration of vehicle delivery at the selling dealership exists between PEV and ICEV customers.	Non-premium	PEV buyers report a longer vehicle delivery stage via dealers than ICEV buyers	Confirmed
H3b	A difference in duration of the vehicle delivery stage exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	Buyers purchasing PEVs via direct distribution report a longer delivery stage than ICEV buyers via dealers	Confirmed
H4	A difference in the percentage of buyers representing conquest sales exists between PEV and ICEV customers who bought through established dealers.	Non-premium	PEV buyers represent more conquest sales than ICEV buyers	Confirmed
H5	A difference in reported intent to return to the selling dealer for paid services exists between PEV and ICEV customers who bought through established dealers.	Non-premium	Fewer PEV buyers intend to return to the selling dealer for paid services	Confirmed
H6	A difference in the percentage of reported cross-selling by dealers exists between PEV and ICEV customers who bought through established dealers.	Non-premium	A greater percentage of PEV buyers report cross-selling by dealers	Confirmed
H7a	A difference in intended make loyalty exists between between PEV and ICEV customers who bought through established dealers.	Non-premium	PEV buyers using dealers report lower intended make loyalty than ICEV buyers	Confirmed
H7b	A difference in intended make loyalty exists between customers who bought a PEV through direct distribution and customers who bought an ICEV through established dealers.	Premium	Buyers purchasing PEVs via direct distribution report higher intended make loyalty than ICEV buyers purchasing via dealers	Confirmed

8 Discussion

This chapter reviews the research findings in light of the research questions and discusses areas for policy attention and future research. Recall that the purpose of the study is to identify potential disparities in the quality of retail delivery to PEV customers and to consider whether distribution channel strategy may explain differences in retail performance. Another central purpose is to examine the efficacy of policies that may affect consumer adoption of PEVs vis-à-vis franchised dealers as well as through direct distribution by auto manufacturers. A principal consideration is the relative importance of distribution channel design for firms introducing innovations that entail changes in established modes of consumer behavior, that require new or highly modified infrastructure on which customers rely, or that disrupt the operations of distributing agents (i.e., retailers). It also discusses conditions that limit manufacturers from selecting an optimal introduction pathway, including pre-existing channel structure, channel partner relations and capture of the regulatory process by incumbent interests.

Given the dearth of literature on the topic of public policy and distribution and sale of PEVs, the study attempts an initial survey of the retail landscape by examining empirical evidence from interviews with industry stakeholders and through the analysis of survey data on customer retail satisfaction collected by market research firm J.D. Power. It further considers relevant theories and empirical evidence from research in innovation studies, marketing of high-technology products and political science.

Findings from the analysis of interview and survey data presented in the previous chapters suggest that the default distribution pathway – i.e., mass-market franchise dealers –

represents a suboptimal conduit for introducing PEVs. In numerous court battles and hearings in state legislatures, dealer lobbies maintain that direct distribution would harm consumer welfare relative to the franchise model (Crane 2015, 29-30). In terms of quality of the retail experience, however, the findings presented here suggest just the opposite. The one instance of manufacturer direct-to-consumer (D2C) sales – Tesla Motors – delivered substantially higher retail satisfaction to PEV customers, even when isolating the analysis to luxury (premium) makes and controlling for demographic variables (see Figure 7-4, page 189).

Ironically, the evidence finds significantly lower than average performance by mass market (non-premium) dealers, revealing a large and significant *retail quality gap* for PEV buyers (Figure 7-3, page 184). By contrast, direct distribution holds the potential to deliver a more uniform, higher quality retail experience to PEV customers (see Figure 7-5, page 190) in addition to winning significantly higher customer loyalty (see Figure 7-12 and Figure 7-13 on pages 229 and 234, respectively).

This significant and strongly correlated evidence confirms the H1 hypothesis in which the researcher theorized that introducing a fundamentally disruptive product such as PEVs through a largely undifferentiated conventional distribution pathway would yield significantly lower retail quality. It further confirms the H2 hypothesis postulating higher retail quality as a consequence of using a direct distribution model founded on establishing a niche market and leveraging a "whole product" approach in which product design incorporates distribution strategy as a fundamental consideration. This is appropriate for innovative new products that disrupt traditional modes of consumer – as well as distributor – behavior. Moreover, conversations with industry experts confirmed that the magnitude of the gap is extraordinary by industry standards (when controlling for demographic factors). That is, the gap is substantially larger in magnitude than had historically accompanied the introduction of more incremental but nevertheless disruptive new features like the first generation versions of BMW's iDrive and Ford's Sync in-car infotainment management systems or the first two generations of Toyota's Prius. The latter of which took a full five years to resolve to a negligible difference in retail quality.

8.1 Early and Mainstream PEV Markets

The findings presented in this dissertation points to a possible division of the market between early and mainstream customers. This division suggests significant differences in consumer risk profiles associated with transitioning from a well-supported, institutionalized conventional product to an unfamiliar product with substantially under-developed support infrastructure.

Dealers identified PEV customers as fitting distinct psychographic profiles that include relatively better educated, more affluent and predominantly male environmental advocates and technology enthusiasts as well as budget-conscious commuters with less strongly-held environmental views. The latter may reflect a 'pulling forward' of demand from the early majority segment made possible by the confluence of incentives that make PEVs an attractive alternative for particular customer segments, namely commuters near corridors featuring HOV lanes. Alternatively, these customers may simply represent another 'flavor' of early adopter in which the economics of the decision supersede other value considerations.

Per Goldenberg et al. (2002), these findings suggest a possible bifurcation of the market between early and mainstream customer segments in which each operate as a fundamentally independent market. If true, each likely weigh elements of the buying decision differently, express different expectations of performance and exhibit different rates of adoption. More importantly, there may be more communication within each segment than between them, underscoring the challenge of creating sufficient early market momentum to breach the chasm between the early and mainstream markets.

8.2 Enlarged Role for Retailers Selling PEVs?

A possible explanation for the gaping disparity in retail quality may rest with the relative importance of the retailer as a sense-making agent for consumers considering a switch to a risky and unfamiliar alternative platform. As a key touch point with end customers, retailers serve a vital function in both facilitating sales to end customers and providing ongoing support during ownership such as warranty, maintenance and repair. For PEVs, however, some of the traditional roles of dealers take on outsize importance. First, in part due to the underdeveloped state of charging infrastructure, PEVs (and especially short-range BEVs) are not for everyone. Retailers act as a form of final check to ensure that the customer and the technology are well-matched based on the customer's individual profile. Though this study found that dealers are marginally more likely to cross-sell PEV customers into (typically) conventional vehicles (see Figure 7-11, page 223), sound rationale exists for doing so in many cases. Regrettably, industry survey instruments, including the one examined as part of this research, offer little information regarding dealer rationale for dissuading customers from purchasing PEVs.

Second, diffusion of innovation theory holds that relative advantage plays a determining role in technology adoption (Rogers 1995). Due to their presumably more intimate understanding of customer needs, retailers are distinctively positioned to relate the unique value of new technologies like PEVs to the end user. Unique value can take a number of forms. These include advantages relative to conventional vehicles along historic dimensions of performance (e.g., smooth ride, quiet operation, off-the-line acceleration) as well as the cumulative benefits conferred by public incentives (e.g., effective no-money down purchase or lease, lower maintenance costs, reduced commute times). Unique value can also pertain to advantages along entirely new dimensions of performance (e.g., charging at home, remote vehicle servicing, real-time feature enhancements or unlocking of entirely new features via OTA updates).

Central to grasping the unique value of PEVs in the first place is the immersion of retail representatives in the experience of driving a PEV on a day-to-day basis for many of the same tasks customers are likely to perform. Examples include commuting to and from the workplace, running local errands, or embarking on longer-distance journeys with passengers and cargo. For conventional vehicles, retailers possess a de facto grasp of the capabilities and limitations inherent to conventionally powered autos. Because of this, they likely can more readily assimilate and relate model-specific distinctions to customers. This base-level knowledge cannot be assumed of PEVs. Rather, PEVs entail material changes in vehicle performance, interaction with unfamiliar equipment, and new or different patterns and contexts of use. Retailers must possess intimate knowledge of these interactions if they are to be expected to shape and deliver effective messages when marketing PEVs, closing the sale or otherwise informing prospective PEV customers and intelligently fielding their questions.

Most importantly, under the right circumstances retailers are positioned to re-frame the value proposition for the customer so as to cast PEVs in a more flattering light than might otherwise occur when part of a conventional sales pitch. For example, the high up-front incremental cost of PEVs relative to similarly equipped conventional vehicles deters many potential customers from even considering a PEV as an alternative. Retailers reported that reframing the value proposition around net monthly savings in the context of total ownership cost has proven a more effective method for convincing prospective PEV buyers. By reframing PEVs in terms of monthly savings and cumulative benefits, dealers end up emphasizing the best attributes and strengths of the new technology, rather than its shortcomings.

Lastly, because of their proximity to buyer populations, retailers are well-positioned to provide support to PEV customers before, during and after the sale. Moreover, as the results illustrated in Figure 7-9 on page 211 attests, PEVs attract more conquest buyers from competing brands than conventional ICEs. Retailers therefore have an opportunity to take a more engaged role in activities that build demand while steering business to the dealership or retail outlet to capture vehicle sales and post-sale services. Examples of these activities include participating in online chat rooms and social media to answer questions, inform customers, and dispel the many myths, misinformation and confusion that accompanies new technology. Notably, retailers can also play an enlarged role in marketing and product development by passing new information gleaned from customer interactions back to the automaker where it can inform the design of future products as well as more effective marketing and advertising approaches for selling PEVs.

Diffusion of innovation theory further maintains that the simplicity and intuitiveness of disruptive products and ideas impacts the rate of uptake by customers (Rogers 1976, 1995, Moore 2014). Manufacturers can aid retailers in this respect through the "robust design" and "whole product design" precepts discussed in Chapter 3 that extend design beyond the product itself to the actual environment in which the product is sold. Automakers could conceivably accomplish this not only through simpler and more intuitive vehicle designs that borrow from institutions familiar to customers, but by streamlining highly opaque, fragmented and counterintuitive shopping and purchase processes required of customers considering a switch from conventional platforms.

Though car shoppers increasingly benefit from the myriad of Internet-based resources and the benefits they afford, PEVs considerably complicate the picture by heaping on additional, yet key considerations crucial to the buyer's ability to realize the full benefits of switching to a PEV alternative. These include availability of charging infrastructure, cost, use and reliability of charging equipment, and readiness of home electrical wiring for vehicle charging. Others include availability of discounted electricity rates that impact household utility costs, and eligibility and availability of public incentives at various levels of government.

Collecting this information entails customers (and dealers) researching a dizzying array of websites while also relying on personal references and even dealers to make sense of it all. While early customers are more inclined to tolerate such inconvenience, the same cannot be expected of mainstream customers. It is also unreasonable to expect dealers to deliver concierge-style special services at mass market scale. Herein lies significant opportunity for OEMs to provide PEV customers – and the dealers that serve them – the resources to surmount these obstacles. For example, OEMs could introduce tools that pull information from disparate sources into a single "one-stop shop" whereby prospective PEV buyers can more simply and intuitively retrieve an online estimate of benefits and savings tailored to their individual needs and household profile. This could significantly aid consumer uptake by helping customers internalize the cumulative value of these benefits and by reducing uncertainty that deters customers from choosing PEVs as an alternative. A tool tailored to retailers could similarly aid learning and retention for dealers and retail representatives and speed the embrace of PEVs by dealers concerned over training a highly impermanent sales force.

In sum, switching from a conventional vehicle platform to an alternative like a PEV involves complex decision criteria with potentially more consequential impacts for buyers. Moreover, these factors materially effect the customer's ability to realize the full benefits of making the jump to a distinctly new and different technological platform. Consequently, customers may expect to lean more heavily on retailers as a resource for making sense of these considerations to inform their next purchase.

8.3 Disparities between Dealer Perceptions and Observations

Non-premium PEV buyers reported spending *less overall time* at the retail facility than their ICE counterparts. This refutes the hypothesis (H2a) advanced by dealers and postulated by the researcher. It is possible that more PEV buyers know exactly which vehicle they want when they arrive at the dealer, which could speed the transaction process. Moreover, dealers may confound transaction time with a longer overall sales process (from time of first contact with the customer to last contact). In other words, because the sales process for PEVs is relatively longer than ICEs, salespeople may implicitly assume a longer period to transact the sale. Non-premium PEV buyers also reported spending *more time at the vehicle delivery stage* of the transaction. This finding comports with dealer statements (H3a). The magnitude of the disparity, however, is much lower than that suggested in interviews (2.7 minutes versus 10-30 minutes reported by dealers). This again reveals disparities in dealer perceptions and empirical findings, suggesting dealers may perceive greater burdens with PEVs than may occur in reality.

Premium PEV buyers reported spending *less total time* at the retail facility than premium ICE buyers, confirming the researcher's hypothesis (H2b). The most likely factors influencing reduced transaction times are the use of set prices and web-enabled transactions. These consequently reduce or eliminate times traditionally spent negotiating the deal, drawing up paperwork in F&I and waiting. The net result slashes the average total transaction time from an industry average of over four hours by nearly one-half. Premium PEV buyers also reported a *longer delivery phase* than their premium ICE buying counterparts (H3b, 46 minutes versus 37 minutes). The IC analysis, however, was less conclusive due to a weak main effect (4.5 minutes longer for PEVs than for ICEs, SE = 4.4 minutes) due to the presence of a strong interaction effect between age group and powertrain choice. PEV delivery times appear to decrease with age group in contrast to the inverse of this trend observed in conventional buyers. In interviews, dealers suggested that they try to minimize the duration of the delivery stage since customer fatigue sometimes sets in. Tesla customers typically take delivery in a separate visit from the initial purchase transaction. This may result in greater willingness by customers to spend more time at delivery for explanation of vehicle operation and features.

8.4 Inducing and Blocking Mechanisms Affecting PEV Market Development

The Technology Innovation Systems (TIS) framework underscores the importance of identifying dynamics within the system of actors, institutions and networks that could undermine the transition to more sustainable alternatives as targets for potential policy attention (e.g., Hekkert 2007, Bergek et al. 2008). TIS frames these in terms of "inducing" and "blocking" mechanisms that either reinforce or undermine desired system behavior. For purposes of exploring the full set of potential factors affecting retail-level dynamics, the researcher chose not to restrict the set of considerations to the set of macro-level functional processes advanced by TIS theory. The next sections examine retail-level drivers that appear to reinforce PEV sales and market development, as well barriers that alternatively impede PEV market growth. Each of these further divided to consider dynamics affecting franchised and direct distribution models jointly and exclusively.

8.4.1 PEV Market Drivers Common to Franchised and Direct Distribution Models

The findings of the previous chapters revealed several potential drivers fueling PEV sales regardless of the distribution model employed by manufacturers. Robust and continued government supports, utility rate incentives and other inducements play a vital role. The single most likely important feature of any incentive is the ability of retailers to apply them – and for consumers to capture them – at the *point of purchase*. The enormous popularity of leasing

(Figure 7-1, page 175) underscores the power of this characteristic. After some prodding by dealers, automakers quickly capitalized on provisions that allowed for capture by the financing agent of the full monetary value of the federal tax credit upon execution of the lease agreement. These took the form of a capital cost reduction on the lease contract that had the effect of substantially lowering the lessee's monthly payment. As a result, "special lease" offers by multiple PEV manufacturers followed in abundance. These significantly increased affordability and placed PEVs in a much more competitive position relative to conventional offerings from a monthly cost of ownership perspective. Retailers cued on this by reframing the value of PEVs around monthly cost savings.

California's execution of its HOV decal program offers another compelling example of the effectiveness of point of purchase incentives. In California, dealers and automakers worked with the state's DMV to secure HOV decals upon taking PEV inventory from the manufacturer. This enabled them to confidently market this incentive to customers, with many electing to affix these stickers to PEVs on the lot and the showroom floor. In another example, though not immediately captured at purchase, California retailers (Tesla included) leveraged the state's (up to $2,500) CVRP rebate as a way to significantly lower or even eliminate the customer's down payment amount. Some even framed the customer's out-of-pocket expense as a personal "bridge loan" reimbursed upon receipt of the state's rebate check. In sum, dealers are better able to leverage and effectively market incentives that maximize benefits to the customer at the point of purchase.

8.4.2 PEV Market Drivers unique to the Franchised Distribution Model

The findings reveal that dynamics unique to the franchise distribution model appear to drive PEV sales. Most notably, a small but potentially influential population of dealers actively embrace PEVs. Consistent with the resourced-based theory of the firm, these "dealer innovators" possess assets unique to the organization not easily replicable by other dealers. Dealers explicitly cited proximity to more affluent markets or location near busy commute corridors, but organizational and cultural factors may also play a determining role. Chief amongst these was the presence of a strong PEV product champion in the executive ranks, alignment of PEVs with existing competitive differentiation efforts (e.g., catering to environmentally-aware customers) and the presence and deliberate use of seasoned, technology-savvy members of the sales team to spearhead PEV sales and outreach efforts. In many cases, the researcher observed that management granted these individuals the latitude to experiment and learn, along with a general willingness to accept potential losses in the near to medium term. Also prevalent at these dealers was the use of a flat, rather than percentage-based, commission and bonus structure (whether for conventional vehicles or PEVs). These ensured that salespersons selling PEVs were rewarded, rather than disadvantaged, relative to peers.

Several other factors appeared uniquely applicable in driving sales of PEVs within the ranks of franchised dealers. First is the robust use of incremental dealer incentives by manufacturers to reward dealers and salespeople for the added burdens of PEV sales. Incentives took on forms common to conventional vehicles that included "spiffs", "spins" and "stair-step" bonuses for achieving volume targets. However, the magnitude, mix and permanence of these incentives varied markedly by make, in some cases waxing and waning in tandem with the internal objectives of the manufacturer.

Second, dealer innovators and automakers alike underscored the greater effectiveness of designating seasoned, tech-savvy sales members as PEV specialists, whether employed as the sole touch point with customers interested in PEVs or as an initial entryway to the sales force. This affords resource-constrained dealers, especially where initial sales comprise a fraction of total monthly volume, an efficient and more effective path to scale sales force competence with evolving demand. Training or utilizing a dealer's entire sales force for PEVs could prove counterproductive, largely because resources end up dispersed among sales members that see customers too infrequently to reinforce or retain learning. Conversely, leveraging PEV specialists concentrates training, resources and customer interactions on a smaller number of assets best situated to benefit. This is achieved by increasing the frequency of PEV sales interactions that contribute to competence-building and learning retention and bolster salesperson confidence to pursue additional PEV sales.

Lastly, high-volume dealers appear better positioned to serve PEV customers based on several contributing factors. First, these dealers are more likely to possess the resources from which to commit the necessary up-front investment in PEV-specific equipment, facility upgrades and training of the sales and service staff. They similarly possess the means to stock a mix of PEVs and popular trim levels sufficient to attract more buyers, and are more likely to access other dealers under ownership to draw additional inventory as needed. They may also leverage complementary assets such as tablet computers, charging equipment or solar canopies to aid salespeople, showcase the technology or to provide ongoing value-added services such as vehicle charging to its customers or the larger EV community.

Second, larger dealers may also benefit from a bigger talent pool from which to designate PEV specialists and can specialize labor to cater to particular facets of the buying process important for PEV customer satisfaction. Larger dealers can also expect designated PEV specialists to witness more PEV interactions with greater frequency, thereby facilitating competence-building and learning retention. Third, high-volume dealers may be better positioned to defend against free riding by rival dealers on its PEV-specific investments by competing more aggressively on price. Finally, larger, high-volume dealers may benefit in terms of more impactful branding from the extended footprint and reach (scale and scope) that often accompanies size.

8.4.3 Drivers unique to Direct Distribution of PEVs

Firms often struggle to communicate the distinctive value of innovative new products to customers beholden to a familiar conventional product. Moreover, the marketing literature for high-tech products suggests that when firms introduce substantially new discontinuous products, there is often a gap between the promised value to the customer and the ability of the product to fulfill that promise (Mohr, Sengupta, and Slater 2013, Moore 2014). Closing the gap between the promised and realized value entails the provision of a number of distinct products and services that cater to the unique needs of customers switching to a new technology platform. Delivering these effectively may entail changes to existing modes of provision or entirely new business models.

Silicon Valley giant Apple Inc. provides a well-known case in point. For much of the 1990's Apple's distinctive products languished on the shelves of big box electronics retailers alongside much cheaper generic alternatives from PC makers Dell, Hewlett Packard, and Compaq. In his biography of Steve Jobs, author Walter Isaacson explained the iconic leader's concern over the company's lack of control of the retail experience: "Clerks had neither the knowledge nor the incentive to explain the distinctive nature of Apple products" (Isaacson 2011, 368). Jobs himself lamented, "All that the salesman cared about was a $50 spiff" (ibid.). "If Apple is going to succeed," Jobs relayed to Ron Johnson, then vice president of merchandising for Target and later senior vice president of retail operations at Apple, "we're going to win on innovation. And you can't win on innovation unless you have a way to communicate to customers" (Isaacson 2011, 369).

In response, Apple launched factory-owned retail outlets specifically designed to support innovative new products to follow like the iPhone and iPad. Dispensing with the conventional wisdom that when making a major and infrequent purchase, customers would willingly make a dedicated trip to a less convenient location, Apple located its stores in popular shopping destinations in malls and on Main Streets, areas with lots of foot traffic where it could reach customers of the conventional Windows platform. Johnson explained, "We may not be able to get them to drive ten miles to check out our products, but we can get them to walk ten feet" (Isaacson 2011, 369-370).

As in Apple's case, direct ownership empowers manufacturers to leverage synergies crucial for raising brand awareness and for assuaging customer uncertainties surrounding the switch to an alternative platform. Foremost is the creation of a safe space for customers to explore and learn about the company's products and complementary technologies. Tesla achieves this via design of the store, the incentive structure of its employees and its unique pricing model. Stores lack physical product but make use of store space to showcase distinctive product features and vehicle cut-aways, trim options and charging equipment. Large, widescreen interactive displays equipped with robust vehicle configuration and simulation tools further invite customers to learn more about Model S performance and capabilities. Customers can also learn about the state of the company's proprietary Supercharger network and observe a time-phased map of the company's ongoing infrastructure build-out.

Equally important, Tesla dispensed with traditional salespeople in favor of no-commission "product specialists." As a result, customers may explore the store free of the high-pressure sales tactics that often accompany a visit to a conventional dealership. Moreover, Tesla employs a set pricing model in which the company sets the prices of its vehicles and optional features, equipment and services. By eliminating negotiations, the company eliminates a particular sore point for many new car shoppers, greatly simplifies the purchase process and channels retailer energies toward delivering a high quality customer experience. These moves likely work synergistically to align retailer behavior with long-term customer development, education and market growth rather than the short-term gain of closing a sale.

The use of retail stores not only contributes to awareness and learning but also represents a powerful physical expression of the brand. Much like Apple, Tesla's direct model enables the company to consistently extend its design ethos of simplicity, elegance and technological leadership uniformly among its stores. Moreover, for a start-up company struggling to gain a foothold in the consumer psyche, the size and presence of the store adjacent other recognized brands further aids in building trust and securing the company's legitimacy among customers as a relevant vehicle manufacturer. More importantly, through the greater ability to communicate with customers via design, Tesla, like Apple, can work toward 'crossing the chasm', i.e., moving its product from cult following to cool status where it stands a better chance of reaching beyond a core set of devoted customers to the mainstream market.

Furthermore, vertical ownership of the distribution channel enables manufacturers to tap additional drivers less available, and in many cases completely unavailable, to manufacturers via their franchised networks. Foremost is greater design space (fewer constraints) from which to translate unique advantages derived from an entirely new architecture into customer value. Tesla, for example, leverages its full-electric architecture to deliver OTA software updates and firmware patches. Tesla delivered OTA firmware updates, for example, that through improved power controls and more efficient battery management, extended the range of vehicles already in the hands of customers. This capability promises to increase manufacturer responsiveness to vehicle safety as well. Under federal law, manufacturers must report safety defects to NHTSA, but the decision to return the vehicle to the dealer for service rests with individual customers (2013c). By bypassing customers (and dealers), Tesla contends that OTA firmware patches hold the potential not only to increase compliance with safety recall events issued by NHTSA (2014e) but to avoid the more costly involvement of customers and dealers in assuring compliance.

Ownership of the distribution channel and charging infrastructure further enables Tesla to quickly respond to challenges unique to introducing discontinuous innovations that could adversely impact customer satisfaction and loyalty. OTA functionality not only enables manufacturers to more quickly address trouble areas as they emerge, thereby assuring customer loyalty and bolstering positive WOM effects, it may yield lower compliance costs as well. In sum, direct distribution aligns manufacturer interests with timely and more efficient problem resolution. Both of which are indispensible for the successful introduction of disruptive new technologies.

The benefits to vertical ownership extend beyond safety to other critical elements of vehicle design. For example, Tesla spurned involvement in the creation of a joint charging standard alongside incumbent firms in favor of deploying its own “Supercharger” network of proprietary fast-charge stations. First generation PEV designs introduced by established automakers leveraged smaller, less expensive batteries capable of all-electric driving over shorter distances (typically well under 100 miles). Tesla’s Model S rested on a more battery-intensive, all-electric architecture capable of travel over much longer distances (200+ miles depending on options). As a result, Tesla’s customers could be expected to use their vehicles differently and express different charging preferences than those of incumbent manufacturers. For example, because of the Model S’s longer range, charging stations positioned to enable inter-city travel mattered more to Tesla customers. Moreover, these customers cared more about quicker recharge times to enable inter-city trips than buyers of shorter-range BEVs or PHEVs available from legacy makes. Consequently, Tesla pursued a proprietary strategy in which it deployed high-power “Superchargers” along major Interstates to assure responsiveness to its own customer needs.

Control over the charging infrastructure also enables Tesla to leverage synergies available through tightly coupled vehicle and infrastructure design. For example, the company introduced two new features via OTA update – Range Assurance and Trip Planner – that use the vehicle’s built-in navigation system to communicate in real time with Tesla’s proprietary network of fast chargers to automatically plan charging stops when a road trip might risk stranding a customer without charge (Nelson 2015).

Fear of running out of charge (a.k.a. “range anxiety”) ranks as a top concern among BEV drivers. Company CEO Elon Musk told reporters that the update “makes it almost impossible for a Model S driver to run out of range unintentionally” (Nelson 2015). Moreover, Tesla implemented these updates well in advance of the lengthier model refresh cycle and without the cost (to Tesla) or inconvenience (to customers) of a visit to a service center. Said Model S program director James Guillen, former head of business innovation at Daimler AG, “We are doing things in a couple weeks that, at my previous employer, would have taken two years” (Rechtin 2013). This level of attentiveness to customer needs in the critical early stages of technology commercialization is only possible through the tight integration of these systems (i.e., the full electric vehicle architecture and proprietary charging infrastructure conferred by direct ownership). Tesla is also piloting “battery swap” capability in a site north of Los Angeles in which customers can swap out a spent battery for a fully charged replacement in as little as 90 seconds at a cost equivalent to a full tank of gas. Only through tight integration between battery, drivetrain and switch station design could this be possible.

Another likely contributor to Tesla's industry-high retail satisfaction and loyalty scores is the company's ample use of web-based tools for both informational and transactional purposes. While most dealerships leverage the Internet by posting vehicle inventory, pricing and specials, few use it as a means to conduct other elements of the purchase transaction. In response to shifting preferences from younger buyers entering the market, several of the nation's largest dealer groups including AutoNation and Sonic are moving toward a digital storefront model in which customers can obtain a committed price, determine trade-in value and secure vehicle financing in advance of visiting the dealership (Wilson 2014). These capabilities promise to cut customer transaction times significantly.

Moving to online media and electronic transactions, however, involves substantial outlays by dealers. Smaller chains and "mom and pop" stores may struggle to follow the lead of larger chains. Moreover, efforts by manufacturers to enable online sales have historically met stiff resistance from dealer groups concerned with automaker overreach (Crane 2014, 2015). Direct distribution, on the other hand, short circuits these hurdles. In Tesla's case, the company could leverage its full resources to design and implement a single, unified digital storefront through which to execute its D2C model. Figure 7-6 (page 194) illustrates how shifting traditional physical processes to online media can slash customer transaction times. As a result, Tesla may be better positioned to afford its customers greater attention during the crucial delivery stage, where buyers are more likely to require instruction on use of unfamiliar equipment and features associated with disruptive new technologies like PEVs. Absent direct ownership, Tesla would likely confront the same resistance, inconsistent implementation and incomplete adoption by independent franchises faced by incumbent manufacturers, to the detriment of PEV customers.

8.4.4 Retail Level Barriers to PEV Adoption

Automakers relying on franchised dealers or factory-owned retail outlets face substantial, yet distinctly different, headwinds impacting their ability to grow PEV sales and to deliver after-market support for PEV customers. Despite the efforts of a minority population of franchises, the research revealed a significant industry-wide *retail quality gap* in which PEV buyers reported lower overall dealer quality after controlling for demographic factors (see Figure 7-3, page 184). Findings from interview and survey data point to numerous and material barriers inherent to the dependence of incumbent automakers on mass market dealer channels for introducing PEV models. This section discusses these barriers at greater length. It then examines the obstacles facing the direct distribution strategy, despite empirical evidence affirming the model's capacity to lift retail quality for PEV customers and to broaden the appeal of PEVs from early to mainstream buyers.

8.4.5 Barriers to PEV Adoption via Franchised Distribution

Disproportionate Returns

Diffusion of innovation theory maintains that *compatibility* with current customer values and practices plays a determining role in adoption of new technologies (Rogers 1976, Moore

2014, Rogers 1995). Though they exist to sell vehicles to end customers and support buyers post-sale, dealers in fact represent an automaker's first customers for innovative new products like PEVs. The evidence, however, indicates that PEVs may be much less compatible with the traditional franchise model for several reasons.

First, there is an inherent chicken-and-egg dynamic in the technology-distributor relationship. Automakers and dealers alike emphasized that robust consumer demand will ultimately compel salespeople to gain proficiency selling PEVs, but building sufficient demand in the first place entails developing new competencies by automakers, dealers and their sales personnel. Absent sufficient demand – a problem typical of early markets for innovative technologies – dealers lack sufficient incentives to invest in innovation-specific practices and processes. Laws governing OEM-dealer relations restrict automakers to indirect and highly limited means for inducing desired behavior. Automakers can reward dealers based on retail performance, including customer satisfaction. They can also set minimum thresholds for participation and even prescribe best practice. But for the most part, dealer participation and embrace of these practices is left to each dealer's individual volition.

This is fundamentally a problem of *disproportionate returns* to dealers. In all but the most PEV-friendly of markets, many dealers expressed that sales of these vehicles comprise a small fraction of a their typical monthly sales volume. Yet selling PEVs involves expenditures on new equipment and facility upgrades and costly outlays for incremental training for sales staff and service technicians. Moreover, sales staff face a much steeper learning curve involving unfamiliar vehicle technologies, support infrastructure and contexts of product use. They also confront myriad public incentives administered from disparate sources, each with unique eligibility requirements and benefits that often vary from customer to customer. Dealers also wrestle with the higher demands of early customers, including lengthier sales interactions that siphon resources from other more profitable activities. Though PEV customers of non-premium makes report marginally longer delivery times (Figure 7-7, page 200) and shorter overall transaction times (Figure 7-6, page 194), dealers nevertheless hold strong perceptions to the contrary.

Moreover, despite the opportunity to win conquest customers from competing non-premium makes (Figure 7-9, page 211), PEVs appear to entail less compelling profit opportunities for dealers and salespeople alike relative to the additional burdens they carry when selling these vehicles. This holds both in terms of gross profit on the front-end of the deal and with respect to back-end revenues resulting from the sale. This is due in part to the higher credit worthiness of early customers and the prevalence of special leases that leaves little room for dealer reserve. These customers also anticipate fewer visits to the selling dealer for paid services (see Figure 7-10, page 217). While the latter may be attributable to lower maintenance expectations for PEVs, it may also result from greater travel by customers away from dealers convenient to home or workplace locations due to highly limited PEV availability. Furthermore, since automakers often peg compensation to retail satisfaction, lower scores from PEV buyers further erodes potential profits realized by dealers and their salespeople. The confluence of these factors likely contribute to reduced customer loyalty as evidenced in Figure 7-12, page 229.

Dealers also face more risk when choosing to sell PEVs. In particular, increased financial liability associated with the potential for stranded PEV inventory in the wake of shifting public incentives and legal liability associated with incomplete or inaccurate information on these programs inadvertently shared with customers. These latter concerns deter some dealers from marketing key public incentives such as the federal tax credit, state rebates or HOV decal programs precisely because dealers cannot determine in advance the magnitude of the benefit or assure availability of, or eligibility for, these inducements for each and every customer.

Dealers accommodating public incentive programs also run the risk of disrupting support for conventional customers due to the more intensive resources these programs occasionally demand. Moreover, dealers (in particular pure BEV dealers), depend on external actors – who are motivated by their own internal imperatives – to build out the charging infrastructure on which growth in customer demand for PEVs hinges. This dependency can lead dealers to take a "wait and see" attitude toward PEVs.

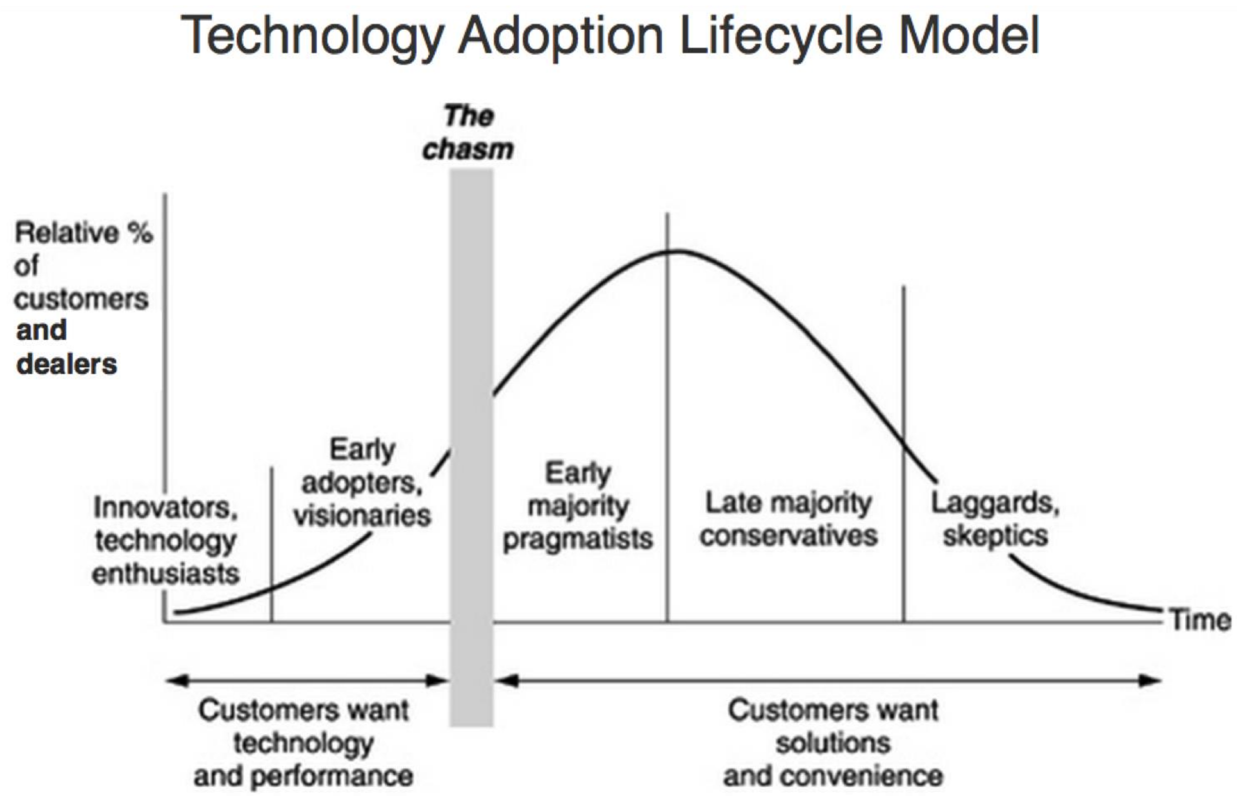
Risk also extends to the inherent pressures of a business model grounded in competition among dealers for both customers and talent. Dealers that do invest in PEV-specific training and practices face free riding behavior by rival dealers. These competitors may poach trained salespeople or offer customers a marginally lower price after capitalizing on the innovating dealer's investments in PEV-specific assets (e.g., trained staff, inventory mix, marketing). Customers may also choose to patronize a convenient dealer – rather than the innovating dealer – for post-sale service and support. Free riding behavior is particularly acute where a greater concentration of dealers operate and compete more on price than on superior retail quality.

Notably, this phenomenon is more common to domestic makes where the gradual strengthening of state franchise laws over many decades effectively prohibit automakers from closing dealerships, thereby contributing to long-standing dealer overcapacity in the industry (Bodisch 2009).

Dual Adoption Curves

The dealer innovators featured in Chapter 5 hold potential to contribute much to manufacturers and other dealers in the form of specialized knowledge, lessons learned and feedback to improve the marketability of PEVs, and potentially future products such as FCEVs, as product categories. They also represent a key voice for improving the retail experience for these customers. Appendix F catalogs an extensive list of emergent practices identified in the course of this research, much of it attributable to these innovating dealers.

Presuming automakers are able to identify effective practices to lift PEV sales or retail satisfaction, unless the added burdens and uncertainties (i.e., business risks) involved in selling PEVs are addressed, it is unlikely dealers will embrace PEVs or the techniques to sell them more widely in the near to medium term. In other words, automakers relying on franchised dealers face a conundrum. The retail interface offers an opportune environment for discovering the emergent needs of PEV customers and for honing the skills to service their unique needs. Yet the voluntary nature of dealer engagement in PEV sales means dealers, much like consumers, will likely adopt PEVs in semi-predictable sequential stages according to their unique resource endowments and disposition for risk. Given the heterogeneous resources and widely varying practices of dealer networks, adjustments specific to PEVs simply won't make business sense for many dealers. Figure 8-1 depicts the anticipated adoption trajectory. At the front-end of this curve lie dealer innovators and early adopters.



(Adapted from Rogers 1976 and Moore 1991)

Figure 8-1. Technology adoption lifecycle model for discontinuous new products as applied to both consumer and dealer adoption of PEVs.

These dealers are the "hand-raisers" who, based on their unique assets, strategic rationale and tolerance for risk willingly take on sales of PEVs. But just as with consumer adoption, reaching mainstream dealers may prove problematic for manufacturers. This is because main market dealers, like consumers, are likely to be differently endowed and use alternate decision criteria when weighing whether to engage in PEV sales. For example, mainstream dealers may operate in less affluent areas or in truck-dominated markets, or rely on salesperson compensation schemes less compatible with sales of PEVs. They are also more likely to consider engagement in PEV sales from a more pragmatic standpoint such as increasing demand, proven processes and demonstrated profitability. In leveraging scale and scope economies[i] to reach more customers, automakers rely on broad dealer adoption to expand the availability of PEVs and ultimately drive down PEV prices (Scherer and Ross 1990). Yet the problem of disproportionate returns limits the appeal of these products to more dealers until sufficient demand exists to justify PEV-specific investments.

The disproportionate returns and dual adoption curve phenomenon arises from two contributing conditions inherent to OEM-dealer relations in the post-"Big Three" oligopoly era. First is the one-to-many relationship with distributing agents in which dealers possess substantial power relative to automakers. The second relates to institutionalized restrictions imposed on manufacturers by the body of state franchise laws and the arms-length OEM-dealer relations they engender. Most dealers, for example, are not required to take unwanted inventory, this includes the right to decline sale of specific products such as PEVs. As a result, manufacturers must

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[i] *Economies of scale* for involve reductions in the average cost per unit arising from increasing the scale of production for a single product type. *Economies of scope* involve reducing average cost by producing more products (see Wikipedia).

balance the need for more widespread PEV availability and PEV-specific investments by their dealer networks against the will of individual dealers.

These institutionally imposed constraints make it difficult for automakers to ensure that only the most suitable dealers sell PEVs. Options available to automakers include restricting rollout of new product to specific markets, providing PEV-specific dealer incentives, and specification of a limited set of threshold conditions for dealer participation (see Chapter 6). However, this influence extends much less to other critical factors that may materially affect PEV retail quality and customer uptake. Examples include bans or substantial restrictions on the manufacturer's ability to specify the vehicle pricing model, inventory mix, facility layout, specialization of labor, or compensation scheme used by dealers opting to sell PEVs.

State Franchise Laws

OEMs have limited options for contending with the chicken-and-egg dilemma of discontinuous technology and disproportionate returns to dealers. Under ideal conditions, manufacturers would choose an optimal distribution pathway for commercializing discontinuous new products. In theory, this could entail a variety of options including vertical ownership of outlets dedicated to PEV sales, restricting sales to best-suited dealers, or bolstering dealer capabilities through supplemental OEM support activities or through procurement of outside resources to support dealers. In reality, however, institutional impositions in the form of a patchwork of greatly fortified state franchise laws subvert these choices at every turn. Lawmakers ostensibly enacted these protections to shield dealers from alleged abuses arising from imbalances in bargaining power during a period in which the Big Three automakers dominated U.S. market share. Yet these laws persist to modern day in greatly strengthened and enlarged form, and despite a considerably more competitive market (Barmore 2014, Crane 2015).

Public choice theory has long maintained that self-interested market participants can use regulatory influence to generate economic rents at the expense of consumer welfare (e.g., Arrow 2012, Downs 1957, Nelson and Winter 2009, Buchanan and Tullock 1962). In the wake of shifting markets and disruptive technological change, state-level franchise laws now impede mobilization of an effective response by innovating automakers. Chief amongst these is the stipulation that OEMs sell all products, PEVs (and FCEVs) included, through independently owned franchised dealers. Limited to existing franchise outlets, these laws then prohibit automakers from favoring particular dealers best suited to sell PEVs at full production scale with targeted, innovation-specific support, even when the economics of technological change and market conditions call for these changes (Delacourt 2007, Crane 2015, Murry and Schneider 2015).

Eliminating or reducing activities traditionally performed at the dealership that add less consumer value may be key to enabling dealers to focus on those elements of the PEV sales process that add relatively more value for PEV buyers. Examples of the former include price negotiations, preparation of paperwork in F&I, and wait times between phases of the buying process (see Figure 7-6, page 194). Examples of the latter include broadened and enhanced product knowledge of dealer staff and extra attention to instruction and use of features and equipment unique to PEVs during vehicle delivery (e.g., various charging types, equipment options and charging network subscriptions, configuration of in-vehicle and smartphone-based PEV apps).

Yet restrictions on vehicle advertising imposed by state franchise laws have historically prevented automakers from leveraging the Internet to offer customers binding prices, vehicle financing options or to complete a vehicle purchase fully, or in part, over the Web (Delacourt 2007). Franchise laws also preclude provision by the automaker – or a procured third party – from ancillary or referral services that could be key to de-burdening dealers from the outsized demands of early PEV customers. These laws, for example, restrict automakers from providing concierge services to assist PEV customers in navigating the inherently fragmented and confusing patchwork of public incentives and equipment options associated with PEV purchases. It also bars OEMs from referring PEV customers to qualified experts such as local electricians for installation of home chargers.

In sum, state franchise laws not only block automakers from choosing an optimal distribution pathway for disruptive new products, they then handicap manufacturers from taking the very actions required to ensure product success within the only channel available to them by law.

8.4.6 Barriers to PEV Adoption unique to Direct Distribution

Economic rationale firmly supports Tesla's decision to forward integrate into the distribution function. As previously discussed, vertical ownership confers Tesla full control over unique factors influencing the retail and ownership experience of its PEV customers. These include product pricing, store location and layout and employee compensation structures. Yet control also extends to the critical ecosystem of end-to-end support services uniquely expected of PEV buyers. This includes build-out of an optimized and highly reliable charging infrastructure, and responsiveness to customers in the face of the inevitable hiccups accompanying innovative new technologies.

From a purely legal perspective, the absence of a pre-existing network of franchise dealers confers Tesla greater latitude (in most, but not all states) to choose an optimal distribution channel for its signature PEV products relative to legacy OEMs. Nevertheless, in blazing a new trail, Tesla's D2C model faces considerable headwinds of its own. Foremost is the substantial weight of existing state laws that greatly restrict or outright prohibit manufacturer-direct sales. The most significant of these is Texas, the nation's second-largest vehicle market, though they are joined by several others including Arizona, West Virginia, Iowa and more recently, Michigan. In these states Tesla is expressly forbidden from selling its vehicles to customers. It can show its wares in "galleries" at malls and shopping centers but Tesla "product specialists" cannot discuss vehicle pricing, facilitate test drives, or transact a sale, nor can the company service vehicles purchased by its customers (2015f).

Legislation introduced by Tesla to accommodate direct distribution in these states has come up short, with some cases interpreting existing law so as to prevent almost all marketing activity by the company (Crane 2015). In the first ten months of 2014, dealer groups introduced no fewer than 33 bills in 26 states to bolster existing franchise laws. In a handful of states Tesla agreed to compromise legislation allowing for a fixed number of factory stores for EV companies or pure direct distribution in a handful of states such as New Jersey (4), Ohio (3) and Pennsylvania (5) (ibid.). Compromise legislation in Washington State goes further in that it makes a one-time exception for Tesla exclusively. As University of Michigan legal scholar Daniel Crane (2015) points out, "This effectively means that other new market entrants down the pike will be prohibited from direct distribution unless they can cut their own legislative deals" (p. 15).

As it so happens, start-up Elio Motors has announced plans to introduce an innovative low-cost, high-mileage, enclosed three-wheeled vehicle in 2016. As of March 2015 the company has secured reservations for 41,000 vehicles and has announced its intent to pursue a direct distribution model. Rumors abound that Fisker Automotive, fresh out of bankruptcy with backing from Chinese manufacturer Wanxiang, may announce its intent to pursue direct distribution when it restarts production of its plug-in hybrid Karma luxury sedan. If so, these entrants face a similar uphill battle in courts, regulatory commissions and state legislatures for accommodation of their model.

As this study illustrates, Tesla's D2C strategy is rooted firmly in theoretical and empirical grounds. Conversely, this study finds little support in the literature for the rationale offered by dealers to justify their ongoing challenge to Tesla's model. Rather, the absence of any legitimate economic rationale or empirical evidence supporting modern franchise laws lays bare the underlying but less public motive for their continued defense: protection of the franchise model from which dealers derive monopolistic economic rents. Nevertheless, dealer lobbies continue to witness success in stymieing Tesla's efforts to gain judicial, regulatory or legislative relief.

Moreover, automakers have largely remained on the sidelines in these battles, though GM and Ford appear to have cast their lot with dealers in blocking direct distribution under the argument of equal treatment for all car manufacturers. GM has taken the more active position, penning a letter to Ohio Governor John Kasich in which it argued against "favorable protection" for Tesla that would grant them a "distinct competitive advantage by avoiding restrictions that all other auto manufacturers face in Ohio". GM similarly opposed legislation in Maryland, arguing to limit Tesla to its two current stores in the state (2015c).

As discussed previously, discontinuous new technologies often require new distribution methods. Crane (2015) argues that car companies are likely using legal barriers to direct distribution as a way to slow the competitive onset of rival technologies by requiring distribution through conventional channels (p 21). "Even though some of those distribution methods might be advantageous to the incumbents also, shutting off those distribution methods may provide a net gain to the incumbents if it disadvantages new entrants more than it disadvantages the incumbents" (p 21). Due to their dependence on but one or a small number of initial products for commercial viability, new entrants – and in particular start-up companies – are far more financially vulnerable than incumbents in this regard. Moreover, the costs to incumbents of alienating existing channels may exceed the benefits of a long-odds possibility of overturning decades of legislative and judicial rulings.

Even presuming Tesla can secure sufficient regulatory relief to pursue direct distribution, and presuming Tesla is able to galvanize demand for its product by mainstream customers, it must still build the distribution infrastructure necessary to meet mainstream demand. Pure direct distribution may yield diminishing returns in this regard. CEO Elon Musk has himself mused publicly whether Tesla may ultimately shift to a franchised model. A dual or hybrid distribution model leveraging both factory-owned and franchised dealers (akin to that currently in use by Apple and telecom giants AT&T, Verizon and Sprint) could also be in the offing.

8.5 Policy Guidance

The findings point to two principal retail-level mechanisms threatening growth of PEV sales and ongoing market development. First, state franchise laws ban entrants from choosing or fully leveraging pure direct distribution to reach customers, despite the weight of theoretical and empirical evidence supporting this pathway. Second, these same laws eliminate direct distribution as an option for incumbent automakers while concurrently thwarting their ability to bolster dealers within the mandated franchise system.

To contend with these twin challenges, the researcher recommends a dual-path policy strategy aimed at accelerating sales and market growth of advanced clean vehicles like PEVs and FCEVs. First, policymakers should back efforts by manufacturers pursuing relief from franchise restrictions to introduce these unique categories of vehicles, whether through the courts, legislative action, or regulatory rulings. Second, policymakers should incorporate retail considerations in policy design. This section suggests a number of adjustments to incentive policy in order to make these programs more "retail friendly."

Shift incentives to the point of purchase

Non-premium PEV buyers overwhelmingly favored leasing compared to their ICE counterparts (53.2% versus 16.1%). The researcher attributes this to OEMs capitalizing on the ability to capture the full value of the federal tax credit as a capital cost reduction that substantially reduces the customer's monthly lease payments. The lease instrument effectively magnifies this incentive by (1) ensuring capture of the credit's full value at the point of purchase rather than the customer's future tax liability and (2) amplifying its effect through reductions in lease payments over a shorter term relative to typical loan-based financing. Salespeople emphasized this incentive as a powerful lever through which to overcome initial consumer resistance to the much higher sticker price of PEVs. This is achieved by presenting PEVs as an affordable alternative to ICEs from a *monthly savings* perspective.

Many dealers lauded changes to the HOV decal program that afforded dealers the opportunity to obtain decals from California's DMV upon purchase from the manufacturer and prior to sale to end customers. This move afforded certainty for dealers, enabling them to market PEVs to customers, especially commuters near traffic corridors featuring HOV lanes. Dealers underscored the need for similar adjustments to other public incentives, namely pulling them forward to the point of purchase where the elements of immediacy and certainty reinforce their efficacy and bolster opportunities for dealers to market them more effectively.

The author contends that similar adjustments could be made to state rebate programs. As presently designed, a number of policy incentives work counter to the needs of dealers and customers, diluting their value and effectiveness. Given the constraints inherent in automaker-dealer relations, removing uncertainty and aligning incentives with retail business drivers and well-established dealer practices should be the first priority of policymakers.

Akin to the HOV decal program, dealers could reserve rebate funds by presenting proof of payment (i.e., the invoice) to the automaker. Upon sale of a PEV to a customer, the dealer would submit a bill of sale to the program administrator, triggering release of a rebate check to the dealer (as opposed to the customer as currently designed). This would ensure availability of the incentive prior to sale, capture the rebate's full non-discounted monetary value, and give customers and dealers the flexibility to fold the rebate into the deal in a way that best meets customer needs. Most importantly, it would provide the policy certainty needed by dealers to mitigate liability concerns, raise customer satisfaction scores by adding value for PEV customers, and evangelize the rebate program with more new car buyers.

Leverage incentives to reduce resale value risk

An important feature of the HOV decal program is that it is the one incentive that continues to carry value as the vehicle changed hands from owner to owner. A study by Audatex, a company that automates processing for insurance claims, found the now discontinued yellow HOV decal program for hybrid-electric vehicles contributed an additional $1,200 to $1,500 to the resale value of used Honda Civic Hybrids (roughly 7 percent its value) (Voelcker 2009). A potential barrier to PEV adoption discussed previously is the uncertainty around the actual resale values of these vehicles as they return to dealer lots. Since a substantial portion of dealer profitability hinges on converting trade-ins into used car sales, the incremental value from HOV lane decals could boost market prices. This not only makes selling PEVs a more attractive proposition for dealers, it in turn could reduce pressure on residual values, thereby lowering monthly payments on newly originated PEV leases. Additional steps to bolster the value of used PEVs could include eliminating the sales tax on these cars or reducing or waiving licensing and registration fees.

Reduce minimum ownership term for rebate eligibility

Another way to align policy with retail-level business drivers is to leverage incentives to increase opportunities to generate return traffic to dealer showrooms. This can be achieved by reducing the minimum ownership term for CVRP eligibility to 24 months from its current 30-month (and previously 36-month) requirement and prorating the amount as necessary. For dealers, doing so increases the rate of 'sales turns,' or the frequency with which customers return to the dealer to purchase a new car. For example, over a six-year period, a customer on consecutive 36-month lease terms would visit the dealer a total of three times. By contrast, over six years a customer on consecutive 24-month lease terms would visit the dealer a total of four times. The incremental increase in transactions translates to more opportunities for the dealer to earn a profit. For OEMs, shorter lease terms may contribute to more stable valuation of residuals.

For customers and the PEV market at large, the merits of expanding eligibility via reduced minimum ownership terms are three-fold. First, the shorter lease term concentrates the federal tax credit over a shorter period, effectively magnifying its impact by significantly reducing the monthly payment and increasing affordability. Second, it increases the exposure of PEVs to a greater number of customers, effectively placing 'more butts in seats'. Third, the shorter term reduces the commitment period, and thus the risk, of being locked into a product where actual driving conditions and/or changing circumstances could prove a poor fit for the customer's needs. Finally, it reduces uncertainty associated with resale value that stems from the relatively more rapid pace of improvements in technology and reductions in price compared to conventional vehicles.

Government incentives for dealerships?

A common debate in policy circles is whether public moneys should be directed toward incentivizing dealers to sell PEVs. On the one hand, dealers respond affirmatively to clear financial signals. A flat bonus of, say, $1,000 per unit sold would ameliorate uncertainty related to profitability, thereby encouraging more dealers to opt in to selling PEVs offered by OEMs. Where PEVs are wanting, dealers may pressure OEMs to pursue production PEV programs. Presuming dealers pass a portion on to the salesperson, a bonus would also likely encourage sales staff to learn more about the vehicles and the ecosystem of public incentives, charging infrastructure and optional equipment that attends the sale of these vehicles. More importantly, a publicly-funded bonus could smooth peaks and valleys in OEM-funded incentives, thereby delivering a more consistent signal over the model year, better assuring ongoing sales momentum that sustains learning and retention.

On the other hand, inducing sales within the franchised system risks a number of possible pitfalls. First, unless also applied to OEMs using pure direct distribution, a public sales bonus would likely tilt sales toward franchised dealers who may or may not be well-suited to take on PEV sales for the reasons catalogued previously. Second, a dealer incentive could meet resistance from OEMs concerned over losing a degree of control over the sales efforts of their dealer network. Recall that manufacturers use financial inducements to calibrate dealer efforts so as to meet the OEM's internal business imperatives. These may or may not be aligned with increased PEV sales at any given time.

Presuming a bonus is enacted, setting the bonus amount could prove problematic. Striking the right balance is key. Too low and it could yield little marginal interest by dealers. OEMs would also be better positioned to reduce their own incentives to offset its impact. Too high and the bonus could end up with dealers pushing consumers into PEVs when a conventional vehicle may better suit their needs. This could erode retail satisfaction and customer loyalty to the dealer and the brand. More importantly for policymakers, it could spur negative word-of mouth for PEV technology, thereby undermining long-term PEV market development.

If enacted, a government incentive program for dealers should focus foremost on ensuring a consistently high level of retail quality delivery and post-sale service for PEV buyers. One way of doing so is to tie bonus eligibility to dealer performance. California, for example, could do so by leveraging the existing CVRP survey instrument. For incentive eligibility, a dealer would need to demonstrate that sales people responsible for selling PEVs complete periodic training that covers particulars attributable to the entire category of vehicles defined as PEVs (or ZEVs), rather than any specific make or model. The emphasis should be on topics that add value to PEV customers and that automakers are poorly positioned to serve. Examples include government incentives, discounted electricity rates and residential solar options. Other examples include optional charging equipment and installation, enrollment in subscription-based charging networks, best practices for selling PEVs, effective language for conveying the value proposition of PEVs to customers, and myriad other topics.

Another way to qualify eligibility and ensure dealer compliance is to require the customer to complete a form at the dealer verifying that the dealer fulfilled its responsibilities. Examples include proper screening of the customer to ensure a match between the customer's driving profile and the PEV, explaining charging options and installation costs and processes, a physical demonstration of how to charge the vehicle, etc.

The merit of such an incentive program organized is that it attempts to get to the heart of the problem: that in an early market, before scale economies are realized, dealers have little incentive to adjust practices until a more robust market emerges that justifies the investment. Further, automakers have no direct control over the business processes of individual franchised dealers. Thus, dealer-level incentives attempt to reduce the inherent variability in the purchase experience that is a natural byproduct of industry structure. By incentivizing a more uniform and consistently higher level of service, key reinforcing dynamics such as positive word-of-mouth may be enabled that contribute to the building of a market for these products.

8.6 Closing Thoughts

In sum, automakers divested of direct distribution and embraced the franchise system at a formative period in the evolution of the industry to focus on critical areas of competitive advantage at the time, namely improvements in manufacturing processes and economies of scale and scope. This structure endures to modern day even as the locus of competition appears to be shifting toward new and more disruptive (to dealers and customers) technologies. In the modern era, the principal role of the dealer is to fulfill pre-existing demand from mainstream customers of well-institutionalized products in a mature automotive market. That is, dealers are optimized to "facilitate the sale" in high-volume demand environments. The evidence presented here indicates dealers may be much less equipped to undertake activities fundamental to the success of innovative new products like PEVs. In particular, dealers may struggle to participate in demand creation and to deliver a broad set of support services to meet the unique needs of PEV buyers and those considering the switch from a conventional vehicle.

9 Conclusions and Avenues for Future Research

Theory spanning a diversity of disciplines and much empirical evidence establishes a critical relationship between product innovation and innovation in product distribution. This is especially important in the context of introducing new technologies that break from historic patterns of industry innovation, entail new modes of consumer behavior, or involve new infrastructure on which customers rely. It is also important where the introduction of innovation conflicts with existing channels of market access.

The evidence presented in this dissertation suggests these precepts apply to manufacturers attempting to introduce fundamentally new powertrain technologies like PEVs to market. Where automakers leverage franchised mass-market dealers for retailing PEVs to customers, the findings reveal significantly lower retail quality and intended loyalty, despite a greater opportunity to win customers from competing makes. It also revealed inherent and substantial disincentives impeding wider uptake by dealers and delivery of a broad range of services for meeting the unique needs of PEV customers. Chief amongst these are greater customer demands, steeper learning curves and questionable profits. Moreover, it highlighted constraints on manufacturers imposed by state franchise laws that prevent automakers from considering other distribution avenues or from more effectively bolstering existing channels.

Conversely, the evidence revealed industry newcomer Tesla Motors achieved industry-high retail quality ratings and significantly higher intended customer loyalty. The study presented evidence attributing these achievements to factors associated with its commitment to a direct-to-customer distribution model. Notably, this model enables the company to build brand

and technology awareness by directly aligning retailer incentives with longer-term imperatives for acceptance of EV technology and market development. Yet the preponderance of state franchise laws jeopardize the company's ability to fully exploit this channel in several states.

The dissertation then elaborated a dual-path approach for policy intervention. The first involves greater accommodations for alternative distribution approaches for PEVs that empower auto manufacturers to more effectively reach both early and mainstream markets for this promising technology. The second involves bolstering the effectiveness of public incentive programs by incorporating retail considerations in "retail friendly" policy design that assures alignment with current and emerging retail practices.

In sum, both incumbent and new entrant automakers face immense challenges introducing PEVs to a fully mature vehicle market. Dealers wield considerable power in the guise of pervasive state franchise laws that greatly limit the options available to manufacturers in terms of distribution and retailing. The established makes possess ready-made infrastructure for delivering vehicles at scale to mainstream customers. The greater challenge for them, however, lies in reaching early PEV customers, broadening the appeal of PEVs to mainstream customers and ensuring that the sales channel is adequately equipped and incented to support their end-to-end needs. For newcomers like Tesla, direct distribution shows great promise in achieving these goals. Their greater challenge lies in building the requisite infrastructure for delivering vehicles at scale to mainstream customers. It is as of yet unclear whether direct distribution, franchise distribution, or some amalgam of the two will prove necessary. The elephant in the room is whether sufficient political will exists to modify these laws to smooth the way for markets to decide the best path for distributing innovative new products like PEVs to customers.

As an exploratory study, the findings presented here yield a number of potential avenues for future research. The study revealed several hypothetical relationships that could be tested through additional research. Examples include the degree to which a mix of additional support services for PEV customers or new training approaches result in higher sales satisfaction scores and/or increased sales. A longitudinal study of survey data would also be useful for determining whether automakers and dealers are making progress toward closing the gap in retail performance revealed in this paper. Yet another avenue for future research could entail broadening the examination of retail-level influences on PEV market development to include the role of other intermediaries and supporting entities like electric utilities, charging network operators, and NGOs. This initial exploration provides a springboard for these potential works.

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Appendix A: Interview Protocols

Draft interview protocol for new car dealership representatives

The following protocol should be referenced the day before an interview. It gives reminders about tasks to complete the day before the interview, what to bring the day of the interview, an interview guide and tasks to be completed after every interview.

The interview guide should be taken as an outline of topics which are to be covered in the interview and does not actually reflect the proportion of time to be spent on each topic. Each interview will have two project researchers attending. One researcher will be designated as the primary interviewer, who's responsible for conducting/ leading the interview. The secondary interviewer, will listen attentively and observe the respondent's reactions to questions, body language, surroundings and take brief notes on follow up questions to ask – in the case that the primary interviewer misses something important. The primary will be responsible for preparing for the interview (day before and day of duties).

Checklist for the day before the interview

- Confirm appointment time and location with the interviewee
- Print out directions to the appointment location
- Review monthly or quarterly PEV sales data for the dealership and make note of it.
- Review dealer website and do an internet search for dealer online presence in forums or online networks (yelp, Facebook, dealer website, PEV forums, ads in the local newspaper and car magazine)
- Make quantitative and qualitative assessment of online presence based on TBD protocol

Checklist for the day of the interview

- Tape recorder with adequate battery charge (always bring a spare set of AAA batteries just in case)
- Business cards
- Print out of directions to the interview location
- Bring the direct contact information of the interviewee (would be a good idea to write it on the directions to the interview location
- A copy of the Interview protocol
- A camera (with fresh batteries)
- A file folder (for any handouts/ promo material gathered at the dealership)
- A project write up/ brief (to be handed out). Describes the project – information on what we're doing and where they can find more information or results from the project when it's finished

General Guidance for Interviews (~ 1.5 hours with dealership tour)

- **Introductions** – Don't rush this as this will set the pace and expectations for the entire interview. Tell the interviewee about yourself (who you are, what is the research you are doing and why you are there). Provide them with your business card and the write up about the research.
- **Tell them they are the expert** – Let them know there aren't any right or wrong answers and that they on the expert on this subject and you are here to learn from them (sometimes people like to tell you what they *THINK* other people would say or will try to make you happy with specific responses).

TIS applied to plug-in electric vehicle dealers: We are looking for a description of how the dealership fills the following TIS functions.

- **General to all TIS processes –** What functions do you think auto dealers serve for customers? OEMs? Other communities? Could you give us some examples?
- **Influence direction of search –** What factors influenced your initial decision to actively sell PEVs? In retrospect, what do you think about that decision? Have any of your original considerations changed in importance or do you have new considerations? Was it customer demand or organizational pull?
- **Resource mobilization –** What resources do you need to sell PEVs? Are there OEM requirements for training and infrastructure? Have you exceeded those? How many sales people are trained? How many mechanics? Have they made investments not suggested by the OEM? Who's idea was it? How is that working out? Do you anticipate investing more or less resources towards selling PEVs in the future?
- **Market formation –** Do PEVs require more work to sell than ICEs? Do they know what market type PEVs are in (e.g., Nursing, bridging, mature market)? What's different about selling PEVs? What activities do you undertake in to develop the market for PEVs? Do you discuss PEVs with every customer? What kind of advertising do you do? Online/ social media presence (follow up on online content discovered, if applicable here). Is there a community of EV drivers?
- **Legitimation –** Could possibly have been covered in market formation and in the tour (look for cues about who or what PEVs are associated with). Do your customers view PEVs as a legitimate option? What about in the future? Will they ever be? Can you ever change someone's mind? Are there any individuals, companies, or ideas that PEVs could be associated with that would help sell them better?
- **Knowledge development and diffusion –** How is knowledge about PEVs or selling PEVs learned and shared by the dealership, especially with regard to the product, the customer, ancillary services, and future business opportunities. How is this information used to improve the operations of this dealer, other dealerships, automakers, utilities or others? Are there particular forums for this exchange? Are there particular individuals or groups that champion information exchange?

- **Entrepreneurial experimentation** – To what degree do you experiment with new techniques, practices, processes or services to support PEV sales? What led to this experimentation? What activities and services do you offer to owners of PEVs? How do you determine success?
- **Development of positive external economies ('free utilities')** - Sometimes called 'positive externalities' or 'free utilities', these result when part of the benefit of producing or consuming a good or service accrues to those that did not produce or purchase it. According to Bergek et al. (2008), "It reflects the strength of the collective dimension of the innovation and diffusion process. It also indicates the dynamics of the system since externalities magnify the strength of the other functions." As a dealer, have you benefitted in any way from what other OEMs or dealers have done with PEVs and supporting technologies?

Part I: Dealer Principal (Owner, General Manager or Store Manager)

The business of selling cars: We need background on the interviewee, the key business drivers, attitudes/views on running the business, motivations to selling PEVs, technologies, social problems and government intervention. In particular, to inform the degree to which dealers contribute to the 7 functional processes and identify mechanisms that may induce or block development of TIS functions.

- **Personal history** – How long have they been in the car sales business? How did they start in the business? The goal here is to let them establish themselves as an expert and to get comfortable with you.
- **Staff Knowledge-base and training** - How many salespeople do you have. What's the turn over rate? What's the hierarchy like (Internet sales? Sales managers? Normal sales people?) How is staff trained? How often? Does the OEM have requirements? Do you have dealership specific requirements? Is everyone qualified to "deliver" cars? Are sales staff required to receive PEV-specific training prior to selling PEVs? Please describe the training process for PEVs.
- **Compensation** – How do sales people make money and how much do they make. Do they ever get more for selling a specific model/ what are the added incentives/ commission structures does the automaker use?
- **Technology** - How do you contend with new technologies that are introduced by OEMs (for example, mobile apps)? How does your business change when new automotive technologies are brought in (e.g., like HEVs - Did that involve new service equipment,

training, ancillary business opportunities)? How did the experience with hybrids shape your perceptions today?

- **Dealership Business Drivers -** What are the expenses of the dealership? What are the revenue generators for the dealership? What kind of customers do you serve? Can they share information on the way they make money? Does the incentive from OEMs ever change their product selection or emphasis? How do PEVs impact your profitability? Are dealer-side incentives (e.g., dealer rebates, "holdback", "back-end money", or other dealer or manufacturer incentives) any different for PEVs?
- **Dealership PEV sales –** What kinds of PEVs do you carry? How long have you been selling PEVs? What percentage of your sales staff is qualified to sell PEVs? What investments are you required to make before you can sell PEVs? Considering all of the models you offer, what is your typical inventory? What is your typical inventory of PEVs? When do you know to get more inventory? Have you ever turned away allocation? Why? How many do you sell?
- **Practices & Processes -** Is there a standard process for determining whether a PEV will meet the customer's needs?
- **Relationship with the OEM –** Describe how you interact with the OEM. Do you coordinate your business activities with the OEM? In what ways? Do you get the support you need to sell PEVs effectively? If not, what additional resources would be helpful?
- **Policy Impacts and Attitudes** – What do you think of the various incentive programs for PEVs? Do they help sell PEVs? Which ones are most effective? Least effective? What could make it better?

Part II: Dealer Salesperson or Retail Representative

The business of selling cars: We need background on the interviewee, their training, sales techniques, attitudes/perceptions, and constraints that they operate under. Key into activities that inform the degree to which dealers contribute to the 7 functional processes and identify mechanisms that may induce or block development of TIS functions.

- **Personal history** – How long have they been in the car sales business? How did they start in the business? The goal here is to let them establish themselves as an expert and to get comfortable with you.
- **Training** – What kind of training do you typically receive? Was it any different for PEVs? Was it enough? How might it be improved?
- **Product Knowledge** – What topics are you expected to be knowledgeable on when selling conventional vehicles? PEVs? How do you get this knowledge?

- **Sales Methods/Techniques and differences from conventional vehicles** – Are customers of PEVs different from traditional customers? Are there differences in your sales techniques? Are there differences in processing of customers? transaction times? What kind of questions do you ask the customer to determine whether a PEV would be a good fit? Do you ever try to convince someone interested in a PEV to consider a conventional vehicle? Why? Do you ever try to get customers interested in a conventional car to consider a PEV?
- **Compensation and commission structures** – Can you describe your compensation? Are you awarded as much for selling a PEV as you are for selling a conventional car? Are there any differences in the compensation scheme for PEVs and ICEs? What should the compensation scheme look like to sell more PEVs?
- **Influence of online sources** – Can you describe the various ways in which you interact with the customer? Does this include online interaction? If so, how (email, dealer website, chat rooms, etc.)? How do you interact with customers in these venues?
- **Screening of customers** – How do you determine whether a customer is a good fit for a PEV? Is it important to do so?
- **Customer needs/wants** – What kind of value do PEVs offer for customers? How did you become aware of this? How do you communicate this value?

Part III: Tour of the dealership (15-20 minutes)

A tour is an important part of this site visit – we get to see the environment/ information / products / services given to PEV buyers and ask specific questions about them.

Participants will usually offer to give you a tour. It's good idea to hint at it during the interview. If they mention something interesting about the dealership – i.e. "we put in a quick charger" follow up with, that sounds interesting could we see that later? Or, what was your motivation for installing a charger? How do you envision it will be used?

Ask for details about the features of the dealership related to PEVs.

- How did this set of services come to be?
- Was it all added at the same time?
- Where did they go for help?
- Are customers asking for more of these services?
- What would they like to do in the future?
- What affects their decision to offer these services?
- Are there services/ products they want to provide but cannot (use experience with past dealerships – i.e.: some dealerships have solar canopies, I see you don't).

The end goal will be to try to categorize features of the dealership/ customer experience into the appropriate TIS function: Legitimacy, knowledge development, direction of search, market formation, resource mobilization, entrepreneurial experimentation, and external economies. **Some** examples of dealership features to photograph or document on the tour:

- Photograph the layout of the dealership sales floor
- Photograph signs / ads / displays to PEVs
- Photograph infrastructure (charging stations, solar canopies)
- Photograph ancillary services for EVs (car rental, charging station purchase)
- Photograph the position of the PEV inventory relative to other ICE vehicles (are they I the front or back of the store, left plugged-in, dirty?)
- Take copies of promotional or educational material related to PEVs

After the interview has been completed

- Review the interview with the secondary interviewer, preferably over an ice cold beer
- Upload the interview recording to dropbox project folder under "interviews" and "recordings". Name the interview using the following convention: "Recording_Make_First Last name of interviewee_title_dealership name_ YYYY-MM-DD"
- Listen to the recording once to get a sense of the entire conversation. Listen to the recording one more time while taking notes on the relevant themes (including updating the assessment of dealer online presence – use track changes so we know what information is new). More will follow on the format of these notes.
- Upload notes to the dropbox project folder under "interviews" and "interview notes". Name the interview notes using the following convention: "Notes_Make_First Last name of interviewee_ title_dealership name_ date"
- Transpose online effort metrics to the Microsoft excel file.
- Put file folder with (if any) reference material in project filing cabinet. Inventory the categories of information the handouts cover in the associated excel file (TBD).
- Upload pictures taken at the dealership to the dropbox project folder under "interviews" and "photos".
- Name the photos using the following convention: "Make_ photo category_Dealership_date"

Appendix B: Interview selection matrix

Retailer Identifier	Metro Area	Top Sales Quartile	Urban (U) / Sururban (S)	Fixed Price Model
	Selection Criteria			
Alfa	BA	X	S	
Bravo	SA		S	
Charlie	SA		S	
Delta	LA		S	
Echo	SD	X	S	
Foxtrot	BA		S	
Golf	SD		S	
Hotel	SD		S	
India	BA	X	S	X
Juliett	SD		S	
Kilo	SD		S	
Lima	SA		S	
Mike	BA	X	S	
November	BA	X	U	
Oscar	SD	X	S	
Papa	BA		S	
Quebec	LA	X	S	
Romeo	LA	X	U	
Sierra	SD		S	
Tango	LA	X	S	
Uniform	LA	X	S	
Victor	SA		S	
Whiskey	SD	X	S	
X-ray	SD		S	
Yankee	*	NA	Both	X

* Greater metro areas: BA = San Francisco Bay Area; LA = Los Angeles; SA = Sacramento; SD = San Diego

Appendix C: Derivation of the SSI Study Buyer Index

Buyer Index

The Buyer Index score is comprised of ratings for four measures of the sales process and 17 attributes.

To ensure statistical validity, each buyer must have answered more than half (nine or more) of the 17 attribute questions to be included in the index score calculation.

A minimum sample of 100 returns is required for a make to be included in the official Buyer Index ranking.

Buyer Index: Measures and Attributes

Buyer Index

	Attribute Weights [within Measures]	Measure Weights[1] $R^2 = 0.86$
Facility		**20%**
Appearance of facility	35%	
Comfort of the area or office where you agreed to the price of your vehicle	25%	
Ease of looking at dealer's inventory	21%	
Variety of inventory	19%	
Salesperson		**25%**
Knowledge/Expertise about vehicles	23%	
Courtesy	22%	
Honesty	21%	
Concern that you purchased the best vehicle for your needs	18%	
Responsiveness	16%	
Working Out the Deal		**33%**
Ease of coming to agreement on a final price	28%	
Fairness of price paid	21%	
Timeliness of completing the final paperwork process	21%	
Honesty of the person who handled your paperwork or finance process	18%	
Clarity of explaining documents	12%	
Delivery Process		**21%**
Timeliness of completing the final delivery	36%	
Thoroughness in explaining your vehicle's features	35%	
Condition of your vehicle	29%	

[1]*Measure weights may not add to 100% due to rounding.*

Source: 2013 U.S. Sales Satisfaction Index (SSI) Study, J.D. Power & Associates

Appendix D: SSI Study vehicle classification by make

J.D. POWER
McGRAW HILL FINANCIAL

2013 U.S. Sales Satisfaction Index (SSI) Study
Methodology and Rank Charts

Premium/Non-Premium Classifications

A make is classified as Premium when more than 50% of model sales are in the Premium segment. A make is classified as Non-Premium when more than 50% of model sales are in the Non-Premium segment.

Premium Classification	***Non-Premium Classification***	
Acura	Buick	Mazda
Audi	Chevrolet	MINI
BMW	Chrysler	Mitsubishi
Cadillac	Dodge	Nissan
Infiniti	Fiat	Ram
Jaguar	Ford	Scion
Land Rover	GMC	smart
Lexus	Honda	Subaru
Lincoln	Hyundai	Toyota
Mercedes-Benz	Jeep	Volkswagen
Porsche	Kia	
Tesla		
Volvo		

Appendix E: IRB Determination Letter

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OFFICE OF RESEARCH
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March 11, 2013

Eric Cahill
(530) 341-3570
eccahill@ucdavis.edu

Dear Mr. Cahill:

On March 11, 2013 the IRB reviewed the following protocol:

Type of Review:	Initial
Title:	Plug-in Electric Vehicle (PEV) Dealership Experience Survey, a study of the sales practices influencing PEV transactions, impact of incentive programs on these transactions, and buyer satisfaction with new car dealerships selling PEVs in the state of California.
Investigator:	Eric Cahill
IRB ID:	435264-1
Funding:	None
Grant Title:	None
Grant ID:	None
IND, IDE or HDE:	None
Documents Reviewed:	Application for Review Protocol Consent Form Questionnaires/Survey Documents

The IRB determined that the proposed activity is not research involving human subjects. IRB review and approval is not required.

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are being considered and there are questions about whether IRB review is needed, please submit a modification request to the IRB for another determination.

Sincerely,

Jill McHale
IRB Analyst

Appendix F: Emergent Retail (Dealer) Practices

No.	Emergent Retail Practices
1	Stock an adequate mix of PEV models and trim packages
2	Active participation in online user forums and chatrooms
3	Engage local EV user groups
4	Conduct ride and drive events at large campuses (corporate, government, university)
5	Pre-affix HOV decals on showroom/on-lot vehicles
6	Supplemental window labels/placards
7	Maintain fully-charged "drive ready" PEVs
8	Deliver fully charged PEVs post-purchase
9	Option for extended test drive via Borrowed Car Agreement
10	Co-locating PEVs with chargers, solar canopies
11	Special discounted pricing packages for targeted populations (e.g., universities, corporations, governments)
12	Designated PEV specialists employed on opposite shifts
13	Daily use of PEVs by sales staff members
14	Facilitate home charger installation
15	Accommodate special incentive programs (e.g., free/discounted chargers offered through special government programs)
16	Assist with completing/submitting public incentive paperwork
17	Demonstrate PEV-specific features at delivery
18	Configure PEV-specific in-vehicle software
19	Configure PEV-specific support apps on customer's smartphone
20	Enroll and issue charging network cards at delivery
21	Provide take-away collateral and resources for PEV customers
22	Provide publicly accessible chargers, especially fast chargers
23	Free or discounted charging for PEV buyers
24	Stock home charging equipment in service lobby
25	Partner with qualified local electricians to quote and perform EVSE installations for PEV buyers
26	Loaner program for access to conventional vehicles
27	Use of PEV as customer shuttle or demo vehicle
28	Follow up with PEV buyers at regular intervals