Driving Connectivity:

The Future of the U.S. Telematics Industry and Its Impact to Toyota Motors

By

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Abstract

As stated by Joe Guglielmi, President of Motorola's Integrated Electronics Systems Sector, in 1998 "… the most important technological advancement of the next decade is the one that will allow consumers to receive computer connectivity, in an easy to operate format, while in the automobile.[i] Guglielmi based his assertion on growing consumer connectivity expectations, resulting from consumer reliance on real-time information fueled by increased usage of the World Wide Web and increasing commuting times. In short Guglielmi asserted that due to growing consumer expectations concerning connectivity, Telematics represented not only a new line of business for automotive OEMs and wireless manufacturers, but a very profitable one as well.

For this reason nearly all OEMs (Globally) of the 1990s entered, or conducted extensive studies on the Telematics space over the course of the next decade. Over these years, in the United States market, certain dominant features did emerge that helped to shape expectations over the course of the decade. These features were based around the themes of both safety (e.g. airbag deployment notification) and service (e.g. 24-hour live-operator support).

By successfully integrating these features, while gaining GM corporate marketing and financial support, OnStar emerged as a dominant design in the US market throughout this period, updating their technologies to meet the gradual evolution of the wireless technologies and customer demand.

While the innovations in the wireless space over the early portion of the decade had been slow enough for OEM's to maintain parity, recent (2005 and beyond) explosions in

wireless and handheld technologies, and in particular the emergence of smartphones, have led to disruption and fragmentation of the Telematics landscape. Much of this disruption has come from the fact that smartphones are delivering technologies that better serve consumers' core needs and are helping to develop new consumer expectations in terms of applications and connectivity. As noted by Bryan Inouye, National Strategic Planning Manager at Toyota Motors, in early 2009, "the rapid advancement in both wireless capabilities and handhelds has caused a disruption to the traditional OnStar model. We are now left contemplating how best to serve our customers by offering the best in safety features, connectivity, and infotainment."

The purpose of this paper is to provide an assessment of the Telematics industry, specifically within the U.S. Market, which, according to experts and OEM leaders like Akio Toyoda, represents the most mature and advanced Telematics market when assessed holistically. Using this assessment, we will then provide a recommendation for the U.S. division of Toyota Motors, Toyota Motor Sales, on how best to proceed into the future. While Toyota Motors is used as an example company, this recommendation could easily be applicable to any Japanese-based automotive manufacturer operating in the United States.

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Chapter1 – Telematics Industry History and Overview

1. What Telematics is: The etymological roots of the word Telematics is derived from the Greek words *tele*, meaning far away, and *matos*, meaning of its own accord. Combined, these words reference the transmission of information over long distances. While the term was used initially to reflect the idea of mobile computing, it did set the stage for what would later define one of the more competitive dynamics in in-vehicle technologies of the early 21st century. While, at a high level, Telematics references the sending, receiving, and storing of data sent via telecommunication devices, Telematics has evolved to become a term of art, referencing the use of such a process within road vehicles.[ii] It refers to providing automation in vehicles such as emergency warning systems, GPS navigation, and hands-free communication. Telematics represents the convergence of wireless communications, location technology, and in-vehicle electronics that is being used to integrate the automobile into the information age. The latter definition will be used to define the term Telematics throughout the context of this paper.

Today, the Telematics market is being served by three major technologies: In-Vehicle Telematics; Portable Navigation Devices (PNDs), and Smartphones. Each is shaping, or has shaped, the market, and is causing fragmentation as a result of market disruptions.

2. Why Telematics is important: Telematics is important to automobile OEMs because it impacts profitability in two ways: the first effect comes from actual product profitability earned through a specific product that has better features and functionality, a better value proposition and hence higher demand; the second way that Telematics impacts profitability results from the brand perception that a technologically advanced product lends to the OEM or device manufacturer respectively. This perception, therefore, leads indirectly to more core product sales.

In terms of assessing product profitability directly, we must first look into the overall volume and profit margin components of Telematics. In assessing volume, Telematics, and its infotainment tie-in, still represent a large and profitable market for both OEMs and direct vendors notwithstanding any pending disruption. The Consumer Electronics Association (CEA) projects that Telematics represents an $11.4 billion market with an annual growth rate of 13%. Assessing profit margin, given the low cost often associated with the hardware, in addition to the higher prices that vendors are able to charge, profit margin, in most all cases, appears favorable.

A good example of this is the hardware associated with Ford Sync which costs less than $50 to produce, but which has a sticker price of well over $300.

In respect to the second aspect, or halo effect, Telematics can drive overall profitability by influencing customers' choice of device or vehicle through brand perception, such as technological leadership, or conversely the perceived obsolescence of the brand.

Per Alan Mullaly's (Ford CEO) keynote speech at the Consumer Electronics Show in 2010, Sync (Ford's Telematics product) has actually provided Ford with competitive conquest purchases from consumers specifically seeking the Sync technology. These consumers are taking the Ford vehicle, simply because they have to if they want the Sync value proposition.

Additionally, industry experts such as Stephen D'Arcy, Global Automotive Sector and Advisory leader at Price Waterhouse Coopers, suggest that, much like rear seat entertainment in minivans, a competitive Telematics offering will soon become the price of entry for all OEMs. According to D'Arcy, not having this feature will remove that respective OEM's competitiveness in the market for new vehicle sales. Several major industry and OEM players also seem to echo D'Arcy's beliefs. This is made evident in that nearly all OEMs are uniformly launching new or upgraded Telematics platforms over the 2010-2012 Model Years. This view was echoed by Jason Schultz, Telematics Product Manager for Toyota Motors, "Telematics is something that is going to spread to the entire world, [Sic] it is important that we establish and maintain leadership in this area."[iii]

3. History of Telematics (In-vehicle, PND, Smartphone): From its early inception, the global approach to Telematics evolved as a result of two factors: available technology, based upon computing infrastructure and wireless standards; and customer demand. It is interesting to note in this context the very different path of evolution that Telematics has taken in Japan versus that of North America, and then to note their recent convergence within the last few years (over approximately the period 2007 – 2009).

The first in-vehicle Telematics system was launched in the United States in 1996 as a partnership between Ford-Lincoln and Motorola for use in the Model Year (MY) 1997 Lincoln Continental. The RESCU (Remote Emergency Satellite Cellular Unit) system, the name for the Lincoln Telematics product, offered only the benefits of Automatic Collision Notification (ACN) and cellular phone service. The architecture was very simple, comprising only four elements: vehicle sensors, tied to frontal collision and airbag deployment; a communications device; an onboard location receiver; and a very simple user interface that had just two buttons - a 'Call' button and an 'SOS' button. The system worked by generating an open cellular call to a service center, which would then provide information or emergency assistance respectively. Lincoln ended the RESCU product offering in 2001 due to an ill suited infrastructure that could not support the unanticipated customer demand, which lead to poor quality levels.[iv]

Figure 1- Screenshot of the Lincoln RESCU System

General Motors' On-Star, while a fast follower to the table, launched shortly thereafter, also being available for the 1997 Model Year. Both technologies utilized the existing analog-based wireless infrastructure; RESCU using it through its retirement, and On-Star utilized this technology through 2006 when it moved to a digital wireless infrastructure.[v]

While the analog infrastructure, combined with a heightened demand for safety features, was shaping Telematics systems development in North America during the 1990's, Japan was using its widespread digital wireless infrastructure (PDC) and Japanese consumer demand for continuous information to develop a very different approach to in-vehicle Telematics.

Toyota entered the Telematics market in the Fall of 1997 with its Telematics Product, Monet, designed solely for the Japanese market. In contrast to the RESCU system and OnStar, which focused on security and safety, Monet targeted driver-related information needs, such as real-time traffic information. Monet offered more than 40 additional unique functions including: the sending of and receiving of e-mail messages; connection to the Internet; restaurant and sight-seeing information; maps of 302 major cities in the country; news; and weather forecasts. Other features of the system included auto-dialing and current location display on the map on the navigation monitor. Safety features, along the lines of those offered by the contemporaneous Lincoln RESCU or GM OnStar services, were not, however, offered throughout the lifecycle of the Monet product.[vi]

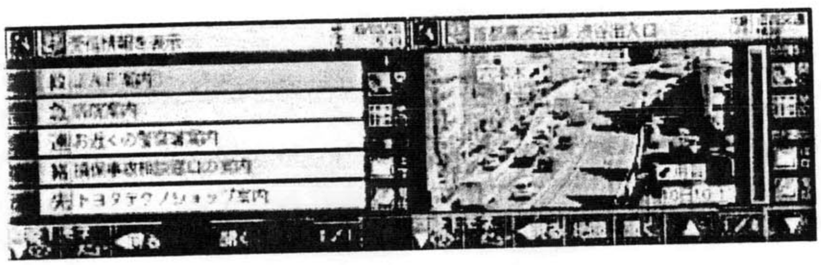


Figure 2- Screenshots of the Monet System Display

Toyota followed Monet with the more sophisticated Telematics product, G-Book, in 2002 which took advantage of the more robust and digital infrastructure of that time. G-Book provided the user with Internet information within their vehicle, but nevertheless still lacked the safety and service features, such as airbag deployment delivery, of the US counterparts.

Today's in-vehicle Telematics market is becoming fragmented as the OnStar model, an approach that relies upon technology embedded in the automobile, focusing on safety and service, is being challenged by the improved capabilities of smartphones which offer greater portability, enhanced navigation, and upgraded applications at reduced prices when compared to in-vehicle Telematics. As a result of this threat from smartphones, however, many of the in-vehicle integrated players like OnStar have since began to entrench themselves around their current competencies such as the crash-tested durability and enhanced usability their solution provides. To further demonstrate the fragmentation in this market, several players have sought an integrated solution, aimed at bridging the gap between the benefits of in-vehicle and mobile device Telematics. These players, such as Ford with its Sync product and Audi, have moved to a hybrid approach which connects mobile devices to the usability features of the vehicle, thus, in theory, offering customers the best of both worlds.

Portable Navigation Devices (PNDs)

While in-vehicle integrated Telematics represented the first phase of the Telematics movement (for uses that were integrated with the vehicle), portable Telematics, or Portable Navigation Devices (PNDs) entered the scene shortly after the launch of the first generation in-vehicle offerings.

Portable Navigation Devices (PNDs) offered tangible lower cost alternatives for consumers and provided the added benefit of portability, or usage outside of the vehicle. These portable Telematics devices originated from portable GPS devices first used by the US military during the late 1980s. The first commercial devices hit the market in the late 1990s. These devices only offered, and still to this day primarily offer, the benefit of GPS Navigation services such as location and directions. While PNDs are GPS enabled, they lack computing power and the ability to support other applications, forcing them to be a stand-alone product and thus limiting their potential when compared to a smartphone. Additionally, these devices lack connectivity in both the one-way communication and two-way communication formats. This limits the effectiveness of PNDs in two ways: service inabilities; and application inflexibility. For these reasons, these devices have now offer few benefits over those of either a smartphone or in-vehicle Telematics units.

Figure 3- Picture of a First-Generation Portable Navigation Device[vii]

Smartphones

The first smartphone, IBM's Simon, was revealed in 1992, and sold to the public in 1993. Although Simon offered only basic telephony properties in addition to a clock, calculator, note pad, email and fax capability, it earned the title of "smartphone" due to these bundled applications. Smartphone capabilities progressed throughout the 1990s with the Nokia Communicator lines through the 2001 Handspring Palm Treo and the 2001 RIM BlackBerry which, by October 2007 had over 10 Million subscribers.

Beginning with the Nokia N95, launched in 2006, smartphones took a turn that would impact the Telematics industry, and would progressively displace PNDs. Combining navigation applications with the device's embedded GPS, smartphones now began to offer turn by turn directions, which were hitherto only available on dedicated PNDs or through costly in-vehicle Telematics units. More importantly, these applications were offered at much lower prices, including on a subscription basis, or at no additional charge to the consumer. In 2007, taking this movement one step further, the iPhone, utilizing the Google application Google maps, now enabled consumer access to rich graphics and enhanced usability features making these devices in fact on par with or even superior (from a navigation experience) to the best PNDs offered by companies like TomTom and Garmin. Additionally, smartphone access to applications through outlets like application stores have further empowered the smartphone by giving consumers access to the latest and greatest application to meet their needs.

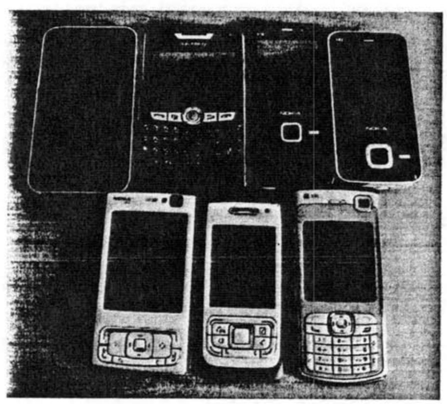


Figure 4- Current Smartphones (2009)

Chapter 2- In-Vehicle Telematics

1. Technology Descriptions (In-Vehicle)

To better understand the Telematics offerings and its future evolution, one must also understand its technical architecture and the business ecosystem within which it operates.

First off, all in-vehicle Telematics architecture involve both a front end (a software and hardware based system, either a subsystem within a vehicle or a stand-alone device), and a back end system (a service based system). The front-end architecture of in-vehicle Telematics generally contains the Telematics Control Unit (TCU), an interface to the vehicle's systems, which work in tandem to communicate both internal (to the vehicle) and external inputs through a user interface to the user. On the back end, information both to and from the vehicle is sent to an operations center (known as the Telematics Operations Center (TOC)) via a cellular wireless network. The service center then relays this information to content providers who then provide information in response back to the TOC who ultimately communicates this information back to the user. A brief diagram of the components, is as shown below.

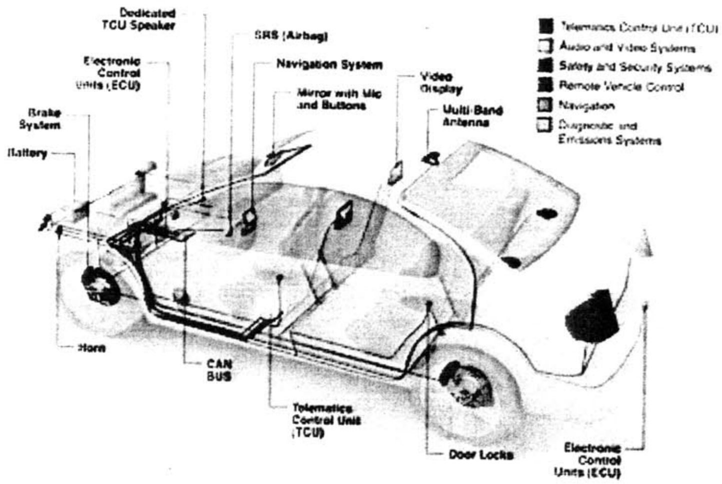


Figure 5- Diagram of elements in an in-vehicle Telematics system[viii]

2. Technology Parameters: **In order** to assess each of the various Telematics technologies, we must first identify the key parameters and establish criteria by which we will evaluate them. As discussed further in the analysis portion of this paper, the key parameters that differentiate amongst the technologies comprise: usability; crash-tested durability; connectivity; application flexibility; portability; cost: and vehicle integration.

In comparing the integrated in-vehicle Telematics system using these criteria, we are left with the following assessment: in-vehicle Telematics provides the best current technology for the areas of crash-tested durability, usability, and vehicle integration. It suffers, however, in terms of application flexibility and portability, and in connectivity.

It sacrifices portability because the unit is not easily removed, and cannot function away from the vehicle. When it comes to connectivity, while in-vehicle Telematics is currently moving to two way-connectivity, current OEM controls and appropriate middeleware have created a scenario where these devices are not able connect to external servers, and thus the applications are not easily upgradable. It is important to note, however, that while in-vehicle Telematics increasingly offers one-way communication (e.g. the download of real-time traffic information) this is fast becoming an industry standard across all Telematics platforms.

For example, as available on both the Android OS and Apple smartphones, Google Maps offers real-time traffic information competitive with the best in-vehicle solutions. Finally, as compared to mobile devices, In-vehicle Telematics units are often very expensive. For example, the price of a Telematics unit on a new MY2009 Lexus is in excess of $2000, as compared to a mobile device that typically costs around $400, and can be much less.

3. Business EcoSystem: To help further understand in-vehicle Telematics and its role and evolution, we must also understand the business ecosystem within which it operates. Business ecosystems are "...loose networks of suppliers, distributers, outsourcing firms, makers of related products or services... and a host of other organizations .... [Additionally] Each member ultimately shares the fate of the ecosystem as a whole."[ix]

Each player influences the design, operability, and the profitability of the previously described architecture. The following is a graphical representation and description of the business ecosystem's key players.

	Junkyards	OEMs	Dealers	Tier 1 Suppliers	Telematics Service Providers (TSP)	Wireless Providers	Software Companies
Disposal	x	x					
Maintenance and Service		x					
Distribution		x					
Assembly		x					
Subsystem Manufacturing							
Body		x					
Chassis		x					
Electrical				x			
Telematics							
Telematics Hardware				x	x	x	
Telematics Software							x
Telematics Service					x	x	x
Instrument clusters				x			
Passenger and safety				x			
Component Manufacturing				x			
Vehicle Development		x					

Figure 6- In-Vehicle Telematics EcoSystem[x]

4. Key EcoSystem Players:

4.1 OEMs: As shown in the ecosystem chart above, OEMs play a large role in the development, manufacturing, distribution, and servicing of Telematics systems. This is first and foremost due to the fact that they own and manage the major parameter of the Telematics experience, the automobile. This ownership has the most impact on feature offerings such as remote diagnostics where the information provided by the ECU can then be considered proprietary to the OEM. Also, given the OEMs role as the leader in the vehicle development and assembly activities of the ecosystem, they can then direct the implementation of features that assist in the optimal usability of Telematics. Key OEM players in the Telematics space include: VW/Audi; BMW, Mercedes-Benz, Ford, Fiat; Hyundai/Kia; Volvo; General Motors; Chrysler, Toyota/Lexus, Nissan/Infiniti, and Honda/Acura. While other players are considering, or have had a brief offering of a Telematics product in the past, the above list provides the more dominant players in the current and near future landscape. When categorizing these players, the OEMs can be grouped into three categories, based upon their product offerings: in-vehicle integrated, external interface; or hybrid player.

In-vehicle integrated players – offer a product, similar to that of OnStar, that provides little to no integration with a nomadic mobile device. With in-vehicle integrated players, all software and hardware reside in the vehicle. Current in-vehicle players are: BMW; Toyota/Lexus; GM; Honda/Acura; Nissan/Infiniti; and Mercedes-Benz.

External interface players – are those that solely integrate nomadic mobile devices with the automobile's usability features, without exploiting its connectivity for the purpose of Telematics applications. While Ford, initially operated in this space with Ford Sync, within a year it had moved to a hybrid approach to Telematics.

Hybrid players – are those that link a mobile device to the usability features of the vehicle, but also provide two-way communication between the vehicle and the mobile phone. For example, with the current generation of Ford Sync, not only does the mobile device connect to the vehicle to project audio and visual media through the vehicle's head unit, but also, should the vehicle be in a crash, a signal is sent through the phone, from the vehicle's airbag beacon, to a 911 center. Current players operating, or who will be soon operating this technology are: Audi; Ford; and Kia/Hyundai.

Viability for OEMs is in part driven by technological leadership in the Telematics arena while ensuring strong and proper sales. This is a result of profitability generated by the technology itself, and the brand effect provided by leadership in this area.

4.2 Telematics Vendors: There are more than 40 viable and profitable specialized Telematics providers. The more notable players include OnStar, Elektrobit, ATX (Cross Country), Hughes, Connexis, and KORE.[xi]

According to both members of Toyota's Telematics team and of OnStar's team, however, these leading players fall into two major categories: current or incumbent providers; and emerging. Current groups on the one hand have ready made technologies which are extant in today's marketplace. These players include ATX, OnStar, and Connexis. Other players, soon to be in market represent the emerging players, and they include players like Hughes and KORE which currently are working with OEMs, for example Hughes with Mercedes-Benz, but do not, however, yet have a viable product in the market.

Telematics Vendors serve as a key partner to major OEMs, and typically provide a range of activities: development of the Telematics infrastructure; ideation of product offerings based upon desired functionality; assistance on hardware development and integration; assistance on project management for Telematics technology launches in product lines; the creation of a process or system for the OEM; and ongoing support of the backend (service) process and billing functions. Viability of these vendors is dictated first and foremost by the relationships and business agreements in place between themselves and

OEMs. Additional elements which have a direct impact on viability include items tied directly to enhanced innovation and product development. For example, Hughes' tie-in with its parent company's satellite and wireless prowess lead to its early industry success, and its ability to quickly establish partnerships with Mercedes-Benz and initially with Chrysler. Additional elements that lead to stronger viability, although not quite as strong, include the vendor's ability to tie directly into the service expectations of the OEM and the OEM's customer base. For this reason, the Telematics Vendor's ability to manage Service Level Agreements (SLAs) at a realistic cost will also provide a competitive advantage on a go-forward basis.

4.3 Tier 1 Vendors (Front-End): Tier 1 Vendors are those vendors responsible for the hardware development for the Telematics specific devices that are integrated into the vehicle. These elements typically include an instrument cluster, vehicle based control knobs (e.g. on the steering wheel, or in the vehicle dash), a display screen, a power outlet (e.g. cigarette lighter), and often a cord hook-up port for a portable device connections. Key players in this space include Denso, Delphi and Continental AG.
The viability of these suppliers, in terms of the Telematics space, is driven by two factors: OEM partnership (which leads to product and integration knowledge with the OEM's vehicle platforms); and technological advancement in terms of hardware, and in certain cases (although rare depending on the OEM) software, development.

As Tier 1 Vendors are in many cases unable to meet needed consumer demands with their current product offerings, in certain cases the OEMs will seek elsewhere for solutions. This was the case during the early development of Lexus' Telematics offering, Lexus Link, where Delphi provided many of the hardware components, and OnStar helped to manage the back end operations despite a preference given to Toyota's primary Tier 1 Vendor, Denso. This example also helps to illustrate a key limitation of Tier 1 Vendors in that often, in cases of emerging technologies, they may not provide the optimal solution to meet consumer demand as a dominant design may have not yet been settled on, and or, may be protected by intellectual property. Such strong relationships, and proprietary integration, between the OEM and the Tier 1 Vendor, therefore, may further slow or prohibit the implementation of cutting edge technology.

Looking outside the realm of Telematics, this reliance on Tier 1 Vendors may have also, for example, contributed to the slower launch of plug-in hybrids, the other major area of technological innovation in the automotive industry. For instance, Sherry Boschert argues, in her book 'Plug in Hybrids: The Cars That Will Recharge America' that intellectual property (IP) protection on certain NiMH batteries, currently owned by Cobasys and Panasonic, have prevented successful entrance of viable plug-in vehicle architecture by OEMs and their supplying Tier 1 Vendors.[xii]

Additionally, as Tier 1 Vendors and OEMs work together to develop vehicle solutions, often times they build their systems with little flexibility to help streamline costs and maximize performance. For example, in many cases, OEMs build their in-vehicle navigation unit with little processing power, as to reduce weight and cost, and to accommodate only software solutions (via creation of a proprietary protocol and platform) developed by the Tier 1 or by the OEM. By doing this, however, it also prevents the integration of additional hardware and software, otherwise often created by an external vendor as a result of a market need that it has noted. This has been the result for numerous OEMs seeking a ready made Telematics solution to run on the vehicle head-units already in production. This is because many of these 3rd-party developed applications and hardware require high processing power and more open access to the platform and standard languages, some or all of which are currently not available given the inflexible system design of the head unit between the OEM and the Tier1 Vendor.

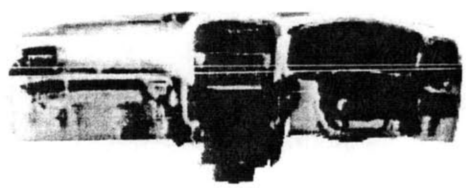


Figure 7- Example of an Instrument Cluster

Chapter 3 – Mobile Devices

In order to gain a better understanding of both the benefits and limitations of portable devices, it is also important to understand, at a high level, their architecture when compared to that of In-vehicle Telematics solutions. Doing so can provide insight as to some of the more robust features of mobile devices over that of their in-vehicle Telematics counterparts.

In particular, the design of both memory and chargeable batteries, provides greater personalization and portability than is available from in-vehicle units. Additionally, the lack of any vehicle integration components (e.g. into the ECU) reflects and demonstrates all portable devices' reliance on the OEM to manage this integration point, and this serves as a limiting factor when comparing them to In-vehicle Telematics solutions.

1. Mobile Device Architecture: Compared to the in-vehicle architecture, the front end architecture of a mobile device consists of a battery (which allows for portability), an operating system (to enable the program), memory (as to prevent loss of information caused by power outages), a screen and relevant buttons or controls, and a GPS unit. The importance of highlighting this architecture is to manifest key differences in the mobile device versus that of the in-vehicle product. First and foremost, a battery allows for enhanced portability, allowing users to be mobile with their device despite not having access to any power sources. While a battery, of course, allows for such portability, batteries inherently represent a constraint in terms of the useful energy life during which the component can be used without receiving a charge. Unlike their in-vehicle counterparts, it is important that, when using a mobile device, access to a constant charge be available, or that use per battery life be considered. Another key difference in the architecture includes its built-in memory, which allows for storage of data as to allow more customized experiences. For example, while many in-vehicle systems have less than 2MB for storage available to applications, many smartphones today have at minimum 8GB of available memory. The back-end architecture, when it exists to provide services, looks very similar to that of In-vehicle Telematics systems; as a result, when designed, back-end architecture does no by itself prove to be an inimitable point of differentiation from solely a design perspective.

2. Parameters: Utilizing the criteria noted in the in-vehicle technology parameters section, portable Telematics units are providing a source of competition for In-vehicle Telematics solutions on the basis of their superior performance on the parameters of portability, cost efficiency, and flexibility. In terms of portability, given its built-in battery, a mobile Telematics unit can be used anywhere any time. That is, when both driving to a location, and while away from a vehicle on that specific location. In terms of cost efficiency, due to the fact that a mobile device can bundle services (e.g. cell phone, internet, and navigation), costs can now be reduced as these Telematics features do not impose much incremental costs, and indeed are often offered as free services when enrolled in a smartphone plan. Also, given that a mobile device is essentially assigned to an individual, and not an automobile, it can be used for multiple vehicles thus eliminating the need to invest in multiple hardware units, further saving cost. In terms of flexibility, mobile devices (when offering two-way communication) can provide continuous software infrastructure and application updates, and thereby provide the most personal and optimal services to a user with minimal or no cost or need for intervention on the part of the consumer. This can in turn maximize consumer satisfaction, while limiting costs to both the provider and the customer. Limitations, as supported by the lack of vehicle-integrated elements in the architecture discussion above, of this technology include poorer performance in terms of vehicle integration, reduced usability, and legal and policy restrictions for use while driving.

3. Envelope and trade-offs: In assessing the strengths and weaknesses of mobile Telematics devices, it is important to tie their benefits and weaknesses back to the main

consumer goal of the a Telematics product: to remain connected while in their vehicle or away from their current locales of operation (e.g. home, office). One of the major benefits of a mobile device, as stated is its portability, or the mobility that it provides. This enables people to not only have such connectivity while driving, but at their destination as well. To do this, of course, it is necessary for the unit to have some form of a battery life (which per the architectural discussion we know this to be true), and must be light and portable in terms of size and weight. The competition amongst device manufacturers on these dimensions may, however, have an adverse effect on usability and durability. For example, leadership in terms of portability requires a device to be compact and lightweight. This in turn may affect the device design in that screens and buttons may become smaller, and mechanical protection, affecting the phone's durability, may become thinner or otherwise less robust.

Cost, as discussed above, is another competitive advantage as redundancies are often reduced. While for many consumers this will be a source of competitive advantage, due to the safety profile of certain consumers, for them redundancy may be both welcomed and fee justified. Based upon internal surveys, to no surprise, this demand proves higher for those drivers and vehicles that tend to serve as family vehicles, when the elderly or children are likely to be passengers. Finally, when it comes to application flexibility, this serves only as a benefit for consumers who seek either or both software optimized for their needs or access to new or emerging applications. Consumers who desire a low rate of application learning may actually see continual upgrades as more a nuisance rather than a benefit. For example, surveys suggest that the portions of the population less likely to see application flexibility as a benefit include a high proportion of drivers over the age of 65.

A high-level summary of strengths and weaknesses can be noted in the chart below.

Device	Strengths	Weaknesses
Smartphone	• Portability • Cost efficient (hardware) • Cost efficient (software) • Rich Graphics • Application Stores	• Poor usability (for driving) • Anti-use regulation • Possibility of malfunction- in collision
In-Vehicle Telematics	• Large Screen • Strong driving usability • Integration with the vehicle • Safety Tested	• Non-portable • Costly (hardware + software) • Limited applications

Figure 8- Telematics Technology Strengths and Weaknesses

4. Business Ecosystem Portable Devices (PNDs, Smartphones)

	Junkyards	Device manufacturers	Retailers	Wireless Providers	Software Companies	Sattelite Providers	OEMs	Middleware Providers	TSPs
Disposal	x	x							
Maintenance and Service		x	x	x					
Distribution		x	x	x					
Assembly		x							
Subsystem Manufacturing		x							
Component Manufacturing		x							
Infrastructure Development				x		x			
Application Development		x			x				
Vehicle Integration		x			x		x	x	x

Figure 9- Portable Device EcoSystem

5. Key EcoSystem Players: Portable devices can then be broken down into two principal categories: Portable Navigation Devices (PNDs) and Smartphones.

5.1. Portable Navigation Devices: PNDs are navigation devices that offer first and foremost, navigation features, with a few additional value added capabilities such as information connectivity. Key players in this space include Tom Tom, Garmin, Telogis, and Telenav. The viability of PNDs relies solely on the capabilities of its product offering, resulting in turn from both enhancements in hardware and most importantly with the applications. Given that PNDs only offer the benefit of GPS based navigation, while the current smartphones offer this benefit in addition to features such as two way communication, and access to cutting edge applications, PND success will depend upon their abilities to expand their service offerings to compete with smartphones. It may, however, force PND manufacturers to transform their PND devices into smartphones, or harvest elements of their product such that they can integrate their offerings with current smartphone manufacturers.

5.2. Smart Phones: A smartphone is a mobile device, with voice capabilities, that offer Personal Computer type functionality. This functionality includes: computing power, memory, data connectivity, and voice connectivity. Tying this back to consumer desire for connectivity with Telematics, consumers can use a smartphone to gain instant access to a variety of applications that facilitate access to data or facilitate human interaction in an easy to use format. Like PNDs, the viability of smartphones relies upon their ability to advance both hardware and application so as to enhance user experiences and device portability. As demonstrated by the chart below with the iPhone, smartphones have enjoyed exponential growth in sales.

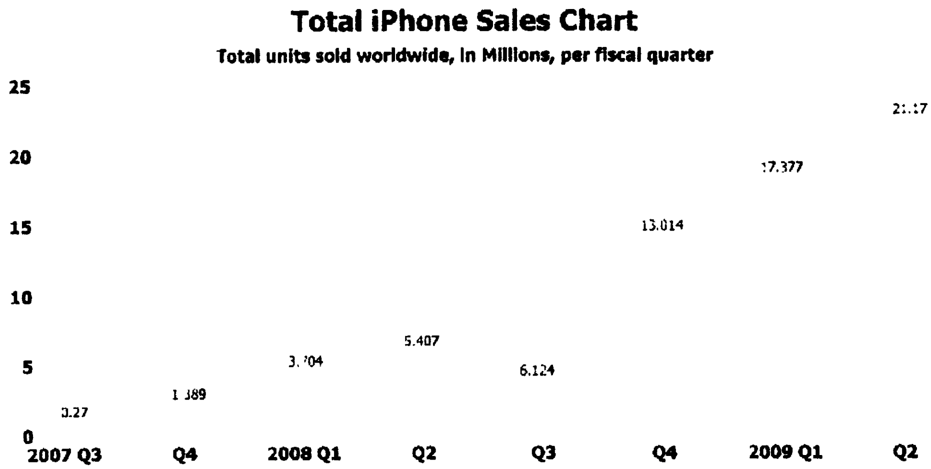


Figure 10- iPhone Sales- in millions[xiii]

5.3. Wireless Providers: A key player in both the ecosystem for both in-vehicle and portable Telematics is the wireless providers who provide wireless connectivity for them. Due to the importance and standards differences of each of the key players, each major U.S. provider is described in detail below.

5.3.1. Verizon: Formed in April 2000, Verizon Wireless traces its roots to the integration of Bell Atlantic Mobile, and the AirTouch portion of Vodafone AirTouch. It is one of the two major mobile carriers in the United States, along with Sprint Nextel, that uses CDMA 2000 technology. In late 2007, Verizon Wireless announced an open access policy, the Open Development Initiative, to permit "any" device or application (that is CDMA-based) to run on its soon to be launched 700MHz Long Term Evolution (LTE) network. Devices will need to meet certain minimum technical specifications, which Verizon Wireless has announced in 2008, but any application would be permitted to run on top of these devices. Also, in 2007, Verizon announced its joint initiative with Vodafone Group to transition their networks to a 4G standard Long Term Evolution-

LTE (which provides high throughput, low latency, and plug and play), with plans to launch the standard by 2010 (although this seems delayed at this point). In 2009 Verizon wireless acquired Alltell. Currently, Verizon provides Telematics wireless support for many OEMs, including Toyota, Lexus, and GM OnStar. These players have sided with Verizon, due in large part to its CDMA technology which despite arguably slower download speeds, has larger coverage area and better service levels.

5.3.2. AT&T Mobility: Established in 2004 as a joint merger between Cingular and AT&T Wireless, AT&T Mobility is a wholly owned subsidiary of AT&T Inc. As of 2009, AT&T was the second largest wireless carrier in the United States behind Verizon Wireless. Due to its growth method of acquiring networks, AT&T Mobility operates netwoks using different frequency bands and wireless standards, althought the core technology it uses is Global System for Mobile Communications (GSM) and now the 3G GSM Standard for circuit switched voice and packet switched data communications. Like Verizon, AT&T Mobility has announced its plans to move to LTE technology in its 4G network. Plans to launch this network by 2010 are currently in progress. In 2007, AT&T announced its partnership with Apple in being the sole wireless provider for the iPhone. AT&T has partnered with DCX and Kore to provide Telematics wireless service to major OEMs, including Mercedes-Benz and Chrysler [xiv].

5.3.3. Other players: While not currently key players in the Telematics space, T-Mobile (GSM) and Sprint (CDMA 2000) can, in the future, become a key partner in this space. Much of their abilities to become significant in this space will be advancements in their current infrastructure as to allow for better coverage and or faster download speeds. Gaining such an advantage would then still require a strong initiative on the parts of these players as to break the relationships currently in place between the OEMs and the providers currently in use. This may be difficult however, as OEMs often work with the service providers as to develop hardware technologies to adapt to the provider's current wireless infrastructure.

Chapter 4 - Relevant Technologies

As the Telematics industry is reaching a state of disruption, thanks largely to the emergence of the smartphone, several key technology areas will define how the future industry and technology architecture will take shape. Each of these technology areas help improve upon the consumer experience by improving connectivity, facilitating the transfer of applications, or by allowing for better technological integration within the architecture of the Telematics system. There are three key areas: wireless connectivity software delivery; and standards and platforms.

1. Connectivity: In the space of connectivity, advancements in wireless technologies will help define what is possible in terms of data transportation across areas of long and short distances alike. Currently, three paradigms of wireless technologies define communication opportunities. These areas in decreasing order of distance are: WWAN, WLAN, and WPAN. The importance of the improvements in this technology is they will determine what is feasibly possible in terms of data transfer to include simultaneous

voice and data transmission. Improvements in these technologies also shape available applications and information security while setting consumer expectations around use and data transfer speeds.

1.1. Wireless Wide Area Network (WWAN): WWANs can provide coverage over very large areas, but offer slower and in some cases less secure wireless transfer methods. This makes them great solutions for small data transfers such as telephony, and they currently are the most widely used forms of wireless information transfer. Despite their increasingly faster connectivity, long latency periods make WWANs slow for interactive Internet sessions. Examples of current WWAN technologies include: 3G, CDMA 2000, and GSM. Future developments in this area, that include LTE (the next generation of WWAN technology), have large impacts on the Telematics industry in that they will provide the most robust additions to the consumer experiences. WWAN improvements will reduce reliance on the mid-range technologies, which are necessary for data transmissions of large files, while improving coverage and range of the data transmission. From a consumer standpoint, it can help evolve an experience to one where any information can be accessed anywhere at anytime.

1.2. Wireless Local Area Network (WLAN): WLANs are wireless networks that currently allow for fast data transfer speeds of large files at medium distance ranges. Unlike WWANs data transfer in WLANs is comparably robust in terms of data speed and security, akin to that of a plugged in wire. Major limitations for WLANs in terms of the Telematics industry result from the technology's limited range (when compared to

WWANs), and the current technology's limited ability to mesh networks (transfer successfully from one LAN spot to the next). This inability to mesh networks leads to potential connectivity disruptions in this area in the world of Telematics as users are forced to reconnect from LAN hotspot to hotspot when they move from coverable range. Emerging protocols for WLANs aim to provide better mesh networking and faster roaming capabilities; these standards have not, however, yet been ratified.

1.3. Wireless Personal Area Network (WPAN) technology is a wireless network ideally used, due to its short access range, for machine-to-machine connectivity within a small workspace. The benefit of WPAN is that it would allow a user to connect a compatible device, such as a smartphone, to a vehicle's Telematics unit. This would in turn, allow a user to benefit from the usability and integrated features of the automobile, while maintaining the portability of a portable device. The major standard in WPAN is Bluetooth. Emerging technologies in the WPAN space, which include Bluetooth 3.0, will allow for more robust and secure data transmission within these short ranges. For example, larger files, not just audio, will be readily available for transmission from device to device. In terms of the Telematics world, this will enhance the user experience in that all applications and information held on a consumer's smartphone, could be transmitted to the integrated Telematics unit's usability features. Benefiting from the smartphone's business ecosystem, which allows for greater accessibility to applications, this could greatly improve the user's overall connectivity experience, by improving access and reducing redundancies.

2. <u>Application Delivery</u>: Unlike the technology advancements of wireless communication where advancements in the technology are providing the actual benefit, the importance of advancements in the application delivery area focus more so on the business paradigm and process of delivering data remotely. This process, known as Software as a Service (SaaS), traditionally has the following attributes: 1) software applications are delivered directly to users via internet connection, 2) information is stored and hosted in servers maintained by the SaaS provider (sometimes known as a cloud), 3) content is maintained and secured by the SaaS provider, and 4) pricing is on a per-term or pay as you go format. SaaS is slowly becoming a method of choice for many software developers due to its low cost of deployment and scalability. For this reason, developers have made significant investment in shifting consumer behavior from traditional in-house server processes to SaaS processes. Strong benefits to the consumer include: disaster recovery of data, enhanced security, and continual upgrades of applications as improvements are made. Successes in this realm range from Salesforce.com to more pertinently the iPhone application store. The importance of SaaS will come from the expectations as set by the consumers. As customers become more comfortable in this deployment, and as the benefits become clear to them, they will then begin to demand this type of delivery which could spell disruption to the imbedded software mechanisms of today's Telematics players.

3. <u>Standards and Platforms</u>: Another emerging trend central to understanding the emerging landscape of Telematics is the emergence of protocols and middleware. This emergence is largely important as advancements, and more importantly acceptance, of

these standards and technologies help to further integrate the mobile and in-vehicle technology business ecosystems. Breaking standards and platforms into two key areas, we start to see the emergence of a one-voice Telematics protocol in addition to the emergence of several middleware providers. In regards to protocols, one of the major initiatives, currently under development, to standardize the operating protocols is the Next Generation Telematics Protocol (NGTP). As part of collaborative effort between BMW, Connexis and WirelessCar, NGTP is aimed to allow for an open and standardized approach to delivering Telematics services which helps to reduce the barriers for OEMs and Telematics providers alike to integrate. The benefits of open standards are profound. Not only will an open standard reduce barriers to entry, thus providing incentives for multiple industry players and increasing innovation, it will also allow Telematics Service Providers (TSPs) who offer certain strengths in certain areas (e.g. call center support) to manage this portion of the service offering while, for example, allowing other TSPs to manage the infotainment.[xv]

While NGTP aims to better integrate the players of the Telematics ecosystem, efforts in the middleware space are improving the integration between the mobile device and the Telematics ecosystem. Through the use of their software, and subsequently established processes, players such as DUN and UIE have allowed for the integration of multiple applications (written for any mobile platform) to be delivered from a mobile device to audio-visual devices of a vehicle. The long-term benefit of this application is that not only would consumers truly have a seamless experience between their favorite device application and their vehicle, but in-turn, it would also create an open standards situation for application developers thus fostering innovation by removing barriers to entry for them given that application developers need not worry about writing applications for numerous operating systems.

Chapter 5- Toyota Motors Company Description

Returning to our original goal, we are not only interested in the general future of the Telematics industry, but are interested more specifically in establishing a model for a company like Toyota Motors to follow. To make such a recommendation, it is important that we obtain a brief understanding of the company's history, and the tenets that guide its culture and business decisions.

Originally established as an automated loom company, Toyota developed its automobile department in 1933 under the leadership of Kiichiro Toyoda. Today, Toyota represents the most profitable and highest volume generating Automotive company in the world.

Currently Toyota operates as four Global Divisions worldwide with its global headquarters based in Nagoya, Japan, or what is now known as Toyota City. The Global Divisions, Toyota Asia, Americas, Africa, and Europe, each act as a separate subsidiary to gain customer needs for the market, while working arm and arm with the Global parent in Nagoya to confirm engineering realities. Marketing and sales responsibilities are also diffused almost solely to the regional subsidiary with lowered input and approval levels needed as compared to engineering considerations. In areas where manufacturing is localized, such as in the Americas, often the sales, marketing and distribution arm, and the manufacturing arm maintain separate facilities and reporting structures such that higher controls and greater autonomy can be provided for the manufacturing arms and sales arm respectively. Within the sales, marketing, and distribution arms, each respective discipline reports up through an autonomous reporting structure through the head of the division who is responsible for all three areas.

A key component about Toyota's culture, that has ultimately led to its success, is its deep rooted philosophy, the Toyota Way. As stated by Jim Lentz, President of Toyota Motor Sales USA, in his address to the University of Denver MBA program, "The key to Toyota's success is not our factories, is not our associates, and is not our dealers. No...the true roots of Toyota's success lie in our basic philosophy…a set of values, beliefs and business practices we developed over the years called "The Toyota Way". This is not a top-down set of instructions…or a manual of behavior instituted by management. It grew among the hundreds of thousands of Toyota workers and was passed along from generation to generation mostly by example and word of mouth." Key tenets of this philosophy include "genchi genbutsu", which translated from Japanese means "go and see", and nemawashi which translated means going around the roots, or gaining all stakeholders' opinions on all important elements prior to making a change or large decision."

Another unique aspect about Toyota's culture is its treatment of vendors. As noted in the Boston Consulting Group's paper, "Getting to Win-Win," Toyota takes great care in both the selection of its vendors, in addition to helping ensure profitability for its vendors such that a long-term and symbiotic relationship is formed. Examples of this include:

- A 3-5 years evaluation a new supplier prior to contract awarding
- An understanding of suppliers' costs structures such that suppliers can make profit.
- Willingness to give 100% of its business for a part to one company.

This article contends that openness and transparency, and a willingness to invest in a relationship far in advance of an actual purchase is what makes Toyota successful with its vendors and helps ensure long-term quality.

While perhaps a slower process than those processes utilized by their competitors, Toyota's philosophies, and their treatment of vendors have lead to unsurpassed quality, such that they have recently focused their brand image around what they call QDR (Quality Dependability and Reliability). In an industry where speed to market and first-mover advantage provide marginal results, where customers and external parties (such as JD Power and Associates) base vehicle ratings on their quality, and where product lifecycles are well in excess of 5 years, such a process and philosophy will continue to lead Toyota down the path of success.

Finally, it is important to note the organizational power of and focus on the engineering element at Toyota. This focus has allowed them to consistently deliver quality vehicles at low costs and increased cycle times. This focus, however, at times can come at the detriment of innovation and consumer desired flexibility. A great example of this is the recent decision to offer a mouse based control on its navigation units. Due to engineering constraints and desired flexibility, the head engineers at Toyota continually fought with the product planners and marketing groups who relayed consumer information about the desirability of the touch screen navigation systems. Further proof of this consumer desirability also came from the pushback of BMW consumers on the iDrive system that received horrible reviews. Further consumer expectations were set concerning touch screens during the mobile device migration to touch screens fueled in part by Apple's iPhone. However, in model year 2009, the engineers finally prevailed by removing the touch screen and offering a mouse based control, thus improving engineering flexibility. Customer feedback of this device is still under examination.

Toyota and Telematics

In terms of Toyota's role in the Telematics space, Toyota entered the US space in 2000 with Lexus Link. This was an analog system that was leased and operated from GM OnStar and which replicated exactly the same services and features. The analog system of Lexus Link was offered through 2004. A digital version of Lexus Link continued through 2008, and like its analog predecessor, was also leased from and operated by GM OnStar. In August 2009, Toyota launched its organically developed Safety Connect (Toyota) and Lexus Enform products. These products, while organically grown and supported, closely resembled the architecture and product offering of OnStar. The Toyota systems offered collision notification, a push button call feature, a fully supported call center, and turn by turn directions.

To launch this product, Toyota partnered with key Tier 1 suppliers, Denso and Continental to supply the necessary hardware, and partnered with ATX to provide the Telematics services to include the back-end operations (call centers and billing). An internal team worked to maintain quality levels (certifications) and strategies to meet organizational needs.

Chapter 6- Current Telematics Landscape

In summary, the Telematics industry, while offering a decade or so of stability, is currently under threat of disruption. A summary of the evolution of this trend can be referenced in the timeline below. Recent advancements in the wireless space, of mobile devices, in software and application delivery, and in protocol and middleware have left questions as to the future of the industry and its ultimate state towards dominant design. It has also begged the question as to if mobile devices will displace the integrated Telematics devices. The current landscape, with emergence and reported success of technologies such as Ford Sync also beg the question if a hybrid model represents the technology of the future. The remainder of this paper will aim to answer this very question.

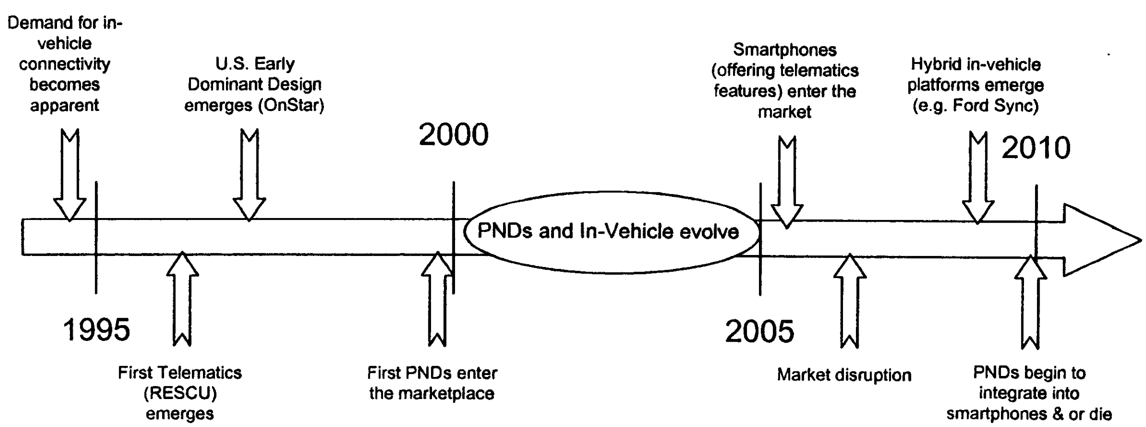


Figure 11- Telematics Industry Timeline

Chapter 7- Analysis and Future Trends

To understand where the industry is moving, we start by understanding what is being demanded and contrast this to then what can be technologically possible. This analysis is also considered in reverse from the standpoint that like with the iPhone, technology can influence consumer behaviors.

1. **Technology Trajectory:** In the review of OEM customer surveys on Telematics, several key criteria have emerged that tie directly to consumer demand for connectivity, amongst which there are four primary factors: cost; portability; usability and integration with the vehicle; and application flexibility.

1.1. Cost: According to Thilo Koslowski, VP of Gartner Inc, while Telematics is soon becoming the norm in the vehicles of tomorrow, given today's economy, consumers are more and more likely to seek only necessary functions that relate to vehicle ownership. Redundant features that provide the exact same functions as other devices that they currently already own will provide a sense of discontentment to many customers. This soon could be the case with Telematics' redundant connection services via the Telematics unit when noting that many drivers today also carry with them cell phones that maintain equal coverage to that of the Telematics unit. Should the OEM not strive to communicate benefits of this redundancy, or fail to provide tangible benefits from such redundancy, they will continue to face an uphill battle with consumers as disposable income becomes thinner and thinner.[xvi]

Additionally, market forces, such as increased competition, will continue to drive OEM profitability towards parity as to derive minimal profit margin. This is the result of two major factors: scalability; and competition. First off, as the number of players (from an OEM standpoint) in the market increases, competition will also place pressures on pricing. As a result, the number of OEMs offering the product will exponentially increase, thus fostering competition. As consumers begin to consider Telematics in their overall purchase consideration set, and as they gain awareness on competitive pricing, they will place strong pressures on the OEMs to reduce pricing as to ensure a lower total cost of vehicle transaction. While consumers begin to demand lower prices, an OEM's ability to offer lower prices will also increase as their total ownership base, or scale, begin to increase. Increases in volume are beneficial from a cost perspective to the OEM based upon stronger negotiation power to decrease both the cost of raw materials and finished goods. Such cost improvements, which lead to better OEM profit margins, can then be passed to the customer. Improved scale also provides a benefit in that that the total cost per customer to serve, when considering the cost of back-end operations (e.g call centers and billing), are also likely to decrease. This is largely the result of a higher profit that helps offset the high initial fixed costs of running a call and data center. An area of further cost consideration for consumers is the redundant costs incurred when both Telematics and other portable devices are used. For example, currently for many OEM Telematics, customers are required to pay for connection service to make connections with the back end operations and call center. Thus, in these cases, when they own a cell phone, consumers are paying for cell-phone connectivity on top of the connectivity charges for the Telematics product. Those OEMs that are able to reduce unneeded redundant fees for consumers in their architectural design, will help improve their competitive standing within the market. Ford's SYNC product is the first Telematics product in this space attempting to reduce cost through redundancy elimination by allowing customers to connect directly to the usability features in their vehicle using their mobile device.

Finally, additional cost leadership may be obtained through a pay per use program from both an application and hardware standpoint.[xvii] As noted by Christensen and Sundahl in their paper "Getting the Innovation Job Done: Matching the Right New Product with the Right Market," customers benefit most when a hiring for pay relationship can clearly be established and communicated. As noted in the previous section, a SaaS delivery method of applications can provide additional cost leadership for OEMs while enhancing customer benefits. Pay per use can help consumers save money from both an upfront and residual cost basis while allowing providers and OEMs the ability to gain revenue from consumers who would not normally wish to commit to financial outlays upfront. ABI research contends that this trend has already begun to emerge in Europe.

1.2. <u>Portability:</u>- In addition to costs, the portability of a Telematics functionality, such that a customer can apply Telematics functionality while not being limited to vehicle proximity, has also proven important to customers. Many of these portability expectations have been the result of continual improvements in portability set by the cellular and smartphone. Within a few short years, the industry has provided connectivity and relevant applications to consumers anywhere and at anytime. As stated by Frank Viquez, Director of Automotive Research at ABI, such portability will improve the user experience, and will continue to push them to seek further advancements in their need to fulfill their internal human desire of connectivity.[xviii] By allowing the integration of a portable device into a vehicle, OEMs will have the ability to take advantage of a convergence of three markets (In-vehicle Telematics driven by automotive OEMs, smartphone and PND devices, and mobile applications). Portability of mobile devices will continue to improve as technical advances and decreases in input costs will allow for smaller and lighter equipment in addition to allowing for better investment in industrial design (ID). Also, as wireless technology continues to evolve, and the benefits of faster and safer connections emerge, portability will further be enhanced in that files and data normally requiring non-mobile connections to transmit will now be able to be sent via portable devices. Limitations will occur, so long as OEMs prevent integration into the usability features of the automobile as such rapid innovation in in-vehicle technology is not likely to advance so quickly.

A good example, demonstrating a recent failure of PND integration into a vehicle concerns the attempt of Toyota engineers to integrate PND sales of TomTom devices into the Toyota FJ cruiser. In an attempt to lower transaction costs to consumers, such to maintain competitive pricing to the younger buyer, but still provide demanded navigation functionality, Toyota tested a vehicle package which offered a TomTom device and mounting unit for the FJ cruiser. While the package received plenty of marketing and promotional support, low sales and poor customer feedback resulted in a product failure.

Most customer complaints centered on reduced usability features and noted comparisons to the touch-screen (with steering wheel controls) usability of the navigation units featured at the time of the product offering. For most of these consumers, the benefit of increased portability, and lower cost didn't outweigh the usability costs noted above. Therefore, while a benefit, portability (as demonstrated by the case of the FJ Cruiser) must provide strong usability while both in-vehicle and for use out of vehicle for it to truly serve as a competitive advantage.

1.3. Usability and Vehicle Integration: The usability factor of Telematics is important for two reasons. First of all, optimal usability helps a consumer maximize his driving experience. Not only does this usability help keep a consumer safe while operating the tool, it also encourages and facilitates use of the Telematics product, further increasing use and dependence. Optimal usability also helps a consumer comply with the increasing legislation seeking to limit device use while operating a vehicle. Several states, such as New York, New Jersey, and California, have prohibited use of portable technology while driving. In addition to laws surrounding portable device use, these states have also required that portable navigation devices be mounted while in use thus often worsening usability features. While usability features may be demanded by consumers, their rather strong tie to the OEMs and the vehicle will prevent radical evolution in a short period of time. This is the result of the long life-cycle of auto vehicles at 5 to 9 years as compared to the 3 year cycle of portable devices and even shorter for applications. This, therefore sets the paradigm for the future of the Telematics industry: rapid evolution in application and mobile devices, with slower innovation in terms of the in-vehicle components.

1.4. Application flexibility: Applications in the Telematics space are important for the reason that they provide the model for the user experience. Currently, much of the applications for OEM Telematics is delivered by in-vehicle DVD which is run on an internally installed DVD player. Updates, to new versions, are rarely made given the cost to the OEM and dealer to replace and deliver the disk. Innovations in this space will likely improve offerings to best meet customer demand. Specifically, if the ability to offer and deliver applications via a SaaS delivery model is developed, the rate of technology upgrade will exponentially improve. This can then help provide cheap and fast delivery of the applications such that evolving demand will continually be met. Mobile devices, especially those tied to application stores, currently use this method to maintain software optimality in line with changing consumer needs. On the mobile application side however, certain software, in the cases where applications have been developed for a proprietary OS, are limited to the application for which it was first developed. Users of other mobile devices, therefore, cannot benefit from such use. To help with this issue, middleware developers, such as DUN, are creating middleware and run-time environments that will allow applications to overcome these standards battles. Successful launch of such middleware will further application development and deployment, in that any application, developed on any OS, will then be available for consumer use. As noted, movement to open protocols such as NGTP will also help open application flexibility to users.

In summary, the future landscape, as dictated by consumer demand and performance trajectories, is one where a lower cost, or pay to play, scenario emerges. Increases in costs will necessitate an increase in benefits to the consumer experience. Redundant services, such as connectivity, will be forced to show benefits if they come at a cost. Additionally, in this landscape, enhanced usability will become the key for mass acceptance, however, will not advance much from its current design and development due to the long development cycles of the automobile. On the other hand, advances in mobile devices and applications will continue to evolve at a rapid pace, further shaping customer expectations for portability, applications, connectivity, and ultimately Telematics.

While the above summarizes the landscape of the Telematics realm as set by consumer demand, it is also crucial to help assess technical advances in order to determine future realities. To do so, we will then focus our attention to patent behavior and technical papers.

2. Product Innovation and Growth: To help illustrate the growth in development in the application, portability, and usability space, it is important to demonstrate the physical innovation in each of these specified areas as to help determine technological realities. To do so, we must look for key signals as to garner a glimpse of this future state. As stated by Utterback and Brown in the paper Profiles of the Future, given the multitude of uncertainties in identifying innovation, it is necessary to identify key "signals" that are inherent to innovation. Two of these key signals include the publishing of scientific

papers, and the formation of new firms. To illustrate innovation in the areas of question, we will assess and trend the volume of each area, over time, in each of the relevant performance trajectories.

2.1. Portability: To demonstrate the innovation in this space we will focus on the innovation signals for portability by focusing on innovations in the Smartphone and cellular phone space and contrast this with the growth in Portable Navigation Devices. Doing so will help to demonstrate the convergence of information accessibility from a portable device that provides a single function, to a device that provides multi-functionality. Through such integrations, consumers no longer need to carry multiple devices, but rather now have bundled applications in one easy to carry device.

Portable Devices (PND): Growth through 2007, recent tapering of publications and firm entry as research has moved to integration into smartphones.

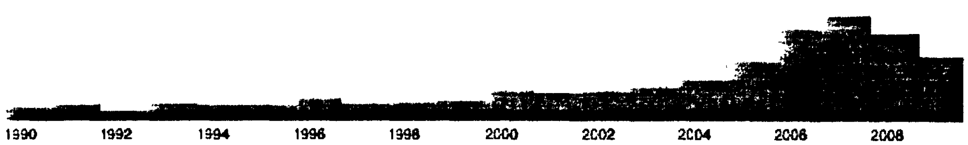
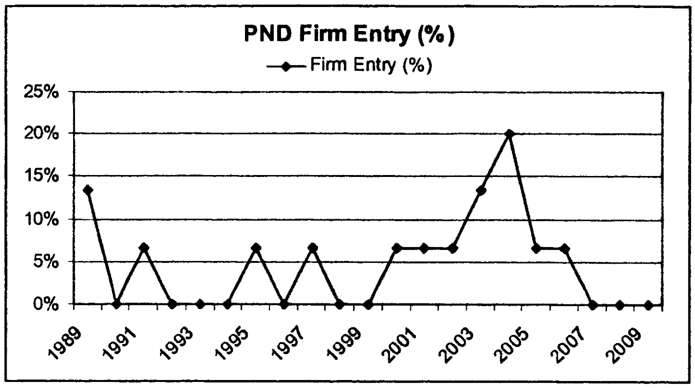
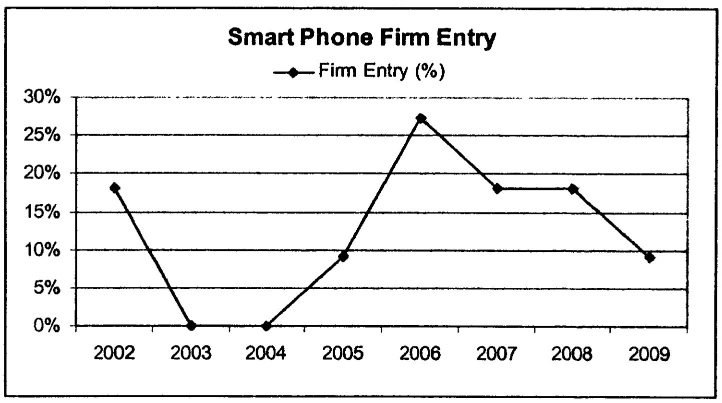


Figure 12- Technical Papers Published (Portable Navigation Devices)

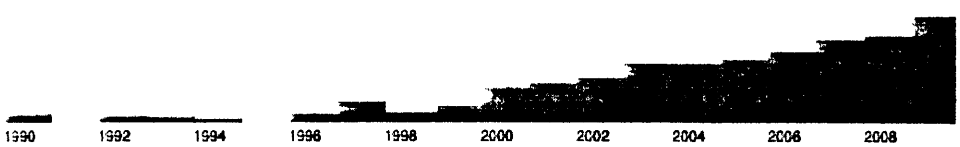


<u>Figure 13- Firm Entry (as percent of total) - Portable Navigation Devices</u>

<u>Smartphones</u>: Exponential growth, suggesting high levels of competition and innovation per Utterback and Brown.



<u>Figure 14- Firm Entry (as percent of total) - Smartphones</u>



<u>Figure 15- Technical Papers Published (Smartphones)</u>

It is interesting to see that in both cases that the timing of the peak of entry for smartphones, in terms of firm entry and technical papers published, was close to the time of degradation in the PND market. This suggests, that benefits being produced by smartphones, and the hardware capabilities as a result of the GPS enabling of the smartphone, rendered redundancies for PNDs. This is evident in the directions features offered by many smartphone providers, including most notably Apple's iPhone Maps application. Further recognition of this trend has been made evident by several PND manufacturers' willingness to offer their specifically branded smartphone application. For example, TomTom released its iPhone application in 2009 at a price less than many of their complete PND systems. Additionally, new PND based applications are emerging as well. For instance, iPhone consumers enjoyed the integration of the phone's GPS used in tandem with its pre-installed Google Maps application which allowed for many of the same turn by turn functionality as the best PNDs. According to Scott Stevens of Strata Capital Management, "This is all part of a natural progression in technology in which software comes along to do the same thing you previously needed stand-alone devices for. And it means that soon enough, consumers won't see any reason to buy GPS devices like those sold by companies like Magellan, that are a private company but a well-known name, because software on their phone does the same thing."[xix]

Additional emphasis of this move are coming from the PND manufacturers themselves as they venture into the communications front. Take, for example, the recently released Garmin Nuviphone G60, aimed to be an iPhone competitor. The product is claimed to have great usability features, robust Garmin navigation features and graphics, and several applications (such as built-in geo-tagging), not available to other smartphone providers such as Apple.

In short, the evidence above suggests a high rate of innovation in the portable device space. The rise in both firm entry and technical papers published for smartphones at the time these criteria decreased for PNDs suggests a movement for navigation functionality from devices unique to one function to an integrated device like a smartphone. This trend has been confirmed as the result of actions such as TomTom and Garmin to develop applications for smartphones at the cannibalization to their own product lines.

2.2. Software Flexibility: As stated, the flexibility and rapid deployment of software to meet consumer needs is necessary for applications to maintain success in the future. A first step in the ability for this to happen was the decision of many smartphone manufacturers to make their software platform open source as to encourage application developers to continue to innovate to meet consumer needs. This in turn provided a benefit back to the smartphone producer in that a fee would be attached to the sale of the application. In the case of apple this is 30%. The application could then help drive sales of the mobile product itself as consumers seeking the application would necessarily need the mobile device to run the application. The developers would subsequently benefit through the smartphone provider's distribution and marketing channels. As the result of players like Google and Apple, a multitude of applications and developing firms have hit the market. As noted by Ofri Marukus in his Thesis The Mobile Common, many of these developers began developing applications even before the actual release of the respective

OS. Yankee Group in Boston foresees the market to grow to 10 times the current amount in terms of profitability to $4.2 Million. To date, Apple already claims over 75,000 applications in its iPhone store as compared to zero just two years ago. Apple also and claims that there are over 1,000 unique developers or firms for every application that successfully enters their app store. While many of these applications are current in the infotainment realm, roughly 73% according to the Yankee Group, search, social networking, and more targeted applications are gaining ground.[xx]. It is likely that once applications find themselves into the driving experience, we are likely to see rapid application growth in this realm as well.

Even currently, prior to any integration between applications and the usability features of a vehicle, we are seeing the emergence of auto related applications such as Dynolicious which utilize the GPS functionality of a smartphone to help communication vehicle acceleration, speed, and other performance related specifications. To further confirm the innovation in this area, it is important to note the exponential growth in technical papers published over the course of the past few years.

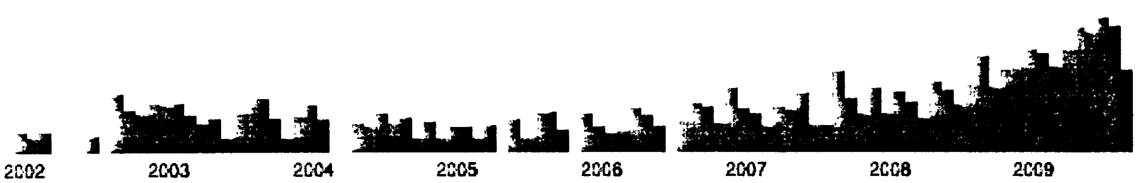


Figure 16- Technical Papers Published (Smartphone Applications)

2.3. Usability: As stated above, much of the innovation concerned with the usability of Telematics features will be limited to the longer life-cycle and production cycles of the automobile. Because of this lengthy process, it is likely that the rate of change for the applications and portable devices will by far outpace innovation and developments within the usability and integrated features of the in-vehicle section. Additionally, it is important to note that, as is supported by the trend of technical paper publishing noted below, much of the usability functionality that is important for Telematics were brought to market in the early 2000's as a result of in-vehicle navigation and early Telematics systems such as RESCU and OnStar. While items such as an integrated screen, steering wheel controls, and an emergency rescue screen have become standards, design battles between touch screen functionality and remote or "mouse" based controls have not yet settled.

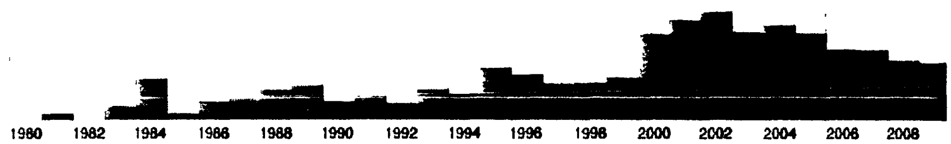


Figure 17- Technical Papers Published (In-Vehicle Telematics)

In summary, the evidence above suggests a scenario in which we are likely to see a rapid innovation in the mobile device and application areas. The innovation of usability features of the vehicle will, however, be limited by the length of the product lifecycle for the vehicle. While certain features, such as a screen, navigation software, GPS, and music integration are emerging as standard, the rapid perceived evolution of the Telematics space in addition to the lack of integration between the mobile and in-vehicle devices suggests a lack of stabilization, and thus a dominant design, following the disruption of smartphones, has not emerged.

3. Industry Implications: In assessing the current landscape, we reiterate the key points from our summary: the current landscape is one where disruption has occurred in

the in-vehicle Telematics market (due to the emergence of smartphones), and as a result, the once perceived dominant design (the OnStar Model) has come into question in terms of its market strength. Due to this disruption, hybrid Telematics solutions (such as Ford Sync) have emerged, and additionally, PNDs are now on a state of decline due to limitation in connectivity and single use paradigm. Examples of this have demonstrated by actions of PND manufacturers like TomTom to integrate their applications into smartphone devices. For this reason, in assessing the future landscape, and its impact on Toyota, PNDs will not be considered further; smartphones have eclipsed PNDs which are now in decline.

On the other hand, while smartphones have spelled the end for PNDs, certain benefits still exist in terms of the in-vehicle integration Telematics solution over the smartphone. For this reason, no clear winner has yet emerged, and we will turn our attention to the dynamic between the two paradigms (current- in-vehicle Telematics and smartphones).

Let us return to the following cost and benefit description with the added Hybrid assessment:

Device	Strengths	Weaknesses
Smartphone	• Portability • Cost efficient (hardware) • Cost efficient (software) • Rich Graphics • Application Stores	• Poor usability (for driving) • Anti-use regulation • Possibility of malfunction- in collision
Hybrids (Sync)	• Portability • Rich Graphics • Application Store • Usablity	• Limited Service o No back –end call center • Limited Integration o No integrated GPS • No durability • Moderate cost

In-Vehicle Telematics	• Large Screen • Strong driving usability • Integration with the vehicle • Safety Tested	• Non-portable • Costly (hardware + software) • Limited applications

Current Technology State

The analysis above suggests that the core strengths and weaknesses of each of the paradigms is likely to become even more extreme. For instance, due to the extreme competition in the smartphone space, prices are bound to continue downward. For instance, the recently released Droid phone, which offers many of the same benefits as does the Apple iPhone, debuted at a price of $199, as compared to the iPhone that started with a $399 price tag. To compete, Apple lowered the price of its 3G version to the $199 price point. Additionally, as noted by the size improvements of the iPhone, from its Edge to its 3G version, and its faster download speeds, smartphones are become more portable.[xxi]

Model	Download Speed	Weight (grams)	Size (mm)
iPhone 3G	497.2 kbps	133	115.5 x 62.1 x 12.3
iPhone (EDGE)	245.3 kbps	135	115 x 61 x 11.6

Figure 18- iPhone Specifications (3G vs Gen1)

This competition on portability and price will then place pressure on screen and button size reductions which then will further mobile device weakness in the driving usability area where large screens and buttons are desired. This move to increased portability and decreased costs will also likely affect the mobile devices durability as casing size is reduced. This in turn will likely reduce its crashworthiness if involved in a vehicle collision.

Additionally, as shown in the assessment above, hybrid models do have strengths and weaknesses. While hybrid models currently offer strong usability, portability, and flexibility, when compared to in-vehicle telematics or smartphones, they provide key weaknesses. For example with costs, while hybrids serve as a better solution than an in-vehicle integrated solution which roughly costs in excess of $2000, the $300 price tag is more expensive than a $199 price tag for a smartphone. Combine this with the hybrid's requirement for a user to own a cell phone, we have a total transaction price of roughly $500 for a hybrid option. Additionally, in terms of integration benefit, smartphones do provide reduced capabilities when compared to their in-vehicle integrated counterpart. For example, the lack of vehicle embedded GPS, can provide limitations should a consumer's vehicle be stolen and needs to be located. Therefore, while a start in the right direction, hybrid options by themselves do not provide the be-all, end-all solution of a dominant design.

4. Dominant Design: Given dilemma presented above, it appears that the industry, as it is, has reached a stalemate in which concessions must be made, in the realm of integration, durability, cost, flexibility, usability, and portability in order to offer consumers with the most beneficial Telematics offering. Those OEMs that find the way to provide such concessions most competitively, in terms of consumer demand, stand the best chance for future leadership. Given the noted limitations, and required tradeoffs of benefits, the emerging dominant design is likely to: provide options for consumers to select and choose the products based upon their specific needs. That is, unlike the current availability, where consumers who want a GM vehicle must take the integrated product,

OnStar, and Ford consumers must take the hybrid version, Sync, consumers will instead have choice. Additionally, given the emerging trends, all players will likely benefit from better integration between the vehicle and mobile devices. This dominant design will likely utilize a WPAN connection, such as Bluetooth, to connect to the vehicle as to offer the audio and visual transfer of applications, and will utilize middleware and SaaS delivery such that all applications can be delivered on demand.

5. <u>Consumer Adoption:</u> Should this technology be developed, it will be a "smash hit" among consumers. Given that behavior change, (in terms of SaaS deliver of software, usability, and the use of mobile technology) will be minor, but the payoff for consumers (in terms of performance criteria) will be very high. Given that SaaS based software providers such as Salesforce.com are shaping the way consumers view SaaS delivery of software and data storage, and that iTunes and the iPhone app store is shaping consumers need for constantly advancing applications, consumers will not have to change behavior much to gain acceptance of this method for their Telematics needs. Usability functions will not change, given the slow evolution of this space it is likely that many features will not have changed by then. Finally, the use of the mobile integration will also continue to be shaped by the mobile device providers along with elements and features such as Bluetooth enabled devices. Additionally, the benefits will be great. As they tie to the performance trajectories listed above, consumers stand to gain from increased portability, enhanced usability, and software flexibility.

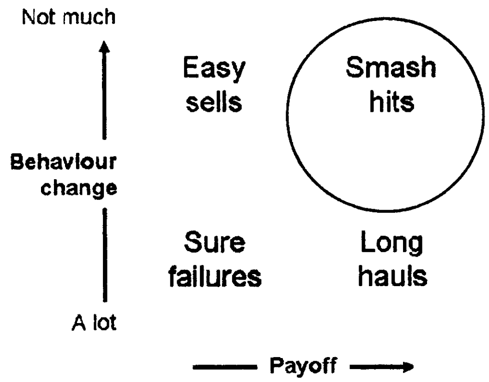
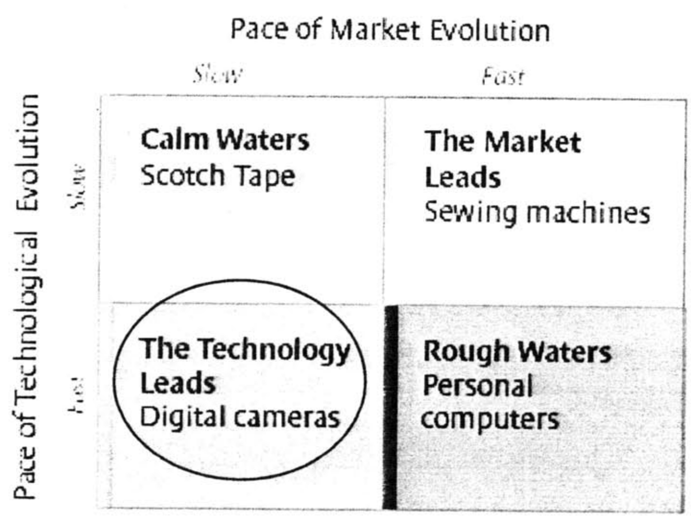


Figure 19. Consumer Adoption Table

6. First mover advantages: As theorized by Suarez and Lanzolla in The Half-Truth of First-Mover Advantage, being first to market can provide competitive advantage in several situations based upon the pace of both technological and market evolution. Suarez and Lanzolla contend that when the pace of technological evolution and market evolution are both slow, a 'Calm Water' situation emerges. In these cases, first movers have the benefit in that later entrants will have difficulty differentiating their products. The slow pace of market growth also tends to favor the first mover by allowing it to identify and adapt to new markets. When situations differ, and the pace of market growth and technological innovation are fast, the first mover is not always advantageous given that jumping too quickly into a technology can risk that a lot of capital is spent developing both the product and the market, and that lasting advantages cannot be held given the high rate of change of the industry and products within them. In the case of automotive Telematics, the pace of market evolution is rather slow, given the limitations of vehicle, while the pace of the technology support the delivery of applications and portability is fast. This leads to a scenario called 'Technology Leads'. In these scenarios, for the long-term, being a first-mover is not-beneficial for both the long-term and the quick-hits. In

the context of Automotive Telematics, the ability to make a "quick hit" with a product is unlikely given the customer impact to the vehicle experience in which they are likely to maintain from 2 to 9 years, and the lifecycle requirements which necessitate in-vehicle technologies often in excess of 3 years. Therefore, first mover advantage is not likely a beneficial move for OEMs to move from current offerings into this market. From a practical standpoint, while benefits to the brand can be made, as is the case with Ford Sync, a failure in this realm could have devastating impact on the brand reputation. For example, if Toyota, often know for its quality and dependability, should embark on a product that soon becomes irrelevant due to technological change, or should be a technical failure, this could have a very negative impact on the brand, thus impacting its core business, vehicle sales.



The Situation Your Company Faces	First-Mover Advantage: Short-Lived	First-Mover Advantage: Durable	Key Resources Required
Calm Waters	**Unlikely** Even if attainable, advantage is not large.	**Very likely** Moving first will almost certainly pay off.	Brand awareness helpful, but resources less crucial here
The Market Leads	**Very likely** Even if you can't dominate the category, you should be able to hold onto your customer base.	**Likely** Make sure you have the resources to address all market segments as they emerge.	Large-scale marketing, distribution, and production capacity
The Technology Leads	**Very unlikely** A fast-changing technology in a slow-growing market is the enemy of short-term gains.	**Unlikely** Fast technological change will give later entrants lots of weapons for attacking you.	Strong R&D and new product development, deep pockets
Rough Waters	**Likely** A quick-in, quick-out strategy may make good sense here, unless your resources are awesome.	**Very unlikely** There's little chance of long-term success, even if you are a good swimmer. These conditions are the worst.	Large-scale marketing, distribution, production, and strong R&D (all at once)

Figure 20- Technology Strategy Table

6.1. Barriers to entry: However, to ensure that a "wait and see" stance wouldn't be potentially devastating to an OEM, it is important we also assess potential barriers to entry. These barriers to entry include marketing prowess, which renders "me too products" less effective given the quality and leadership perception of the respective brand for being first to market. They also include specific barriers to entry as a result of features such as patents.

Brand name and reputation

In terms of brand name associated with in-vehicle Telematics, it is very common that the branding of the Telematics system will follow conventions of the vehicle branding. For example, while we have seen brands such as On-Star emerge, they have always been tied to the GM brand which is notably described as On-Star by GM. Other brands include Lexus Enform, and Ford SYNC. In certain cases where a partner or vendor brings a notable benefit to the product, as will be recognized by consumers, often this brand will be noted in much of the marketing media. A good example of this is Ford SYNC and its ties with Microsoft, a notable brand in the software and technology space. In much of the marketing, and on the brand label, it is clearly noted that Ford SYNC is powered by Microsoft.

Figure 21- Sync Branding Logo (Via Ford Sync Website)

Currently, while a positive image of a Telematics brand may lead to higher consideration for both the Telematics unit and even the vehicle itself, much of the perception of the Telematics brand ties back to the perception of the vehicle brand itself. As stated by a senior GM Sales Executive when questioned in 2005 as to why GM made the decision to place the GM brand next to the On-Star logo: "GM's corporate name has a stronger public image than some of the brands that make up the company." This assessment was re-confirmed by a leading consultant from CSM worldwide.[xxii] However, as Telematics gains scale, and as more and more consumers begin to experience the benefits of Telematics, this may begin to change. Additionally, as OEMs, and aftermarket providers, begin to differentiate themselves in terms of offering, brand can have such an effect as to provide a competitive advantage. The limitation of this brand leadership however will be its ability to expand reach outside its current OEM offerings as rival OEMs will be unlikely to change their proprietary practices. The only way that branding has the chance to fully serve as a competitive advantage is if a brand and product offering is managed by an external vendor that has ties to more than one OEM.

6.2 Inimitability

An additional factor in determining the ability for a first mover to establish barriers to entry is the inimitability of the Telematics products brought to market. Inimitability is a factor based upon the physical uniqueness, the path dependency, causal ambiguity, and the patents surrounding a product. In regards to physical uniqueness, path dependency, and causal ambiguity, from an architectural standpoint there is really nothing that cannot be re-engineered, or any product that has a unique path of history and design, or cannot be designed in such a way that emulators could not provide a similar benefit. Patents, however, can serve as a source of inimitability that can provide lasting benefit. Currently many Telematics providers hold patents and IP protection in the Telematics space, and as standards such as NGTP emerge, OEMs such as Toyota can adopt such technology simply by signing with that vendor for the particular service for which they hold the protection. This trend is also similar to the patents held by middleware and mobile device developers who are also not uniquely tied to individual OEMs, but are moving towards open licensed agreements. Current trends also support this as is demonstrated by Microsoft's current partnership with Hyundai/Kia to offer the same technology it offers Ford in its Sync product.

In summary, many of the barriers to entry will come as the form of patents and other IP protections mainly coming from middleware, application, and mobile device providers. This provides a competitive advantage to OEMs only in the form of establishing key partnerships with these vendors or ensuring compatibility with the market leading devices and applications.

7. Value Capture and Demand Opportunity: As stated by Raynor and Christenson in their article Skate to Where the Will Be, money (or value) is captured in products where the entirety of customer needs are somewhat, but not fully yet met. That is, a standard has not been exceeded, but has been made to be expected, and thus needs have not yet been met. In this case, it will fall to the applications and the mobile devices which will continually evolve and improve much the way personal computers and software do today. For OEMs, the ability to capture value will be limited given the emergence of extreme price competition between OEM competitors on their hardware and residual service offerings. Value capture, in terms of telematics will likely come from the profit it extracts from its provided applications, much like Apple does with its iPhone applications.

Chapter 8- What this means to Toyota Motors

To maintain optimality and flexibility in the ever-changing Telematics landscape, Toyota should look to offer a connected services (or hybrid) model across all of its product lines. This connected services technology would integrate, at a minimum middleware and wireless connectivity that would allow consumers to access usability features of the automobile while having access to the current dominant applications of mobile devices. Doing this would also allow Toyota to avoid the costly infrastructure needed to support the consumers' dynamic expectations in terms of applications, and focus on usability aspects for which competitive advantage can be maintained. This course of action however is not without risk.

Moving to the connected services model can isolate current customers who are happy with the Safety Connect model due to the safety features and full service that it brings. Certain consumers, especially the more affluent consumers have noted, via internal surveys, their satisfaction with these elements. Another concern deals with value capture. Should Toyota move, in full force, to the connected services model, the revenue generated from the residual monthly service fee would also be eliminated, hence impacting profitability from those consumers seeking this treatment.

In terms of benefits, certain consumers will be happy with the lower end-to-end costs of the product. Given that connected services reduces the amount of imbedded components in its architecture, its transactional hardware price ends up at a figure close to $300 rather than the $2,000 price of Safety Connect Hardware. This in turn would reduce the overall transaction price of the vehicle, thus positively affecting vehicle volume.. A summary of such risks, in addition to the benefits are noted in Figure 22.

Option	Features	Benefits	Risks
Connected Services	• Smartphone Integration • Enhanced Apps • Vehicle Integration	• Portability • Cost (no redundancy) • Usability • App Flexibility • Connectivity	• Crash tested durability • Service • Redundancy • Profitability (Service).
Safety Connect	• Usability- Big Screen • SOS Button • Airbag deployment beacon • Interconnectivity with ECU • Large Screen • Full scale service	• Automatic call center support • Crash tested durability • Redundant communication in case of emergency	• Portability (none) • Cost • App flexibility • Lower demand • Higher vehicle price

Figure 22- Risk/Benefit Chart of Connected Service and Safety Connect

Noting the risks of the Connected Services Model, the question then remains if and how Toyota should implement the technology and what to do in terms of its current product offering, Safety Connect. In terms of a total migration to new the new technology, a total migration may have disastrous consequences in terms of customer impact and cost. In regards to the financial impact of a migration, the costs of sunsetting a system can be substantial. For example, Lexus estimates having spent over $800M on the costs of sunsetting the analog system. Costs involved included the retrofitting of consumer vehicles, disposal of legacy assets, and the implementation of processes to locate and communicate with consumers.

Referencing a recent OEM survey, the best course of action, however may be model (and thus customer) specific. When asked about their willingness to pay a premium and monthly fee for full-service support, consumers who purchased vehicles at a high transaction price, $30k plus, seemed very favorable for such service. These consumers also averaged at age brackets over 45, and often had families. The younger the average age of the buyer, and the lower the price paid for the vehicle, the lower the demand for call center support. For example, only 70% of Chevy Cobalt drivers (an entry-level vehicle) sought call center support. Contrasting this to the Lexus LX vehicle, a vehicle priced at roughly $80,000 which tends to have an older buyer base, roughly 100% of those surveyed sought call center support. Using these results, it is encouraging, that a model based approach will be more successful, and help to avoid costly migration fees as was the case with Lexus Link. Specifically Toyota should integrate connected services in models that are lower priced, such as the entry level Toyota and Scion products.

However, on the high-end Toyota and Lexus areas, a joint approach should be taken. This approach would adhere to the findings of the conducted research, concerning demand, and would also prevent conversion costs of sunsetting a legacy system.

When looking to offer redundant services, (e.g. connected services on top of Safety Connect) however, it is very important that the benefits of redundancy be clearly communicated and studied, and once again targeted towards customers who are not price sensitive. For example, in the case where connected services and safety connect be offered, it would be prudent to communicate the added safety features the redundancy provides (e.g. a dual call is made on multiple networks should you be in an accident in a remote area.

In terms of timing, a fast follower role still remains the most optimal role for Toyota to take given the slow market dynamic with the quick pace of technological innovation that defines this space. While the connected services model is somewhat revolutionary in terms of its technology deployment however, Ford Sync offers many of the same functionalities and user experiences and has already earned huge success in this market. For this reason, the timing is rite for Toyota's launch into this product in the current market climate as certain consumers are already demanding this type of product.

In regards to future development, it important that Toyota maintain its awareness of developments in the protocol space as doing so will improve the flexibility offered to them from a TSP perspective. Also, research should consistently be done on their partners, such as ATX, to determine if their current service levels and pricing are optimal given potential emergence of alternative providers. Additionally, improvements in the wireless space, specifically in the WPAN and WWAN areas will also determine connectivity abilities thus helping to shape what is possible for the consumer experience. Doing so will allow forward thinking in terms of technologies as to assess future possibilities and markets.

Finally, in terms of value capture, it is important that Toyota extract as much off the applications as possible, when offering connected services alone. Following an industry standard, as set by Apple, Toyota should seek to earn 30% of the sale per application. This is a result of the fact that due to price competition in the OEM Telematics space, value capture will not occur in the OEM controlled product area. Setting the precedent early, with the application developers, could increase overall profitability for Toyota Motors.

Chapter 9-Summary and Conclusions

In summary, due to the emergence of smartphones, and the wireless infrastructure, and software delivery mechanisms and ecosystems that support them, the Telematics industry is now in a state of disruption. As a result, players in this potentially profitable market (both from a direct sales aspect in addition to a vehicle branding aspect), are now seeking to establish the dominant design of tomorrow. While the smartphone does offer the benefits of portability, cost efficiency, and application flexibility, it is limited in terms of durability, usability, and vehicle integration when compared to the in-vehicle telematics unit. While the OnStar method served as the previous leading design, many players, such as Ford have abandoned this model in favor of a hybrid model that integrates the benefits of smartphones with the usability and integration of the in-vehicle option. This product, while a step in a more integrated direction, is not without its limitations in that it sacrifices cost leadership and certain integration benefits when compared to other available options.

While currently a player in the integrated in-vehicle solution, given the apparent benefits of a connected services model (one where mobile devices can connect to the usability features of the vehicle), Toyota should integrate connected services into its portfolio of Telematics offerings, and tie this product into certain model line-ups. Most likely, due to cost considerations, and desire for leading applications, this product should be available in cars that attract the more youthful buyer and cost conscious consumer. However, given that consumers in higher end vehicles reported to liking the full scale service, it is recommend that in the high-level luxury vehicles, such as in Lexus, the current full-scale offering (Safety Connect) be supplemented with a connected services model that provides the best of both worlds. Toyota need not be a first-mover into this area, but should ensure that they spend the time to build a quality product. This includes the building of strong partnerships with middleware providers, pushing their Tier1 vendors to maintain flexibility, and conduct ample testing. Should this be done, Toyota is likely to have a smash hit product which is poised to take advantage of a growing and profitable market.

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