

**A STUDY IN PRODUCT-SERVICE SYSTEMS STRATEGIES**

by

Mark D. Moran

Bachelor of Science in General Engineering  
University of Illinois College of Engineering, 1993

Master of Business Administration  
University of Iowa Tippie College of Business, 2003

Submitted to the System Design and Management Program in Partial Fulfillment of the Requirements  
for the Degree of

Master of Science in Engineering and Management  
at the  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

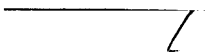
June 2011

[February 2011]

© 2011 Mark Moran. All rights reserved.

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic  
copies of this thesis document, in whole or in part in any medium now known or hereafter created.

Signature of Author: \_\_\_\_\_



\_\_\_\_\_

Mark Moran  
System Design and Management Fellow  
January 5, 2011

Certified by: \_\_\_\_\_



Michael Cusumano, Thesis Advisor  
Sloan Management Review Distinguished Professor of Management



Accepted by: \_\_\_\_\_



Pat Hale  
Director, System Design and Management Program

*This page intentionally left blank*

# Abstract

---

Title: A Study in Product-Service Systems Strategies

Author: Mark D. Moran

Submission: Submitted to the System Design and Management Program in partial fulfillment of the requirements for the degree of Master of Science in Engineering and Management at the Massachusetts Institute of Technology.

Abstract: What are examples of successful companies innovating in services to create Product-Service Systems that can command a price that exceeds the cost of capital and enhance, protect, or replace the core products?

After a brief literature review and discussion of the challenges of classifying and defining services and how they are related to products, this thesis provides a series of brief case studies looking at how companies construct a services strategy that complements, strengthens, or replaces their product strategy. Service-centric offerings are categorized into three primary types: product-based (e.g. customization or repair), information-based (e.g. telematics), and value-based (e.g. financing, leasing, or utilities). The thesis focuses on positive examples, but some negative examples are also presented. Summary conclusions on the nature and elements of successful product-services strategy are also presented.

Primary research tools are corporate annual reports, SEC 10-K (and other) filings, corporate websites, the Internet, and business research tools like Orvis, Hoovers, and Lexis-Nexis. The thesis studies mainly (but not exclusively) publically traded US-based companies with a strong emphasis on the automotive, heavy machinery, and information technology sectors.

Thesis Advisor: Professor Michael Cusumano  
Sloan Management Review Distinguished Professor of Management

Keywords: services, product-service strategy, product-service system, innovation, platforms, service innovation, telematics, cloud computing

*This page intentionally left blank*



# Acknowledgements

---

Nothing can survive in a vacuum. No one can exist all alone.

- Neil Peart, *"Turn the Page"*

Iron sharpens iron, and one person sharpens the wits of another.

- *Proverbs 27:17, NRSV*

As a part of the MIT SDM cohort of 2009, I am humbled and enriched by the talents and experiences of my colleagues. I have never been as overwhelmed and intimidated as I was on January 5, 2009 starting the SDM "boot camp" when we all gave our brief bio's in 51-325. My interactions with my neighbors-in-time from the 2008 and 2010 cohorts show them to be equally impressive groups. I had been told by a number of work colleagues in other executive advanced education programs that the network of relationships you develop may be the most valuable asset of those programs. The same is true here.

I am thankful for the chance to learn from so many gifted and committed professors as well. Before my experiences as a part of MIT, I believed that undergraduate- or graduate-level education was about either application or theory. MIT sets the very high standard that it can and should be both. *Mens et manus*, indeed. I am especially thankful for the guidance of my thesis advisor, Professor Michael Cusumano. His unique combination of research interests could not have lined up better with my thesis interests and his leadership style meshes well with my needs and work style. I have also been especially impacted by the opportunities to study under Professors Oli de Weck, James Utterback, and Deborah Nightingale in my coursework. They embody not "just" the brilliance and technical excellence you expect at a place like MIT, but it is clear that they also care deeply about their students and are called to teach.

To the SDM program and the Institute itself, I am indebted because they have chosen to accept the mantle of leadership in education, not just leading in content and pedagogy, but in delivery as well. A school of MIT's caliber simply does not have to make a distance-learning option available, but they do and that made it possible for me to be a part of this transformational experience. Thanks especially to Pat Hale, the SDM Program Director; and Bill Foley, who so often acts as hands and feet for those of us at a distance. The distance experience is different than on-campus, but it is never treated as less.

I am aware of few (if any) employers that support continuing education and a culture of learning to the level of Deere & Company, my employer. This is the second masters degree for which they have supported me by investing both money and time. That gift of time comes in two forms: managers allowing me focus for my studies (four over the course of this degree program: Mano Mannoochahr, Alan Tillman, Jason Brantley, and Glenn Baker) and colleagues picking up the slack while I do (my team: Heather Hayes, Jeff Knutsen, Mike Mrozowicz, and Steve Nash).

As a part of Deere's commitment to employee development, I was also given a mentor, Howard Gerwin (MIT SDM 1998), who went through this degree program while at Ford before coming to Deere. Howard

has been a great sounding board and voice of reason not just regarding the degree program but also my professional development within Deere.

As I reflect back over the last couple of years, I also think of my good friend and running partner, Bill Minard, who did lots of listening when I needed it, and kept reminding me that this journey was much like a marathon itself, and that it too required a cycle of conditioning and rest. Bill has also encouraged me as I have made choices about time management in order to “cross the line” for the degree and for the thesis.

I am also thankful for my “twin brother”, friend, and mentor, John Cochran, with whom I have shared most Friday morning breakfasts over the last five years. John and I journey together through all the tough stuff of life and keep stretching each other to be better students, better leaders, better fathers, better husbands, and better men of Faith.

Some of the most peaceful time my family has had together in the last two years was a result of the hospitality of our good friends, Jim & Melissa Sears, who shared their cabin with us in Northern Minnesota a total of three times over the course of this degree program. I took my last class for the degree program and wrote the last words of this thesis both while staying at “Hilltop” on the shore of Deer Lake. I only regret that MIT would not accept the thesis topic, “The Wonder that Is Jim Sears” as Jim had proposed...numerous times.

While all of those factors have been necessary, they are not sufficient for my success. I am blessed with the most patient, loving, grace-giving, and supportive wife I could imagine. Without Lori’s un-yielding support of my need to stretch myself, and un-questioning belief that I am capable of the task at hand, I could not endeavor on a journey like this. Time is not a renewable resource, and in our family it is treated as a communal asset. Lori was exceptionally gracious about allowing me a massively disproportionate amount of time over the last two years to pursue this degree and work through this thesis. That is to say nothing of the practical implications on the family that were left for her to manage as a result of me spending about a fifth of my time during this two-year period living over a thousand miles from our Illinois home.

Lori, the girls, and I have also been exceptionally blessed – throughout these last two years and our entire marriage – by the support of our parents: Gary & Connie Moran, and Vern & Shirley Winter. We lost my dad in 2006, and I know he would be proud of this accomplishment.

My deepest thanks and love also goes to my beautiful daughters, Grace and Rose, who always understood when I needed to give time and attention to school and have cheered for me all the way through.

Mark Moran

January, 2011, Rock Island, Illinois

# About the Author

---

Mark Moran joined Deere & Company in 1998 as an IT Infrastructure Analyst and spent his first nine years in a variety of roles of increasing managerial responsibility and technical complexity as a part of Deere's data center operations. Those roles included expanding Deere's enterprise Windows NT and UNIX environments, leading the build-out of Deere's Internet infrastructure, introducing Linux to the corporate data center, acting as a part of the core technical team for a redundant data center, and managing the capacity planning & performance team.

In 2007, Mark joined Deere's Enterprise IT Architecture team where he focused on evaluating alternative hosting strategies like Cloud Computing, and led efforts to leverage Auto-ID technologies in Deere's factories, on their products, and at their dealers. In 2009, Mark joined the Enterprise Advanced Marketing team at Deere's Moline Technology Innovation Center to continue his work with Auto-ID, focusing on developing the business case and transitioning the technologies into Deere's global operations. In 2010, Mark accepted the newly created role of Manager, Tracking Systems to lead Deere's Auto-ID implementation from suppliers to customers, across all operating divisions, and around the globe.

Prior to joining Deere & Company, Mark was a civil engineer focused on airport construction.

Mark holds a BS in General Engineering from the University of Illinois College of Engineering, and an MBA from the University of Iowa Tippie College of Business. This thesis completes the requirements for an SM in System Design and Management, granted jointly by MIT's Engineering Systems Division and the MIT Sloan School of Management.

Mark and his wife Lori (of 17 years at the time of writing) live in their hometown – Rock Island, Illinois – with their daughters Grace and Rose, and their three dogs.

*This page intentionally left blank*

# Table of Contents

---

Abstract .....	3
Acknowledgements .....	5
About the Author .....	7
Table of Contents .....	9
Table of Figures .....	13
Table of Tables .....	15
Introduction .....	17
How the Product-Service Systems Will Be Analyzed .....	17
A Few Disclaimers, of Sorts .....	18
Chapter 1 – What Are “Services”? .....	19
1.1 - The Importance of Services .....	19
1.1.1 – Why Do Companies Care About Services?.....	20
1.2 – Economic Classification of Services.....	21
1.3 – A False Dichotomy.....	23
1.4 – A Porous Boundary, a Swinging Pendulum .....	24
1.5 – The Data-Information-Knowledge-Wisdom Hierarchy .....	26
1.6 – Service-Centric Elements of Product-Service Systems.....	27
1.6.1 – Product-Based Services .....	28
1.6.2 – Information-Based Services .....	29
1.6.3 – Value-Based Services.....	29
1.6.4 – Energy-Based Services.....	30
1.6.5 – Hybrid Product-Service Systems .....	30
Chapter 2 – Product-Based Services.....	31
2.1 – Differentiating Product-Based Services.....	31
2.2 – Product-Based Services ≠Physical Services .....	32
2.2.1 – Efficient Delivery: Video Rental: Redbox, Netflix, and Blockbuster .....	33
2.2.2 – Efficient Encoding.....	34
2.2.2.1 – The Changing Face of Books.....	34
2.2.2.2 – Products beyond Media.....	36

2.2.3 – The Changing Nature of Product Complexity .....	37
2.2.3.1 – Managing Product Complexity by Integrating the Languages of Design and Manufacturing .....	37
2.2.3.2 – Pushing Differentiation as Close to the Customer as Possible, and Changing Complexity .....	37
2.2.4 – Trust and Relationships .....	39
2.2.4.1 – Web-Based Recommendation Agents .....	39
2.2.5 – Experiential Retail .....	39
2.2.5.1 – Impact of Music .....	40
2.2.5.2 – Smell .....	40
2.2.5.3 – Touch .....	40
2.2.5.4 – The Store Itself .....	40
2.2.5.5 – Adding Them Together .....	40
2.3 – What Is All of This Doing to Product-Based Services? .....	41
2.4 – Best Buy .....	44
2.4.1 – Highly Integrated Multi-Channel Service Delivery .....	44
2.4.2 – Experiential Retail .....	44
2.4.3 – Geek Squad and Other Product-Based Service Elements .....	44
2.4.4 – Blurring the Lines the Other Direction .....	45
2.4.5 – Leveraging Complexity .....	45
2.4.6 – Best Buy Is Doing the Right Things. Is It Working? .....	45
2.5 – Tying It Together: Trends in Consumer-Oriented Product-Based Services .....	47
2.6 – Some Other Important Examples – Beyond Consumers and Retail .....	51
2.6.1 – John Deere .....	52
2.6.1.1 – John Deere Construction and Nortrax .....	52
2.6.1.2 – John Deere Landscapes and LESCO .....	52
2.6.2 – IBM Global Services .....	53
2.6.3 – GE .....	54
2.7 – Tying It Together: Generating Measurable Value from Knowledge through Product-Based Services .....	54
Chapter 3 – Information-Based Services .....	57
3.1 – Defining Telematics .....	57

3.1.1 – A Simple Taxonomy .....	58
3.2 – A Tale of Two Systems: Ford SYNC and GM OnStar .....	62
3.2.1 – A Brief History of GM’s OnStar.....	63
3.2.2 – Is OnStar Profitable?.....	64
3.2.3 – A Brief History of Ford’s SYNC.....	65
3.2.4 – Ford’s Related Offerings .....	66
3.2.5 – Total Sales .....	67
3.2.6 – Why Such Different Approaches? .....	67
3.2.6.1 – Different Architectures .....	67
3.2.6.2 – Different Times.....	68
3.2.7 – How Do We Interpret the Industry?.....	70
3.2.8 – GM OnStar & Ford SYNC – Some Observations and Conclusions .....	72
3.3 – Construction Equipment Telematics.....	74
3.3.1 – About the United States Construction Equipment Industry.....	74
3.3.1 – About Caterpillar & Trimble.....	75
3.3.3 – Caterpillar’s Telematics .....	75
3.3.4 – John Deere’s Telematics .....	76
3.3.5 – Comparing the Approaches of Caterpillar and John Deere .....	76
3.3.6 – Some Observations about Caterpillar Product Link and John Deere JDLINK.....	80
3.4 – Agricultural Equipment Telematics.....	81
3.4.1 – The United States Agricultural Industry .....	81
3.4.2 – Analysis.....	83
3.4.3 – Putting Some Numbers to It .....	85
3.5 – Tying It Together .....	86
3.6 – Telematics Systems as Platforms .....	89
Chapter 4 – Value-Based Services .....	90
4.1 – Value-Based Services – a Framework.....	90
4.2 – The Product-Service Spectrum of Cars for Value-Based Services.....	91
4.2.1 – Cash Purchase .....	91
4.2.2 – New Car – Warranty & Finance.....	92
4.2.3 – Car Lease.....	92
4.2.4 – Car Rental .....	92

4.2.5 – Car Sharing .....	92
4.2.6 – Taxi .....	93
4.2.7 – Subway .....	93
4.3 – Product-Service Spectrum in Different Language.....	93
4.4 – Financial Services in the Heavy Equipment Industry .....	94
4.5 – IBM Pay as You Drive (PAYD) .....	96
4.6 – Rolls Royce TotalCare .....	97
4.7 – Bombardier FlexJet .....	99
4.8 – Microsoft: Cloud on the Horizon, Storm Brewing Ahead.....	99
4.9 – Tying It Together .....	104
Chapter 5 – Conclusions .....	105
5.1 – A Brief Review.....	105
5.2 – The Problem with Products .....	107
5.2.1 – Linux .....	107
5.2.2 –787 Dreamliner .....	108
5.2.3 – Products Are Not Enough .....	108
5.3 – How Then to Approach Services? .....	108
Question 1: How Involved Does a Company Want to Be in the Services that Surround their Products? .....	109
Question 2: If You Are Investing in Services, How Deeply Do You Invest? .....	110
Question 3: How to Package the Product-Service System.....	111
5.4 – For Further Study .....	112
A Rigorous Definition and Consistent Classification .....	113
D-I-K-W for Services.....	113
Services and the Double Helix.....	113
Product-Based Services: Logistics as a Competitive Advantage.....	113
Advanced Products and Services in Mature Product Markets.....	113
Appendix A – Selected Company Backgrounds.....	114
Index of Companies, Products & Services .....	120
Works Cited.....	122



# Table of Figures

---

Figure 1: The Growth of Services in the US Economy, 1899-2001 (Bryson and Daniels, 2007).....	19
Figure 2: Distribution of Economies between Agriculture, Manufacturing, and Services for Economies of Difference Development Levels (Soubbotina and Sheram, 2000) .....	20
Figure 3: From Commodities to Experiences (adapted from Pine and Gilmore, 1998) .....	23
Figure 4: Three Types of Restaurants. Source: Teboul, “Service Is Front Stage”, 2006, Palgrave Macmillan. Reproduced with permission of Palgrave Macmillan.....	24
Figure 5: Product-Based Services for a Product-Service-System .....	31
Figure 6: Comparing the flow of Information Before and After STEP-NC .....	37
Figure 7: The Agile Supply Chain (Christopher, 2000) .....	38
Figure 8: Best Buy, the S&P 500, and S&P Retailing Group Over 5 Years.....	46
Figure 9: Price-Experience Curve, Part I .....	48
Figure 10: Price-Experience Curve, Part II .....	49
Figure 11: Price-Experience Curve, Part III .....	49
Figure 12: Price-Experience Curve, Part IV .....	50
Figure 13: Price-Experience Curve, Part V .....	51
Figure 14: D-I-K-W transmission in traditional organizations.....	55
Figure 15: D-I-K-W transmission in a company like GE .....	55
Figure 16: Goals of Vehicle Telematics Systems .....	58
Figure 17: Comparing the Needs Met by GM OnStar and Ford SYNC.....	61
Figure 18: Comparing the Knowledge Domains Used by GM OnStar and Ford SYNC.....	62
Figure 19: Comparing a Standards-based and Commercial OS Telematics Architecture (Baughey, 2007) .....	67
Figure 20: The 2006 competitive landscape for Automotive Telematics Systems, for Smart phones.....	68
Figure 21: Scientific and Academic Publications about Vehicle Telematics, by Year.....	71
Figure 22: Dominant Design and the Migration of Resources .....	72
Figure 23: US Construction Spending by year and sector. Source: Standard & Poor’s .....	74
Figure 24: Comparing the Needs Met by Caterpillar Product Link and John Deere JDLink.....	79
Figure 25: Comparing the Knowledge Domains Used by Caterpillar Product Link and John Deere JDLink .....	79
Figure 26: Positioning Telematics in a Company's Capability Chain for Passenger Cars and Construction .....	80
Figure 27: US Corn Revenue, 1998-2009 .....	82
Figure 28: US Average Corn Grain Yields, 1863-2002.....	82
Figure 29: Positioning Telematics in a Company's Capability Chain for Cars, Ag, and Construction .....	84
Figure 30: CNH Ag vs. Trimble Field Solutions Operating Profit % 2005-2009 .....	86
Figure 31: CNH & Cat Construction vs. Trimble Constr. & Eng. Operating Profit % 2005 - 2009.....	88
Figure 32: Comparing Total Market Returns for Caterpillar and Trimble.....	88
Figure 33: Value-based Services in terms of a passenger car .....	91
Figure 34: Various Expressions/Languages of the Servitization of Products .....	94
Figure 35: Comparing Operating Profit of Equipment to Financing for Cat and Deere 2003-2009 .....	96
Figure 36: How D-I-K-W Flow at Companies like GE: Use Services to Enhance Products .....	98

Figure 37: The Product-Service continuum for Passenger Cars and Computers .....	101
Figure 38: Comparing Operating Profit of Microsoft and Salesforce.com 2006-2010.....	103
Figure 39: Four approaches to the Product-Service Relationship.....	110
Figure 40: Four Levels of Product-Services Integration.....	111
Figure 41: How to Structure the Financial Transaction - All Product to All Service .....	112

# Table of Tables

---

Table 1: D-I-K-W Hierarchy .....	26
Table 2: Types of Complex Systems (de Weck and Magee, 2004) .....	28
Table 3: Summarizing the Impact of Trends on Brick-and-Mortar-Based Service Delivery - Negatives ....	42
Table 4: Summarizing the Impact of Trends on Brick-and-Mortar-Based Service Delivery - Positives .....	43
Table 5: 2009 Performance of IBM Divisions.....	53
Table 6: Characterizing the Needs Met and Knowledge Domains Used by GM OnStar and Ford SYNC....	60
Table 7: Spotty OnStar Statistics .....	64
Table 8: Inferring Some 2010 Statistics for OnStar .....	64
Table 9: Potential 2010 Profitability for OnStar .....	65
Table 10: Summary Comparison of GM OnStar and Ford SYNC .....	66
Table 11: Caterpillar Product Link Product Attributes .....	77
Table 12: John Deere JDLink Product Attributes.....	78
Table 13: Comparing Caterpillar Product Link and John Deere JDLink Business Model .....	80
Table 14: Estimated 2010 US Crop Revenues .....	81
Table 15: Elements of Major Precision Agriculture Systems .....	84
Table 16: Comparing Trimble and CNH Ag Operating Profit 2005 2009 .....	86
Table 17: Comparing Trimble, CNH Construction, and Cat Equipment Operating Profit 2005 - 2009 .....	87
Table 18: Comparing Cat and Deere Equipment Sales and Financing Operating Profit 2005 - 2009 .....	95
Table 19: Comparing Microsoft and Salesforce.com Operating Profit 2005 - 2009 .....	103
Table 20: Microsoft vs. the World in the Cloud .....	104

*This page intentionally left blank*

# Introduction

---

What are examples of successful companies innovating in services to create product-service systems that can command a price that exceeds the cost of capital and enhance, protect, or replace the core products? Why should product-centric companies care about services? What happens when they don't? This thesis attempts to wrestle with those questions.

After a brief literature review and discussion of the challenges of classifying and defining services and how they are related to products in Chapter 1, this thesis provides a series of brief case studies looking at how companies construct a services strategy that complements, strengthens, or replaces their product strategy. For this thesis, service-centric offerings are categorized into three primary types. Those three types represent the main chapters of the thesis:

- Chapter 2: Product-based services (e.g. retail sale, customization or repair). These are in many ways what we would think of as the “classic” services. They tend to require lots of product knowledge and their delivery has been traditionally more tied to the location of the product, although – as we will see – that seems to be changing.
- Chapter 3: Information-based services. Here, we focus on telematics in the passenger car and heavy equipment industries and see the tension in opposing business models: integrate the service capabilities and move more slowly, or partner to move quickly but risk giving away the future.
- Chapter 4: Value-based services (e.g. financing, leasing, or utilities). We look briefly at financial services and then show some examples of more advanced forms where the product disappears and the service for which we originally wanted the product is what we see (and pay for).

A brief review and summary conclusions on the nature and elements of successful product-services strategy are presented in Chapter 5.

## **How the Product-Service Systems Will Be Analyzed**

This thesis primarily looks at publically traded, US-based companies. In some cases, the product provider's entire value chain will be reviewed (e.g. independent dealer networks or service organizations) but the primary focus is the product-centric companies themselves. Companies will be studied by reviewing annual reports to shareholders, reviewing 10-K (and other) reports filed with the Securities and Exchange Commission, using corporate websites, using the Internet, and using business research tools like Hoovers, Orvis, and Lexis-Nexis.

The tools used with each case will vary. By their heterogeneous nature and the immaturity of Service Sciences, there is (yet) no standard way to analyze, describe, and discuss services.

## **A Few Disclaimers, of Sorts**

While Deere is my employer, no John Deere-proprietary sources were used in the preparation of this thesis. All information, including that which is about or related to John Deere or its competitors throughout this thesis is from either publically available sources or sources available to the MIT community.

In general, I have tried to stay clear of companies like Apple and other companies where their story is well documented and the topic of popular discussion, not because they are not interesting or relevant, but because it is tough to say something new. As an illustration, iTunes is an exceptional example of a product-service system that provides value for the whole platform. It elevates the value of the core product, it allows Apple to make money off of competitive products, and generates incremental services revenues through an automated system...everything you could want in a product-service platform, but that notion is very well discussed elsewhere.

In some cases, there is a good deal of “set up” involved to explain the proper context on why what a company is doing is interesting (e.g. Best Buy in Chapter 2). In others, practically none at all. That makes the overall flow of the thesis a bit lumpy and uneven. I have tried to use appendices footnotes and rigorous editing to help with that, but the end result is still not as neat as I would like. For what ends up being an overall lack of cadence and rhythm to the thesis, I ask for your patience.

In a related notion, how to handle background information on the companies mentioned throughout this paper was a challenge. For different readers, different companies will be familiar. The organizational approach, based on types of services instead of companies or industries, which allows companies to appear in more than one place exacerbated that problem as well. After going back and forth, I settled on placing background information into an appendix (Appendix A) where I put some basic vital statistics and then a little bit of commentary on the companies. None of the companies in the paper are too esoteric, so I am hoping it will not be a problem for the flow of the main body of the thesis. I have also included an Index of Companies, Products, and Services that lists each time that a company or a product is mentioned.

Also, some theses come down to one big idea and take a very scientific approach to proving that single, idea. That is not this thesis. This thesis is best thought of as a series of case studies of varying length collected around some major themes. As Services Science evolves, more cohesive treatments will be possible. I would be pleased if this thesis contributes to that evolution in some small way.

# Chapter 1 – What Are “Services”?

Classifying and defining services is tricky. Most of our ideas and systems around accounting and economics are pretty closed tied to things we can count easily, and since services usually don't fit into that notion, they tend to be under-represented, under-measured, and under-understood by corporations and governments. This chapter will try to provide a little bit of background on that subject as well as propose some ideas on how to get past those limitations. This chapter will present a useful definition for services as they relate to products (which they always do) and present a simple taxonomy for services that will act as the framework for the rest of the thesis as well.

## 1.1 - The Importance of Services

In developed economies, economists observe that services often account for 75% or greater of the economy (Bryson et al., 2004). Figure 1 and Figure 2 below both show the trend that as economies develop, the service sector becomes more and more significant. Additionally, in developed economies like the US, practically all new job creation is service-based, as nine out of 10 new jobs are classified as services (Bryson and Daniels, 2007).

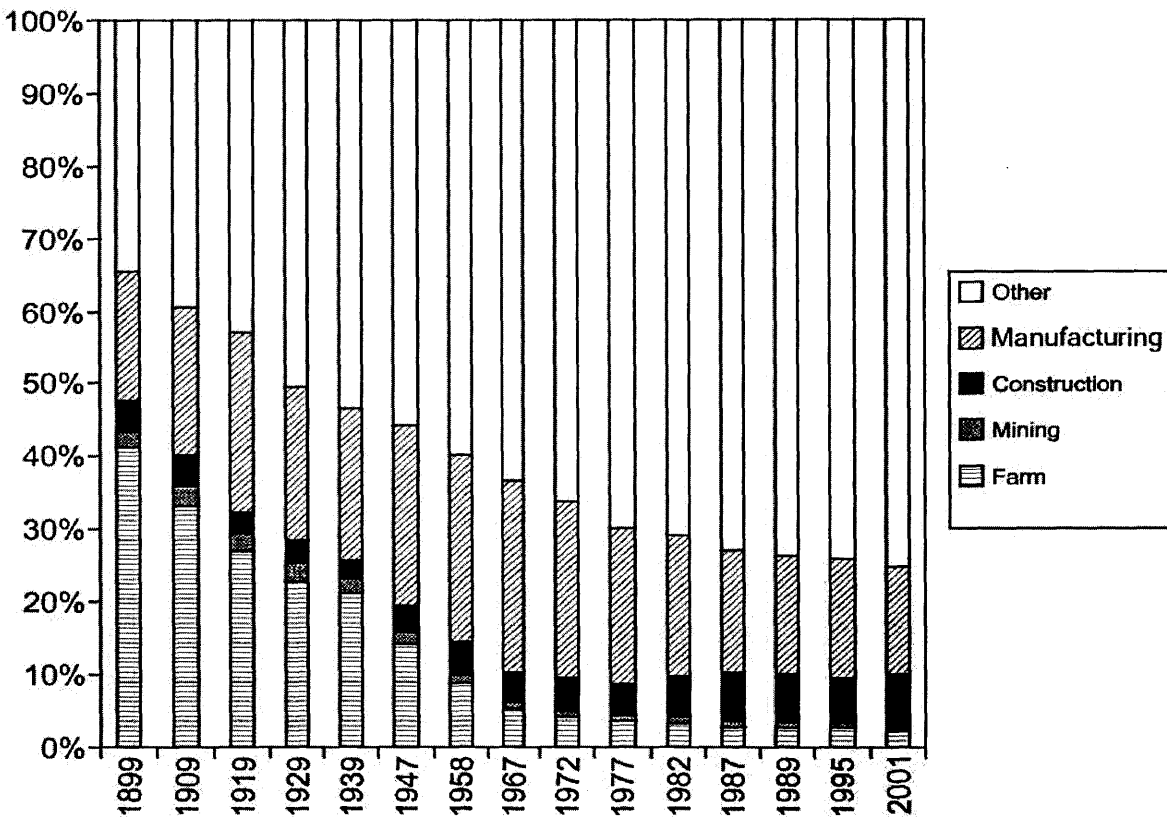


Figure 1: The Growth of Services in the US Economy, 1899-2001 (Bryson and Daniels, 2007)

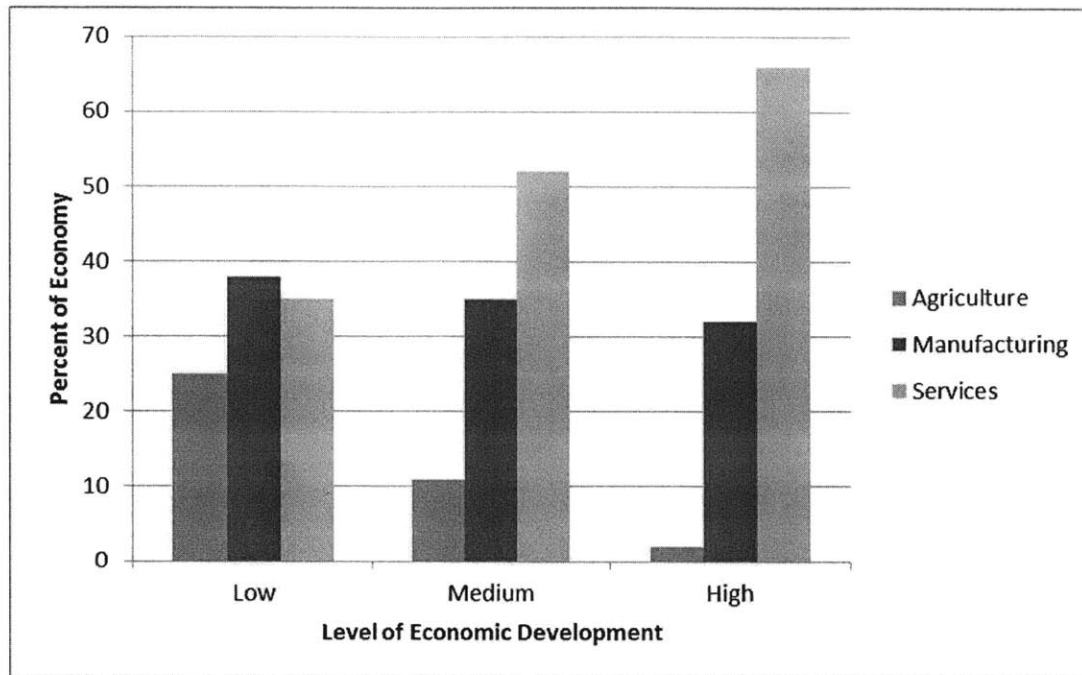


Figure 2: Distribution of Economies between Agriculture, Manufacturing, and Services for Economies of Difference Development Levels (Soubbotina and Sheram, 2000)

Perhaps even more significantly, on a global scale, the “2007 International Labor Organization reports that for the first time in history, employment in services (40%) exceeds agriculture (39.4%) and manufacturing (20.7%)” (Tang and Zhou, 2009).

For some large companies like GM and Ford, the majority – if not the entirety – of their profits in even their healthiest of recent years have come from activities generally thought of as services like loans and leasing (Cusumano et al., 2008).

There are at least three reasons why product companies should care about services (Oliva and Kallenberg, 2003):

- Economic benefits: service can generate long, stable revenue streams that may be of a higher margin than the products they complement (or replace).
- Customers demand it as a result of more complex products and more focused companies.
- Services can be harder to duplicate and may therefore create a more sustainable competitive advantage than products alone.

### 1.1.1 – Why Do Companies Care About Services?

Many authors observe that as a product company matures, it may more naturally look to services (Cusumano et al., 2008; Oliva and Kallenberg, 2003; Potts, 1988). In mature markets, products have often devolved into a commodity status and their low margin may make services more attractive. In other cases, even new companies and industries may need service capabilities to deploy (retail and installation) or finance products.



Additionally, services are also more difficult than products for competitors – existing or would-be – to reverse-engineer and copy. When Toyota and Nissan started manufacturing cars, they bought American cars, tore them apart, and made their first products very similar to those (Cusumano, 2010). The perishable, intangible, heterogeneous nature makes that much more difficult to do with services. It is easy to put a micrometer to an engine and measure it. It is tough to put it to a process. As products move toward commodity status and can only attract the cost of capital, more complex, less externally measurable offerings in the market can be a source of at least survival and at best advantage.

In all cases, whatever the reason, there is a clear link between products and services. As such, it is reasonable – perhaps important – for a product-centric company to develop and execute a strategic approach to services. Otherwise, the plight of the American auto companies seems likely, where the core products may actually lose money and the only thing profitable is the services.

## 1.2 – Economic Classification of Services

What are services in an economic sense? How do we classify them? While all agree that when totaled, they represent the majority of developed economies, and have for decades, there is no consensus of what “they” are. Colloquially, services have been thought of as “you can buy them or sell them, but you cannot drop them on your feet.” (Bryson and Daniels, 2007) While that is a useful heuristic, it is not adequate for definition or classification<sup>1</sup>.

Economists traditionally speak of the economy as consisting of three sectors (Bryson and Daniels, 2007):

- primary (extraction – producing goods directly from raw materials)
- secondary (manufacturing – modification of material goods)
- tertiary (everything else)

As the tertiary sector, services are relegated to “what’s left” and identified not by what they are, but instead by what they are not. This definitional challenge goes all the way back to the founder of modern economic thought, Adam Smith<sup>2</sup>. In “Wealth of Nations,” Book II, Chapter 3, he says the following (Smith, 2004 - Original Publication 1776):

The labor of some of the most respectable orders in society is like that of menial servants, unproductive of any value, and does not fix or realize itself in any vendible commodity which ensures after that labor is past. In the same class must be ranked both of the gravest and most important, and some of the most frivolous professions: churchmen, lawyers, physicians, men of letters, players, buffoons, musicians, opera singers, and so on.

It seems that since Smith forward, services have just been the “other stuff” of the economy and because of its “unproductive” nature they were deemed as not worth measuring. As early as 1952, the

---

<sup>1</sup>While the citations to the original sources are accurate and complete, it is also important to note that this section relies heavily on the histories outlined in chapters 2 and 3 of Bryson & Daniels “The Handbook of Service Industries.” For a more comprehensive treatment on this subject, please see that book.

<sup>2</sup> Several authors observe that the view goes all the way back to Adam Smith. Bryson & Daniels are among them.

Economist Allan G.B. Fisher documents the limitations of the primary/secondary/tertiary definitions and how they came to be and be accepted. Fisher indicates that their original purpose was more about how economies grew than to indicate hard boundaries for rigorous classification. Fisher describes their development in the following manner (Fisher, 1952):

World economic history, it was accordingly suggested in 1933 might be conveniently, if roughly, sketched in three stages. After the primary and secondary stages, where effort was concentrated first mainly on agricultural and pastoral and similar occupations, and then on manufacturing production and the activities associated therewith, the richer economies emerged into a tertiary stage, where it was possible to divert an increasing proportion of human time and effort and of capital equipment into the production of goods and services which are not in the ordinary sense of the words to be included in either of the categories of primary or of secondary production, namely, facilities for travel, amusements of various kinds, personal and intangible services, flowers, music, art, literature, science, philosophy, and the like.

Since Fisher forward, there have been numerous efforts to improve and refine this classification system, none of which have really “stuck.”

But as is often the case, good is the enemy of great, and the “good enough” boundaries of primary, secondary, and tertiary have just stuck, and with each passing decade the inertia of long-term economic statistics makes them more entrenched.

Fisher’s evolutionary view of economics can also be told in terms of a birthday cake (Pine and Gilmore, 1998):

- 100 years ago, a cake for a birthday was a collection of ingredients – commodities – that were purchased by middle-class families for what would be a few dimes in today’s costs.
- 50 years ago, a boxed mix – a product – costing five-to-ten times that of the raw materials – would have been bought by that same middle class family to celebrate a birthday.
- 25 years ago, a middle-class family would have gone to the bakery – a service – for the same birthday cake, paying again five-to-ten times as much.
- Today, that same middle-class family might go to Chuck E. Cheese<sup>3</sup>, Monkey Joes<sup>4</sup>, or other regional equivalents for a birthday “experience” at again five-to-ten times the cost, and the cake may be thrown in for “free.”

That evolution of the birthday cake is an excellent metaphor for the relationships between the primary (materials), secondary (goods), and tertiary (services) economy. It can be portrayed graphically as in Figure 3.

---

<sup>3</sup> See <http://www.chuckecheese.com/> for more information. Observed October 17, 2010.

<sup>4</sup> See <http://www.monkeyjoes.com> for more information. Observed October 17, 2010.

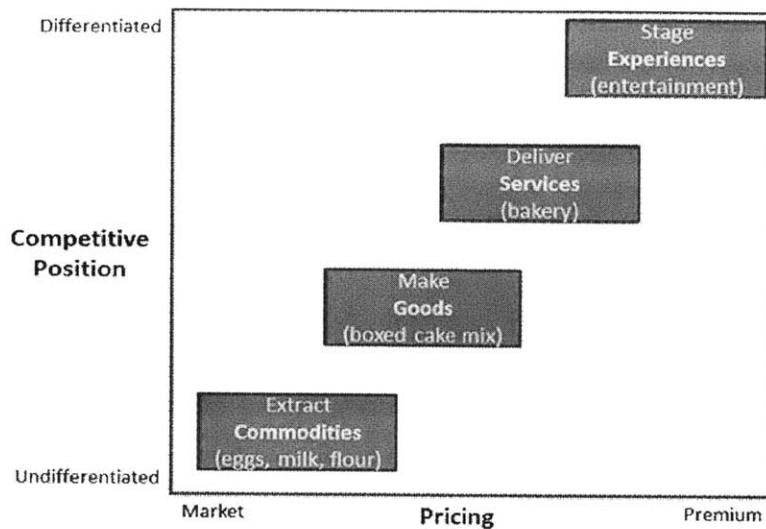


Figure 3: From Commodities to Experiences (adapted from Pine and Gilmore, 1998)

Closely related to the efforts to classify services in the broader economy, substantial efforts to define service have been undertaken as well. Most attempts to define services are very awkward and non-intuitive. As one of many available examples, T. P. Hill proposes the following definition of a service: “a change in the condition of a person, or of a good belonging to some economic unit, which is brought about as the result of the activity of some other economic unit, with the prior agreement of the former person or economic unit.”(Hill, 1977) Hill’s attempt is representative of the nature of most definitions, and it leaves us wanting for something more workable, more easily applicable, and more intuitively understandable. Several other awkward definitions of services could be presented here as well.

### 1.3 – A False Dichotomy

Perhaps the classification and definition problems stem from an attempt to enforce a false dichotomy on goods OR services. These problems go away if we accept the notion that everything is – as proposed by Tang & Zhou - a product-service system (Tang and Zhou, 2009). Said differently, there are no pure products and there are no pure services.

Dr. Victor Tang & RuoYi Zhou propose the following definition of a service: “a solution performed for consideration with a taktchronously co-produced product-IHIP solution to create a stream of benefits.” The word, “taktchronous,” represents the notion of delivering the product-service system at the right tempo, closely related to the traditional service attribute of co-production. “IHIP” is an acronym standing for some of the traditional attributes associated with services: Intangible, Heterogeneous, Inseparable, and Perishable. Perhaps more significantly than the details of the definition, the definition from Tang & Zhou asserts that a service in isolation simply does not exist. It is always a product and a service delivered as a product-service system (Tang and Zhou, 2009). This fundamental assertion is the key to unraveling the earlier classificational and definitional problems around services.

Professor James Teboul of INSEAD conveys a similar notion (Teboul, 2006). Teboul defines a “pure product” as raw materials transformed with labor and capital to finished products. Teboul defines “pure service” as customer who has an experience created with labor and capital and stays a customer. Further, Teboul divides all businesses into “front stage” (which creates the service component) and “back stage” (which produces the product component). Teboul further says, “There are no such things as service industries. There are only industries whose service components are greater or lesser than those of other industries. Everybody is in service.”(Teboul, 2006) Tang & Zhou would agree.

Teboul elaborates and illustrates further by comparing three restaurants, as portrayed below in Figure 4. For a fast-food restaurant (McDonald’s in this example) nearly all of the value is product production – what Teboul calls “back stage” – with very limited services. A traditional restaurant features much more interaction with wait staff and ambience, providing something closer to a balance, but the food is still produced “back stage.” At the other extreme of the spectrum from a fast-food restaurant is a Japanese steakhouse where the food is prepared “front stage” at the table as a part of the service experience. All are tertiary sector businesses that are identical by traditional economic classifications. Tang, Zhou, and Teboul would recognize them both as product-service systems with varying mixes of product and service, or “front stage” and “back stage” in Teboul’s parlance.

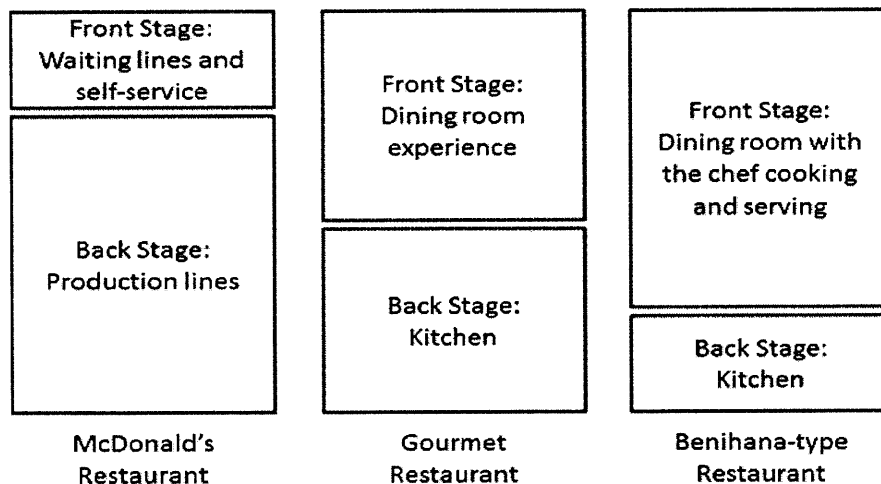


Figure 4: Three Types of Restaurants. Source: Teboul, “Service Is Front Stage”, 2006, Palgrave Macmillan. Reproduced with permission of Palgrave Macmillan

### 1.4 – A Porous Boundary, a Swinging Pendulum

Consider a bank in the 1930s. Every transaction is recorded and calculated by people with relatively limited technology into a physical ledger. Loans are evaluated by people, and the decisions are influenced by the strength of relationships. Money is received and dispensed by people. All of that happens locally. It is very clear that such a business is service-intensive and each interaction is unique and customized. Consider that same bank today. My ATM reads the checks I deposit, determines the amount, and records the deposit to an electronic ledger. Basic loans are approved electronically with no human interaction. My paycheck is deposited and divided between accounts electronically and

automatically. Besides the ATM, most of the information technology supporting all of this activity is somewhere other than my local community. I find it hard to consider that level of automation and technology as providing me a co-produced, customized service as the bank did in the 1930s. There now appears an element of that experience that is productized through standardization and automation – done “back stage.”

What if we consider music? A century ago, if you wanted music at your party, you likely hired a band or a musician. That was a clearly produced-as-it-is-consumed service. Fast-forward 75 years. In the 1980s, for that same need, you could still hire live music, but you would very possibly use cassette tapes or compact disks – same need, but now fulfilled with products. What if you wanted to mix that music? Would you hire a DJ (a service) or buy a CD changer (a product)? Fast-forward again to the present. Now perhaps the need would be filled using an iPod with thousands of songs (a product). Maybe instead the need is met with Pandora, or other Internet-radio services where the music is customized and the song choice is produced as it is consumed, yet at the same time, it is technology making the choices (no human involvement) and the songs are pre-built building blocks. Product or service?

Consider the history of software. Software companies were originally providing entirely custom hardware and software delivered as services. In the 1960s and 1970s IBM began standardize hardware and software offerings, productizing them, now requiring much more limited configuration to make them useful for customers. Now, IBM and other IT giants are looking at offering their products as hosted offerings running “in the cloud.” – as a service – to the customers.

What if we focus on traditional primary or secondary sector items? When my wife and I bought our two most recent Honda’s, they each came with three months of XM satellite radio as a part of the purchase<sup>5</sup>. If instead we would have bought GM cars, they would have come with OnStar pre-paid for one year<sup>6</sup>. If instead we had bought BMWs, they would have come with all routine service for the first four years or 50,000 miles of their lives included in the purchase price<sup>7</sup>. A recent ad<sup>8</sup> for GM’s Chevrolet Malibu boasts “a transferable 100,000-mile/5-year Powertrain Limited Warranty” as well as “roadside assistance and courtesy transportation programs.” Products or services? What if we chose to lease the cars instead of purchase them? Products or services?

The examples illustrate the artificial choice. In all case, the answer is “both.” These are all product-service systems, and in many cases, the balance shifts (and shifts back) over a long enough window of time. These examples also point to how technology is central to blurring the lines. As labor is replaced with technology, the offering seems to move toward the product end (“back stage” in Teboul’s language) of the spectrum and away from the service end.

---

<sup>5</sup> See <http://automobiles.honda.com/cr-v/audio.aspx>, observed September 5, 2010

<sup>6</sup> See <http://www.chevrolet.com/equinox/features-specs/>, observed September 5, 2010

<sup>7</sup> See <http://www.bmwusa.com/Standard/Content/Owner/BMWUltimateService/Default.aspx>, observed September 5, 2010

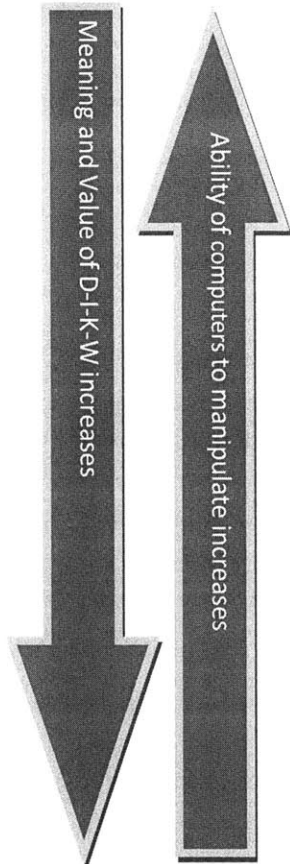
<sup>8</sup> Runner’s World magazine, October 2010, pages 48-49

## 1.5 – The Data-Information-Knowledge-Wisdom Hierarchy

Before further exploring the relationship of the different types of product-service systems, it's necessary to briefly discuss the difference between Data, Information, Knowledge, and Wisdom. The origin of this hierarchy is not clear, but Ackoff<sup>9</sup> is often attributed. For context of this thesis – grounded in systems-thinking – that is certainly the most appropriate citation. Since these terms come up throughout the thesis, getting common language now will be useful.

While used almost interchangeably in conversation and writing outside of the fields of information theory and knowledge management, Ackoff and others proposed that Data, Information, Knowledge, and Wisdom form what is variously portrayed as a hierarchy or a pyramid. The terms are generally defined (Rowley, 2007) as portrayed in Table 1:

Table 1: D-I-K-W Hierarchy



Term	Meaning	Time Frame	Example(s)
Data	Symbols void of context, lending themselves perfectly to algorithms and programming.	Historical, Present	GPS Coordinates
Information	Contextualized, processed data. Answers the “who”, “what”, and “when” questions.	Historical, Present	Directions to Panera Bread <sup>10</sup>
Knowledge	Applied information and data. Answers “how” questions.	Historical, Present	Where can I get a good cup of coffee with a warm bagel in front of a fire?
Wisdom (Some use the term “insight”)	Evaluated understanding. “Why?”	Future-looking	Where is a good place to locate a new restaurant?

Meaning and value both increase as we move up the “stack” from data to wisdom, as do the requirements for human insight. Information technology and algorithmic or programmatic

<sup>9</sup> Ackoff R. (1989) From data to wisdom. *Journal of Applied Systems Analysis* 16:3-9.

<sup>10</sup> Panera Bread is a franchised bakery-café throughout North America. For more information, see <http://www.panerabread.com/>. Observed 09/12/2010.

interpretation is – similarly – less useful as we move further up the stack. Said differently, computers manipulate symbols (data) very well and can deal very effectively with information. In some cases, when knowledge can be classified adequately, computers can appear to provide value in that space as well (e.g. Zagat<sup>11</sup> surveys make it possible for computers to “recommend” restaurants<sup>12</sup>, or book-buying patterns make it possible for computers to “recommend” book, music or movie titles<sup>13</sup> and appear to move up the D-I-K-W hierarchy) but in general, knowledge and wisdom are still reserved for humans to make actual decisions

## 1.6 – Service-Centric Elements of Product-Service Systems

Since this study is focused on the product-service relationship, it is useful to put some bounds on the types of services considered; the intent is not to study product- or service-centric firms acting as holding companies, where the services are strictly for financial value to the parent company and do not interact with the product elements. Cusumano, Kahl, and Suarez use the following boundaries to define the relevant product-service relationships: “activities that generally: (a) can be sold or given away separately from the industry’s ‘physical’ products; (b) relate directly to the industry’s products and may even be necessary to use those products, but; (c) are not part of the production process of the physical goods themselves” (Cusumano et al., 2008). This paper will follow those same guidelines.

MIT Professors Olivier de Weck and Christopher Magee (de Weck and Magee, 2004) propose the following classification for processes and operands in complex systems shown in Table 2. In support of the table below, de Weck and Magee cite the following as examples of classes of operands:

- Matter: packages, vehicles, crude oil, animals, plants, water, memorabilia
- Energy: potential, electrical, kinetic, thermal, nuclear
- Information: news reports, email, TV shows, voice conversations, books (content), bits
- Value: stocks, bonds, cash, inventory, loans, credit, currencies, options

---

<sup>11</sup> Zagat is a ratings company. See <http://www.zagat.com> for more information. Observed 09/12/2010.

<sup>12</sup> As with Acura. See

[http://www.acura.com/Features.aspx?model=MDX&modelYear=2011&context=Audio+ +Navigation#zagat reviews](http://www.acura.com/Features.aspx?model=MDX&modelYear=2011&context=Audio+ +Navigation#zagat_reviews) for more information. Observed 09/12/2010.

<sup>13</sup> As with Amazon.com. See <http://www.amazon.com>. Observed 09/12/2010. For more information about Amazon.com, please see Appendix A.

Table 2: Types of Complex Systems (de Weck and Magee, 2004)

Process/Operand	Matter (M)	Energy (E)	Information (I)	Value (V)
<b>Transform or Process</b>	GE Polycarbonate Manufacturing Plant	Pilgrim Nuclear Power Plant	Intel Pentium V	N/A
<b>Transport or Distribute</b>	FedEx Package Delivery	US Power Grid System	AT&T Telecommunication Network	International Banking System
<b>Store or House</b>	Three Gorge Dam	Three Gorge Dam	Boston Public Library	Banking Systems
<b>Exchange or Trade</b>	eBay Trading System	Energy Markets	Reuters News Agency	NASDAQ Trading System
<b>Control or Regulate</b>	Health Care System of France	Atomic Energy Commission	International Standards Organization	US Federal Reserve

The organization of the taxonomy of complex systems and the examples given imply that both product elements and service elements can be derived from any of the operands, depending on the process applied. This paper will base its organizational structure for product-service systems on the operands of that taxonomy.

This thesis will endeavor to explore the product-service relationship by looking at specific companies and trying to develop some generalizable principles of what would make a successful product-service strategy. This paper reviews the service efforts of primarily companies that produce complex electro-mechanical build-to-order products, but also draws on Information Technology and other sectors as well. It presents brief case studies of particularly illustrative service offerings.

Based on de Weck and Magee, in this paper, the service-centric elements of product-service systems are categorized into three major types:

- Product-based (e.g. customization or repair) – that is, material-based
- Information-based (e.g. telematics)
- Value-based (e.g. financing, leasing, usage-based services, or utilities)

### 1.6.1 – Product-Based Services

Product-based services are the “classic” services that we associate with a product’s value chain. Common examples include pre-sales consulting, configuration, wholesale or retail sale, customization, installation, integration, maintenance, warranty, repair, and disposal. Product-based services are almost always based on a high-level of knowledge about the product (Cusumano et al., 2008). They often have



traditionally involved physical proximity to the product, but do not necessarily require it, and that heuristic is becoming less true. Some of these services may be included in the purchase price or appear free, especially those that occur before the sales transaction. Others may not. These services may also require a high-level of knowledge about the operating environment and/or competitive market of the product as well. They can happen before, during, or after the product sale. The entire breadth of product-based services from cradle to grave of the product is generally provided by a combination of providers both within and outside of the corporate boundaries of the product company. Of the service types presented in this paper, these product-based services are the most likely to be outside of the product company, especially for products whose markets had to mature in an era of lesser communication infrastructure, and for products where physical location is important for sales and service (e.g. automobiles). These services will be addressed as two major types in this thesis:

- Retail-centric, studying on the changing nature of brick-and-mortar service delivery.
- Business-to-business, looking at the major strategies businesses can use to augment their products with services.

### **1.6.2 – Information-Based Services**

Information-based services draw on three primary sources of information:

- The operator
- The product itself
- The operating environment

They are differentiated from product-based services by either the volume of information to be processed or the speed at which results are required to make the information valuable. The requirement of speed and/or volume means that information-based services are not possible without primarily automated processing. They normally create value by answering questions about who/what/where/when. Product-based services are more likely to answer questions about “how” and “why.”

### **1.6.3 – Value-Based Services**

Value-based services will be discussed here in three forms:

- “Traditional” value-based services like product financing where the product payment for the product is more aligned with the consumption of the product (e.g. paying for a car over 60 months or leasing a server for three years).
- Product-servitization, where the product consumption is tied to the co-production of related product-, information-, or value-based services and payment is tied to that co-production.
- Utilities where there is an servitized product that can leverage economy of scale or scope on the product side, and potentially eliminate consumption-side underutilization of the product being replaced.

#### **1.6.4 – Energy-Based Services**

To complete the de Weck/Magee taxonomy, there is an obvious question about energy-based service elements. While they do exist, they often most naturally break down to either product-based services (in the form of consultative knowledge about the product), or finance-based services. In early research, I attempted to treat them separately, but it ended up feeling artificial.

#### **1.6.5 – Hybrid Product-Service Systems**

Hybrids (combinations of those three types of service elements) also appear throughout the thesis. Common examples hybrid services include logistics, operations, or fleet management for customers related to the core product element. In those cases, evidence of value-based, information-based and product-based service elements are all evident. Other hybrids are online stores tightly integrated with traditional brick-and-mortar stores or online publications tightly linked with traditional print media.

In most cases, there is one element that dominates and defines the product-service system. As an example, Rolls Royce TotalCare (more colloquially known as “Power by the Hour”) enables providers of jet transportation to completely outsource the operations and maintenance of the system to Rolls Royce and pay for it based on consumption. The most compelling feature is the pay-by-the hour nature of it, and – for the purposes of this thesis – it would be treated as a value-based (financial) service.

# Chapter 2 – Product-Based Services

---

As indicated in Chapter 1, product-based services are those services that are closely tied to the physical product. In many ways, they are the “classic” services that we associated with a product, especially if we think of a pre-World-Wide-Web world. Common examples include pre-sales consulting, configuration, wholesale or retail sale, customization, installation, integration, maintenance, warranty, repair, and disposal. Product-based services are usually based on a high-level of knowledge about the product itself (Cusumano et al., 2008) and traditionally they often – although not always – involve physical access to the product. There are a number of trends, some whose progress can be measured in months, and others that may be best measured in decades – that are changing the dynamics that have traditionally tied product-based service delivery to the physical world. While there are many other things that could be said about product-based services, this chapter will look at two main things:

- Studying the interactions between products and traditional brick-and-mortar-based service delivery and how that is changing.
- Looking at different approaches to integrating products and services.

## 2.1 – Differentiating Product-Based Services

Though not exhaustive, Figure 5 represents many of the major types of product-based services in the lifecycle of a product-service-system.

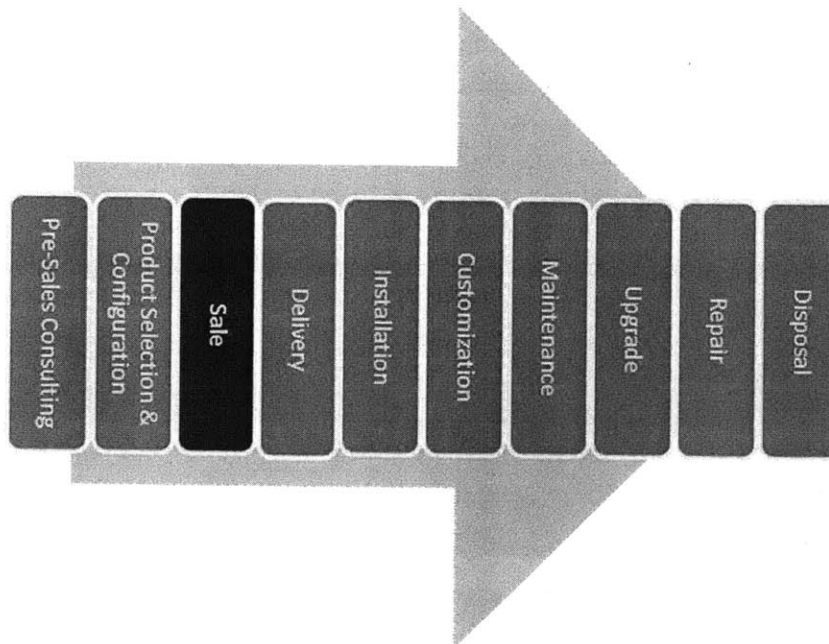


Figure 5: Product-Based Services for a Product-Service-System

It can be conceptually useful to classify them temporally into three major categories:

- Pre-sale
- Point-of-sale
- Post-sale

It is important to note that in some cases the culminating financial transaction may not actually be a “sale” but could be a financing, leasing, or pay-to-use arrangement.

When using that simple organizational model, it is important to note that many of the elements after the point of “sale” may have a small sales cycle associated with them as well, such as maintenance or upgrade where parts may be required.

## **2.2 – Product-Based Services ≠ Physical Services**

As discussed in Chapter 1, product-centric services are those that are generally based on differentiated product knowledge (as opposed to simply information or data). Said differently, while often true, product-centric services are not necessarily tied to the physicality of the product or its delivery. The powerful forces of digital information and other types of technological advancement are eroding the physical world’s hold on product-centric services from many directions.

At this point in the evolution of information technology, logistics, and just-in-time production methods, there are fewer and fewer product characteristics left that support the need for traditional, physically-based, brick-and-mortar service delivery infrastructure. It seems that the product-service systems that will still support physical delivery have a higher mix of the following three attributes in the product:

- The product is difficult to encode in a timely and cost-efficient manner at point of consumption.
- The product is difficult to deliver in a timely and cost-effective manner without pre-positioning inventory in a brick-and-mortar store.
- Complexity of product makes it difficult for customer to have enough confidence to commit to consume without interacting with it.

Similarly, it seems that the digital, online world has the toughest time replicating the advantages of the physical world in the following two areas:

- The entire retail experience, with sights, smells, tastes, touch, and complementary services can be much more compelling in brick-and-mortar-delivered, product-based services
- Trust and relationships with service delivery staff and other patrons can be more compelling in brick-and-mortar-based service delivery model

In the coming pages, the thesis will briefly review a number of trends, some of which are still quite nascent, that are starting to change even these dynamics and further accelerate the de-coupling of product-based services from tradition, physical delivery channels.

## 2.2.1 – Efficient Delivery: Video Rental: Redbox, Netflix, and Blockbuster

Video rental services like Netflix<sup>14</sup> and Redbox<sup>15</sup>, stand in contrast to Blockbuster<sup>16</sup> and its much more traditional brick-and-mortar-based service delivery infrastructure.

While the ultimate delivery of the product element for these relative new-comers to the video rental business relies on physical infrastructure (delivery services for Netflix<sup>17</sup> and vending machines for Redbox), all of the services before point-of-sale (or more accurately here, point-of-rental...more generally, point-of-consumption) are provided using information technology in an online format<sup>18</sup>. That is possible for two primary reasons:

- Strong brand awareness and equity for the products was already created by the theater release or television first-run.
- Established and accepted information standards assure the consumer that they will be able to watch the DVD or Blu-ray on their system.

Those factors contribute to making the customer confident to commit to a transaction with an unseen, untouched product. It also leverages a growing level of consumer confidence and comfort regarding online transactions. In a situation like this, where movie companies have already spent as much as tens of millions of dollars in marketing the titles, the physical store is able to offer very few advantages in the form of product knowledge.

In the case of Netflix, the service results in delivery directly to your door. Netflix also recommends titles, as would a brick-and-mortar retail associate, Redbox pushes the limits and confuses traditional boundaries even more by having the customer pick up the video at the vending machine, making the customer responsible for delivery and return while interacting with what amounts to an automated store. Redbox charges \$1/day for DVD rentals. Meanwhile, Blockbuster and their traditional brick-and-mortar delivery model – which seems to have equated product-centric services with physical services for too long<sup>19</sup> – has entered into chapter-11 bankruptcy proceedings<sup>20</sup> and charges \$4 or more per DVD rental.

According to Redbox's President Mitch Lowe in a 2009 interview in Forbes Magazine<sup>21</sup>, Redbox shares a similar movie cost structure to that of Blockbuster for the media that both companies buy in order to

---

<sup>14</sup> For more information about Netflix, please see Appendix A.

<sup>15</sup> Redbox is a subsidiary of Coinstar. For more information on Coinstar, please see Appendix A.

<sup>16</sup> For more information about Blockbuster, please see Appendix A.

<sup>17</sup> Netflix does offer delivering entirely online as well, using a PC, gaming system, or some other endpoint. While not contradictory, that example does not make the case for blurred lines as effectively, so it is not considered here. That example is more on-par with the evolution of e-readers, which is addressed later in the chapter.

<sup>18</sup> Redbox movies can also be selected at the vending machine using a PC-based interface to make the selection.

<sup>19</sup> Blockbuster does have online offerings like Netflix, but it is generally accepted that they waited too long to respond and enter into that market. There are also Blockbuster-branded kiosks that will be discussed briefly later in the chapter, but they are owned and operated by NCR. Blockbuster missed that one too.

<sup>20</sup> See <http://www.nytimes.com/2010/09/24/business/24blockbuster.html?emc=eta1>. Observed October 2, 2010

<sup>21</sup> See <http://www.forbes.com/2009/10/26/dvds-mitch-low-e-business-entertainment-redbox.html>. Observed October 4, 2010.

rent. Lowe indicated that – if anything – Blockbuster had more favorable terms. Since that article was released, additional studios have banned Redbox from featuring their titles for the first 28 days. Despite that disadvantage, Coinstar’s Redbox subsidiary is growing rapidly and the parent company is profitable, while Blockbuster is struggling to stay alive, and closing locations. The only apparent bright spot in the Blockbuster story is its emerging kiosk-based business, where NCR licenses the Blockbuster name and uses a business model very similar to Redbox. The NCR example, while it may help Blockbuster, only re-enforces the notion that a kiosk is good enough for DVD rental and the brick-and-mortar element of those product services is very near death.

That both Redbox and Blockbuster may ultimately lose to online providers is not the point. The point is that brick-and-mortar infrastructure to physically deliver products to point-of-sale is no longer necessarily required. DVDs are not the only products now being sold by kiosk, either. Progressively more complex products like skin care<sup>22</sup> and consumer electronics<sup>23</sup> are sold that way as well.

Complex, efficient logistics infrastructure coupled with robust communication networks, fierce competition for market share and profits, and tech-savvy, tech-comfortable customers make it possible and effective to centralize the storage, delay the production of many products, and ship to point of consumption on-demand. Netflix and Redbox show that physical, local services now have very limited protection created by the simple (traditional) physicality of the product. Customers don’t miss the “personal touch” of a retail clerk for simple transactions like a video rental.

## 2.2.2 – Efficient Encoding

### 2.2.2.1 – The Changing Face of Books

Books<sup>24</sup> have a much lower information payload than movies. An average book can be stored electronically in less than 1MB of storage<sup>25</sup>. A typical movie, by contrast, takes more than 1,000MB to store in an acceptable format for home-theater-quality entertainment<sup>26</sup>. That is a three orders-of-magnitude difference.

---

<sup>22</sup> Proactiv sells skincare products out of vending kiosks. To find one near you, see <http://www.proactiv.com/kiosklocator.php>. Observed November 29, 2010.

<sup>23</sup> Best Buy’s vending kiosks are discussed briefly later in the chapter.

<sup>24</sup> Music fell sooner to purely digital delivery. It’s relatively small informational payload and abundance of efficient and adequate encoding schemes coupled with a robust market for mobile (and therefore space-efficient) consumption made it a natural. CD sales are in decline and services like iTunes are taking over. It would have been easier to tell this story with music instead, but the growth of e-readers tells a similar story, there has been much less written about it, and the stability of the book – until now – makes it very compelling.

<sup>25</sup> Based on Amazon’s Kindle technical specifications available at <http://www.amazon.com/Kindle-Wireless-Reader-3G-Wifi-Graphite/dp/B002FQJT3Q>. Observed October 2, 2010. Technical specifications indicate that Kindle will hold 3,500 books with 3GB of user storage. 3,000MB/3,500 books = 0.857 MB/book. Whether this number is exactly accurate is not important, since we are looking at orders of magnitude in difference.

<sup>26</sup> Based on the ISO standard for DVD’s available at [http://standards.iso.org/ittf/PubliclyAvailableStandards/c035641\\_ISO\\_IEC\\_16448\\_2002\(E\).zip](http://standards.iso.org/ittf/PubliclyAvailableStandards/c035641_ISO_IEC_16448_2002(E).zip). Observed October 2, 2010. A single-layer DVD holds 4.7GB. Since only a single movie is generally stored on a DVD, it is reasonable to assume it at least half-full. Even at 1GB, the movie would require 1,000 times more storage. Online sites like

Since the rise of moveable type, books have not changed much. Said differently, their product form has been stable for half of a millennium. That is exceptional. The Sumerians were the first to use a dedicated form of storage for the written word. They used clay, which could be inscribed when wet and then dried for more permanent storage. When those clay “pages” were assembled and bound together, an obvious fore-runner of the modern book appeared (Carr, 2010).

Early reading and writing were specialized skills, not generalized as they are today. No spaces, no punctuation and no notion of upper and lower case made writing – and especially reading – more difficult. It was well into the Middle Ages when the accommodations to the written word that we take for granted and rely upon (i.e., mixed case, spaces, and punctuations) were generally accepted to make reading easier for amateurs (Carr, 2010).

Those changes began to create the demand for easier access to the written word, but there was still a great cost to its production. In the mid-1400s, Johannes Gutenberg developed his famed invention. In the late 1400s, a scribe would charge one florin to make a single copy of Plato’s Republic. For three florins, over 1,000 copies could be printed (Carr, 2010) using the moveable type-based printing press. The price of information transmission had dropped by orders of magnitude almost overnight. Since then, the form of the book has not really changed. It is exceptional for a product form to remain that static for so long of a period of time. With that much inertia in the product form, it clearly takes a massive disruption for a new form factor to begin to emerge.

Enter e-readers.

An e-reader is a small, portable electronic device for reading and information storage that supports many of the traditional attributes of printed forms (Scholnik, 2001). In early 2010, Amazon’s<sup>27</sup> Kindle was reported to hold an astounding 90% of the dedicated e-Reader market, based on “book” sales<sup>28</sup>. The Kindle uses 3G cellular or 802.11 Wi-Fi networks to deliver books to a device purpose-built for long-form reading and storage of what would have traditionally been books or paper-based periodicals. Amazon now claims that Kindle “book” sales are out-pacing print sales for their top titles<sup>29</sup>. Barnes & Noble makes similar claims regarding its “nook” e-reading platform, B&N’s own, proprietary, dedicated e-reader<sup>30</sup>.

As with Netflix and Redbox, the physical infrastructure involved in delivering what was traditionally a book is now minimal with e-readers. Because the actual informational content of a book is so small, it can be delivered all the way to the point of consumption without a dedicated medium for transmission

---

YouTube do it in less space, but not at a generally acceptable resolution for long-form, movie-quality entertainment.

<sup>27</sup> For more information about Amazon, please see Appendix A.

<sup>28</sup> See <http://blogs.wsj.com/marketbeat/2010/02/16/analyst-amazon-e-book-share-to-fall-from-90-to-35/> Observed October 2, 2010.

<sup>29</sup> See <http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1486648&highlight=> Observed October 27, 2010.

<sup>30</sup> See <http://www.fonerbooks.com/booksale.htm>. Observed October 2, 2010.

like a DVD<sup>31</sup>. A format which dominated information storage for readable information for centuries is now possibly being disrupted and displaced in the period of years or decades.

#### 2.2.2.2 – Products beyond Media

While it is clear that products that can easily be encoded into “pure” information like books and movies are being disrupted, what about other product types? Are there still barriers to traditional physical distribution? Yes, but those barriers cannot be assumed to be permanent for all applications.

Three-dimensional printing was patented by the Massachusetts Institute of Technology in 1989 (Bak, 2003). As early as 2003, it was observed that three-dimensional printing systems, traditionally used for rapid prototyping, could be used for low-volume or mass-customized production applications. On that subject, David Bak said the following:

Rapid manufacturing – defined as the direct production of finished goods from a rapid prototyping device – remains at present more of a goal than reality for industry. The application of 3D printing technologies, however, promises to merge rapid prototyping capabilities with the high-volume throughput of conventional manufacturing. Proponents believe that these processes may soon lead the tool-less production of finished goods and the mass production of individually customized parts (Bak, 2003).

Three-dimensional printers are able to produce products that have “the appearance, surface finish, and physical characteristics of injection-molded ABS thermoplastic” (Bak, 2003). Additionally, automotive parts producer Parker-Hannifin describes an example of running the output of a three-dimensional printer mounted as a filter on a V8 automobile engine for 40 hours of service, collecting waste at 160°F with no evidence of fatigue or degradation at the end of the 40 hours (Bak, 2003).

Three-dimensional printing systems are able to work with plastics, polymers, ceramics, metals (Sachs et al., 1990), and even bio-materials (Pfister et al., 2004). Further, companies like Kovio – spun out of the MIT Media Lab – are using Inkjet-type technology for printing printed silicon electronics – actually printing a chip. Imagine a repair shop carrying little-to-no inventory except raw materials (“printer ink” in a manner of thinking) and printing the needed parts to repair or maintain your toaster, shoe, phone, or car. There is no doubt that today it sounds like science fiction, but 20 years ago, it sounded like fantasy.

In the nearer term, testing the fit of a part with a model generated by a three-dimensional printer to confirm the correct part to be ordered from a central location is also possible, which creates a way to deal with complexity. Additionally, similar to the Parker-Hannifin scenario above, a limited-use part could be fabricated using a “desktop manufacturing” or “desktop production” system while a permanent part is ordered, eliminating the need to carry part inventory. Instead of streaming a movie or downloading a song, we may find ourselves downloading a washer or a pair of bookends.

---

<sup>31</sup> A broadband connection is defined by the FCC as in excess of 200 kilobits per second (See [http://www.fcc.gov/Daily\\_Releases/Daily\\_Business/2010/db0720/FCC-10-129A1.pdf](http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0720/FCC-10-129A1.pdf). Observed October 2, 2010). DVD-quality video exceeds that threshold.



Any product-based service today that has extensive capital tied up in physical infrastructure or inventory must consider itself a potential target for disruption in the coming decades. Basic three-dimensional printers are now sub-\$1,000, and milling machines that were once \$150,000 can now be bought for \$4,000 (Anderson, 2010). Commoditized, point-of-consumption, or at least point-of-purchase fabrication is slowly becoming real across a progressively broader range of products. That change will create massive disruption is how physically encoded products are delivered.

“Atoms are the new bits” (Anderson, 2010).

### 2.2.3 – The Changing Nature of Product Complexity

Complexity is “the amount of information necessary to describe the system effectively” (DeLaurentis, 2008). There are forces at work that are changing the nature of product complexity from multiple directions.

**2.2.3.1 – Managing Product Complexity by Integrating the Languages of Design and Manufacturing**  
Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) each trace their roots to the 1960s. Traditionally, the accepted ISO standard for describing mechanical parts in the world of CAD has been ISO 10303, known as “STEP” (Xu and He, 2004). Computer Aided Manufacturing grew up following a different standard, ISO 6983, which describes a language known as “G-Codes” which was developed in a world for computer-driving machining equipment was very simple, with very limited processing capabilities, and – therefore – required a very simple language. The different roots and different goals of ISO 10303 and ISO 6983 have created a chasm between the digital worlds of design and manufacturing.

A new ISO standard, ISO 14649, known as “STEP-NC” integrates those two worlds (Xu and He, 2004) and – for the first time – creates a common, standards-based language for both design and manufacturing. Doing so reduces the stickiness of the product information and allows it to flow more easily across departmental – and even organizational – boundaries. ISO 14649 is gaining wide acceptance across the automotive industry (Xu and He, 2004). Figure 6 portrays the “before” and “after” of STEP-NC<sup>32</sup>.

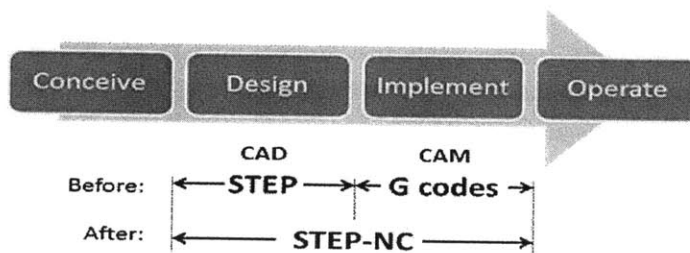


Figure 6: Comparing the flow of Information Before and After STEP-NC

### 2.2.3.2 – Pushing Differentiation as Close to the Customer as Possible, and Changing Complexity

The nature of product design has changed substantially over the last several decades. As design tools and processes have matured, it has become progressively easier to de-couple product design from

<sup>32</sup> MIT Professor Ed Crawley was the first I ever heard use the “Conceive-Design-Implement-Operate” (CDIO) as an abstract product lifecycle.

product manufacturing and let the information flow without impedence to where it needs to be in the supply chain. Companies like Zara<sup>33</sup>, the Spanish fashion company, embody the evolution with a robust postponement strategy.

Zara uses a Flexible Manufacturing System (FMS) to help it achieve agility (Christopher, 2000). While agility embodies many of the characteristics of lean, it is a distinct attribute. Agility is about a responsive supply chain based on virtualization, process integration, market sensitivity, and a leveraged network. Traditional manufacturing drove down price through off-setting massive set-up times by producing huge runs of identical products to drive down unit prices. Lean manufacturing focused on reducing and eliminating change-over and set-up time to make small (or no) batches of product competitive. Agile takes lean concepts and applies them more broadly than manufacturing. It achieves agility by doing two important things to its supply chain: it creates the earliest possible de-coupling point, and it creates the latest possible postponement in manufacturing. Those ideas are portrayed graphically in Figure 7. De-coupling drives as much of the backward supply chain as possible off of actual demand and not forecast by allowing as much of the value chain as possible to work off of the same demand information. It's kan ban on steroids. Postponement delays product differentiation as long as possible to reduce raw material SKUs and match production to demand as quickly and accurately as possible.

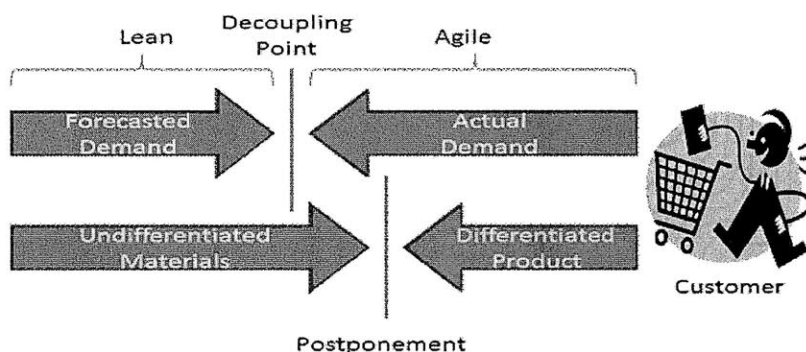


Figure 7: The Agile Supply Chain (Christopher, 2000)

As research proves the value of agile supply chains, more companies – where applicable – are moving to adopt this approach (Christopher, 2000) (Feitzinger and Lee, 1997). Central to the success of postponement in material flows is reducing product complexity, making it possible to push undifferentiated material as close to the customer as possible (Christopher, 2000). The Zara example is significant in this context for two reasons. First, the most extreme case of pushing differentiation as close to the customer as possible is desktop manufacturing and pure information services like e-readers, both discussed earlier, and companies like Zara are creating more pressure across all product types for that trend. Second, reducing overall product complexity further loosens the hold the physical retail experience has on product services because it makes IT-based retail and distribution better equipped to handle product comparisons. Said differently, simpler products can then be more easily compared and understood using more technology and fewer people, more clicks and fewer bricks.

<sup>33</sup> Zara is a part of the Inditex Group. For more information on the Inditex Group, please see Appendix A.

## 2.2.4 – Trust and Relationships

While the online world has a long, long way to go, there is some evidence that it is starting to make inroads into the areas of trust and relationships traditionally reserved for the brick-and-mortar world.

### 2.2.4.1 – Web-Based Recommendation Agents

While new standards and agile supply chains reduce product complexity and increase information flow in the supply chain, the evolution of online retail makes it – at the same time - more capable to handle it. This too erodes at the physical world's hold on product-based services. As customers become more and more comfortable with recommendation agents in their online experience, the role of “trusted advisor” traditionally played by a clerk or sales associate in a brick-and-mortar store comes under fire. On the subject of online recommendation agents – here, “RAs”, “[t]here exists ample theoretical and empirical evidence that people respond socially to RAs and that they perceive RAs as exhibiting human-like characteristics (e.g., benevolence and integrity). Although human properties do not intrinsically exist in RAs, the salient fact is that they are perceived as such by those who interact with them” (Wang and Benbasat, 2008). Web agents are able to begin to replace the traditional role of the subject matter expert. As such, product complexity's tie to the physical world continues to be eroded by online retailers with services and increasing robust and effective algorithms based on larger and larger information sets for recommendations, as with Amazon.com and Netflix (also called “shopbots” or “infomediaries” (Swaminathan, 2003)),

Ben Shneiderman proposes this definition of trust: “the positive expectation a person has for another person or an organization based on past performance and truthful guarantees. Trust is about expectations of the future. It accrues to individuals and organizations due to their previous good works and clear promises” (Shneiderman, 2000). Based on that definition, the success that recommendation agents find is a virtuous cycle, where past success increases the likelihood for future success. That means that the ability to replace human sales associates with expert systems can (and likely will) get stronger in the future. As reputation management systems and peer reviews are more strongly incorporated into ecommerce systems, the virtuous cycle continues.

Additionally, online sites that use chat sessions with support staff, or offer the opportunity for someone to call you, or avatars that answer your questions, further move the digital world into the world of being able to slowly build trust and create relationships in an online format, slowly eroding at the brick-and-mortar service delivery model.

## 2.2.5 – Experiential Retail

Of the three product attributes and two brick-and-mortar store attributes, where physically delivered product-based services seem to have an advantage, the only one where Information Technology has not been proven to make some gains against brick-and-mortar is the customer experience, “experiential retail” as it is often called. That is not to say that there cannot be a good online experience. It is to say that there are still some things that highly automated, IT-driven product-based services cannot reproduce. To be clear, the online retail experience does matter and is the subject of significant research in both academia and industry, but the ability to deliver complex and compelling experience as a context for the retail experience is an area very difficult for the pure online retail experience to match

when compared to brick-and-mortar done well. While the bar will continue to be raised, the combination of pleasing sights, aromas and complementary services can continue to be an advantage for the foreseeable future for the physical world.

#### **2.2.5.1 – Impact of Music**

Music has been empirically proven to positively impact several aspects of product-based services. David Allan reviewed 29 papers on the impact of music on retail and concluded that music can make a positive impact on the perception of and interaction with sales staff. Music has also – in some cases – been proven to increase both willingness to buy as well as total amount spent. That is a compelling advantage for traditional delivery channels (Lowrey, 2008).

#### **2.2.5.2 – Smell**

It is widely believed that sense of smell is the most compelling of the senses to evoke memories. Crader and Zaichkowsky observe that “fragrance is processed by the limbic system, the most primitive part of the brain, and place where immediate emotions are experienced. Therefore if a retailer is able to create a connection between a particular scent and the brand or product, any time the scent is present in the consumer’s daily life, they will remember the store, and the positive emotions tied to the previous experience with it.” (Crader and Zaichkowsky, 2007) That is a compelling advantage for the physical world.

Martin Lindström’s popular book, “Brand Sense,” tells of other olfactory examples as well: “Recently Mitsubishi’s ad agency placed a fragrance ad in two major newspapers that simulated the leathery ‘new car’ smell. The result: the company’s Lancer Evo X sold out in two weeks and the car company’s sales increased 16 percent even in a recession.” (Lindström, 2005) He gives other examples of the physical world, like Bloomingdale’s pumping the smell of Johnson & Johnson’s baby powder into their stores, and the positive association that consumers have with the smells of stores like Abercrombie & Fitch, and Hollister.

#### **2.2.5.3 – Touch**

The ability to touch a product, as you can at a brick-and-mortar store, has been proven to help as well. “Haptic senses appear to moderate the relationship between product and experience and judgment confidence.” (Crader and Zaichkowsky, 2007) That also fits our common sense. It’s much easier to imagine and understand yourself using and enjoying a product that you can touch and with which you can interact.

#### **2.2.5.4 – The Store Itself**

Just having a store has been proven to make a limited difference, even when that store is not easily accessible to potential consumers. It seems to provide some sort of legitimacy no matter what. Beyond that, it also makes it easier to exploit other potential advantages, like positive experiences with service providers, a positive brand association, and ease of product exchange (Brady and Darke, 2008).

#### **2.2.5.5 – Adding Them Together**

Crader and Zaichkowsky mentioned earlier further assert that “using both scent and music to complement the other atmospheric elements, marketers will be able to create a carefully controlled

store environment that gives customers a pleasing experience.” (Crader and Zaichkowsky, 2007) They further point out that the providers where the service element is much larger than the product element have been perfecting the experience for a long, long time, and that retailers are now learning the atmospheric conditions that galleries, salons and restaurants – places where we spend hours instead of minutes – have been perfecting for decades, perhaps centuries.

### **2.3 – What Is All of This Doing to Product-Based Services?**

Five attributes where traditional brick-and-mortar-based product-centric services have an advantage over online systems were identified earlier in this chapter – three product attributes and two service delivery attributes. It is useful to look at those five attributes across the range of product-based services. Here, they are arranged temporally as in Figure 5 at the beginning of this chapter. Table 3 and Table 4 show four of them are being eroded by these trends in various ways, indicated by “minus” signs. Also indicated are the experiential advantages of brick-and-mortar, indicated with “plusses.”

Table 3: Summarizing the Impact of Trends on Brick-and-Mortar-Based Service Delivery - Negatives

Domain	Attribute	Example	Impact on Brick-and-Mortar										Comment		
			Pre-Sales	Configuration	Sale	Delivery	Installation	Customization	Maintenance	Upgrade	Repair	Disposal			
Product	The product element of the product-service-system is difficult to encode in a timely and cost-efficient manner at point of consumption.	Netflix delivery, Redbox vending "no touch" vs. Block-buster		-	-	-									Sale element of "maintenance", "upgrade", and "repair" services are considered a part of initial "sale" in scoring.
		3-D printers beginning of "desktop mfg" revolution?				-	-	-	-	-	-				
	The product element of the product-service-system is difficult to deliver in a timely and cost-effective manner without pre-positioning inventory in a brick-and-mortar store.	e-readers vs. traditional books				-									Delivery element of "maintenance", "upgrade", and "repair" services are considered a part of initial "delivery" in scoring.
	Complexity of product element makes it difficult for customer to have enough confidence to commit to consume without interacting with it.	Step-NG: Better info flow throughout supply chain		-	-										Reducing complexity barriers makes a difference where there is product selection to be done, including upgrade, repair, and maintenance
		Zara: Postponement and decoupling		-	-										Reducing complexity barriers makes a difference where there is product selection to be done, including upgrade, repair, and maintenance
Service Delivery	Trust and relationships with service delivery staff and other patrons can be more compelling in brick-and-mortar-based service delivery model	Online chat, avatars, call-back begin to emulate brick-and-mortar service elements	-	-	-	-	-	-	-	-	-	-	-	Starts to emulate higher-touch service delivery.	
Total Negative Impact of Product and Service changes on brick-and-mortar delivery of product-based services			3	4	2	4	2	2	2	2	2	2	1		

Table 4: Summarizing the Impact of Trends on Brick-and-Mortar-Based Services Delivery - Positives

Domain	Attribute	Example	Impact on Brick-and-Mortar										Comment	
			Pre-Sales	Configuration	Sale	Delivery	Installation	Customization	Maintenance	Upgrade	Repair	Disposal		
Service Delivery	The entire retail experience, with sights, smells, tastes, touch, and complementary services can be much more compelling in brick-and-mortar-based product-based services	In-Store Music	+	+	+	+	+	+	+	+	+	+	+	Proven to make a difference at several points in retail cycle.
		Smell	+	+	+	+	+	+	+	+	+	+	+	Proven to cause stronger, more immediate emotional response.
		Touch	+	+						+	+	+		Proven to mediate judgment related to purchases.
		Brick-and-mortar itself	+	+	+	+	+	+	+	+	+	+	+	
	Service Delivery Positive Impact		4	4	3	3	3	3	4	4	4	3		

From Table 3 and Table 4, we can learn some useful things. The attributes of service delivery – trust, relationship, and experience – tend to apply more broadly than the product attributes, as indicated by the plusses and minuses going more end-to-end in the “Service Delivery” part of the tables. As was mentioned earlier, they are also not tied to product type, so whether an advantage for bricks or clicks, once it is mastered, it should more easily ported or scaled to new products or new classes of products. There is an important lesson there for companies focused on physical delivery.

It’s important to note that all of these trends are double-edged swords. Brick-and-mortar done well is an opportunity to create a compelling service delivery with which online cannot (any time soon) really compete. On the other hand, brick-and-mortar done poorly may send consumers online faster than anything else. Similarly, one problem with a Redbox vending machine may guarantee Blockbuster or other brick-and-mortar rental stores a customer for a long time to come. But the point is bigger than any one plus or minus in Table 3 or Table 4. The bigger picture is that there is evidence of a major disruption to brick-and-mortar service delivery that is much broader than buying a book at Amazon.com. If that is the case, are there examples of companies that are applying these ideas and winning?

## **2.4 – Best Buy**

The electronics retailer Best Buy<sup>34</sup> is an example of a company leveraging many of the trends identified in this chapter<sup>35</sup>. If these are winning strategies, then that should be evident in their market performance.

### **2.4.1 – Highly Integrated Multi-Channel Service Delivery**

Best Buy has among the most robust multi-channel strategies in retail. They have three delivery models in the United States:

- Brick-and-Mortar stores
- Online presence
- Kiosk vending machines

Among their brick-and-mortar stores, they also have different footprints, including small “Best Buy Mobile” stores in the mall and traditional big-box stores near to or anchoring retail complexes. The lines between the three channels are such that consumers can affect purchase, pick-up, and return (if necessary) transactions in practically any combination. Online purchases can either be delivered or picked up at a convenient brick-and-mortar store, often eliminating the delivery charge. Online shoppers can also check inventory of favorite stores and reserve in-stock items for pick up. While kiosks are not integrated to the purchase/pick-up interoperability of the brick-and-mortar and online stores, returns or exchanges for all three channels can be made at the brick-and-mortar stores, which overcomes a major concern for online shoppers: how to handle returns. While they are not broadly deployed, kiosk vending machines can be found at major airports and sell – among other things – products geared to the needs of travelers, like personal music systems, headphones, chargers and travel adapters.

### **2.4.2 – Experiential Retail**

Best Buy’s brick-and-mortar stores are bright, clean, and have a consistent appearance. They feature “Best Buy radio” and “Best Buy TV” as the in-store music and video featuring content that can be bought in the store. Gaming systems are set up to enable customers to try them. TVs are set up allowing you to see the pictures. Stereo systems, digital cameras, computers, and even printers are similarly available for test drives in the store.

### **2.4.3 – Geek Squad and Other Product-Based Service Elements**

Companies like wal\*mart and Target are expanding their electronics departments and improving their brand selection, allowing them to compete more and more directly with stores like Best Buy. As they do, Best Buy has to respond to pricing pressures, and it becomes more difficult (impossible?) to be adequately profitable on the hardware sale alone. To continue to create value in product-based services, Best Buy has started to capture more of the product service delivery chain by buying and

---

<sup>34</sup> For more information about Best Buy, please see Appendix A.

<sup>35</sup> Unless identified otherwise, the content regarding Best Buy is based on personal experience.



integrating the Minnesota-based Geek Squad into Best Buy, making them available for product-based services from delivery all the way through to disposal.

By doing so, they are doing the most to capitalize on the after-sales services chain where the value of IT automation has been much lower (since those services lend themselves much less to automation because they are not as standardized). In fact, they are creating product-based service opportunities as far as they can in the product value chain by providing recycling kiosk for e-waste (no matter where it was purchased) in many stores and hauling away old appliances when they deliver new<sup>36</sup>.

Best Buy also makes gift cards available for online music services or pre-paid cards to download some releases available for sale, integrating them with CDs, DVDs and Blu-ray discs for sale. Best Buy also owns [napster.com](http://www.napster.com)<sup>37</sup>, one of the original digital delivery music brands, in an attempt both to enrich the online, multi-channel experience and to stay connected with the changing nature of information delivery.

Best Buy also generates revenue by selling extended product warranties that extend beyond those of the product companies.

As a result of all of those efforts, services revenue (not including credit services, which are administered by HSBC<sup>38</sup>) for FY2010 was six percent of total revenue, and 12 percent of revenue in Best Buy's more rapidly growing European operations<sup>39</sup>.

#### **2.4.4 – Blurring the Lines the Other Direction**

Best Buy also blurs the lines of product and service the other direction by selling exclusive house brands including Dynex, Init, Geek Squad, and Rocketfish.

#### **2.4.5 – Leveraging Complexity**

Best Buy also leverages the product complexity of mobile phones by setting them up so that a potential customer can experience their weight, look, and feel, as well ask questions, and buy a wide range of (very profitable) accessories. PDAs and mp3 players have also been sold at Best Buy using that same format in years past.

#### **2.4.6 – Best Buy Is Doing the Right Things. Is It Working?**

The evidence is that Best Buy is doing what this paper would propose as the best things they can do to enhance their position. They are improving the pre-sales through sales and distribution service elements with a highly integrated multi-channel strategy. They are creating a positive, pleasing, and memorable retail experience. They are pursuing a services strategy that extends all the way through the product-based services value chain from pre-sales consulting on complex products to facilitating

---

<sup>36</sup> See <http://www.bestbuy.com/recycling>. Observed October 25, 2010.

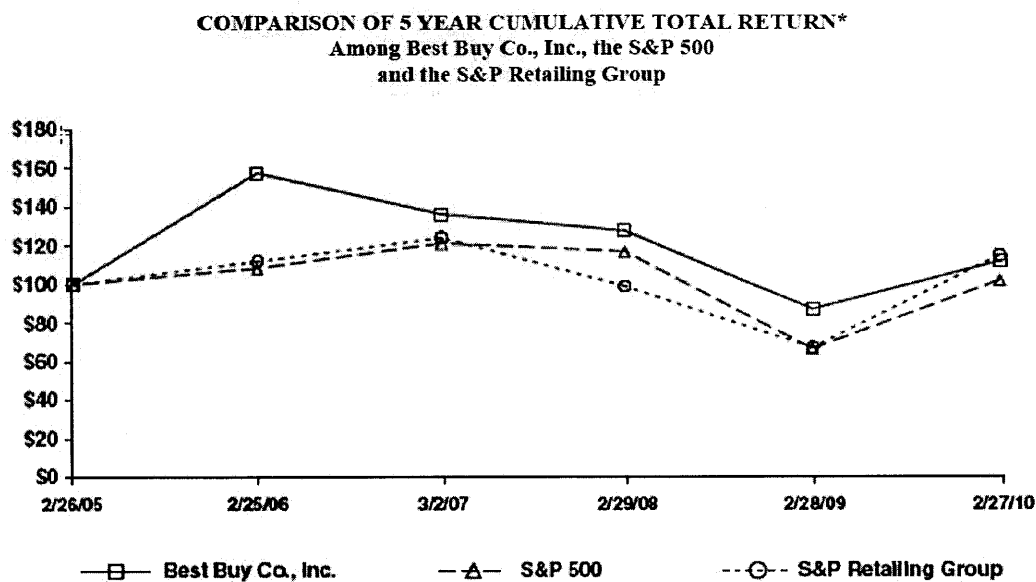
<sup>37</sup> See <http://www.napster.com> – “a Best Buy company.” Observed October 25, 2010.

<sup>38</sup> See <http://www.bestbuy.com/site/null/Credit-Cards/pcmcat102500050032.c?id=pcmcat102500050032>. Observed October 25, 2010.

<sup>39</sup> Source: Best Buy 2010 Annual Report.

disposal, and integrating the disruptive nature of digital encoding by buying napster.com. The obvious and important question is whether or not these steps are making a difference.

While it is always difficult to identify causality without a longer lens of time, there is strong evidence that what this thesis is recognizing as best practices are paying off. Figure 8 shows that Best Buy has out-performed both their peer group and the market for the last five years<sup>40</sup>.



	FY05	FY06	FY07	FY08	FY09	FY10
Best Buy Co., Inc.	\$100.00	\$158.00	\$136.43	\$127.81	\$86.96	\$111.84
S&P 500	100.00	108.40	121.38	117.01	66.32	101.88
S&P Retailing Group	100.00	111.97	124.14	98.88	66.82	114.87

\* Cumulative total return assumes dividend reinvestment.

Figure 8: Best Buy, the S&P 500, and S&P Retailing Group Over 5 Years

Over that same five-year period, comparable store sales have increased each year except 2009, during the recession<sup>41</sup>. The most obvious and compelling evidence, however, is that their biggest competitor, Circuit City<sup>42</sup>, declared bankruptcy in 2008. A New York Times article summarized it well (Rosenbloom, 2008):

In the 1980s, Circuit City was one of the nation's strongest retailers. But then came a series of critical missteps. "In the 1990s, they signed cheap real estate leases in inferior locations, and sealed their fate doing that," Ms. Widlitz said. Many of the spaces were too big and made for an uninviting shopping experience. As its fortunes worsened, Circuit City laid off thousands of its most experienced salespeople last year to save money, killing morale at the stores and angering customers.

<sup>40</sup> Source: Best Buy 2010 Annual Report.

<sup>41</sup> Source: Best Buy 2010 Annual Report.

<sup>42</sup> For more information about Circuit City, please see Appendix A.

Meanwhile, analysts said, its archrival, Best Buy, secured better real estate, offered better service and adapted more quickly to a difficult marketplace for electronic goods.

Best Buy also appears to be gaining market share, even with wal\*mart and Target competing more directly<sup>43</sup> in their core market of consumer electronics. It is tough to imagine more compelling indirect evidence of a successful strategy than (1) gaining against wal\*mart and (2) taking out your biggest direct competitor. It will take time to know the real causes of Best Buy's apparent success, but their present strategy which incorporates much of what is discussed here appears to be working well.

## **2.5 – Tying It Together: Trends in Consumer-Oriented Product-Based Services**

As is indicated above, at this point in the evolution of information technology, logistics, and just-in-time production methods, there are fewer and fewer product characteristics left that support the need for traditional, physically-based, brick-and-mortar product-based service delivery infrastructure.

Technology, logistics, and just-in-time/lean methods continue to erode the first two (efficient delivery and efficient encoding). The last two (experience, and trust & relationships) are highly de-coupled from the products themselves and can become easily ported to new product-service systems.

A personal example helps illustrate the point. Our dishwasher is 15 years old. It worked fine, but the gasket around the door leaked if we ran it twice in a row. With the holidays coming (as I write this) and my wife an excellent cook, I wanted nothing to stand in the way of cooking process so I ordered another gasket. I used one website to help me figure out where to find the model number for the dishwasher, another website to help me figure out the part number for the gasket for this particular model of dishwasher, and compared the price on three different sites, two of which had it in-stock for next-day shipping. Had I needed to, I could also watch a YouTube<sup>44</sup> video to help me understand how to install it. Throughout that process, things that traditionally would have been implicit knowledge reserved for service professionals are now readily available information that let me wander my way through a relatively craft-based industry – appliance repair – and do the job.

The best multi-channel service delivery systems let the consumer choose how much “front stage” and how much “back stage” (to refer back to the language of James Teboul from Chapter 1) we each want at every step of the process. And, even in the cases where physical delivery of the service may be required or preferred, it can often be brought the consumer's location, as do many vehicle window repair services, eliminating the traditional service bay experience<sup>45</sup>. Even traditional artisan-based services like shoe repair leverage a strong logistics network to get materials to the point-of-consumption in a timely, cost-effective manner. It seems that there simply are no more “pure” physically based product-centric

---

<sup>43</sup> See <http://blogs.reuters.com/shop-talk/2010/01/08/check-out-line-best-buys-claims-on-market-share-gains/>. Observed October 25, 2010.

<sup>44</sup> See <http://www.youtube.com> for more information...about YouTube in general, not my dishwasher. Observed October 2, 2010.

<sup>45</sup> See Safelite Autoglass at <http://www.safelite.com/> as an example. Observed October 2, 2010.

service delivery channels. In those cases the physical delivery of the service still exists, but it is – without question – slimming down from what it traditionally has been.

All of these changes can be seen as a blessing or a curse. Change and disruption are hard because they created the opportunity (inevitability?) for new winners and losers in markets. It is what Schumpeter called the “gales of creative destruction.” (Schumpeter, 1942) While Redbox and Netflix begin to prosper, Blockbuster struggles. As Best Buy adapts and improves, Circuit City is left behind.

Figure 9, Figure 10, Figure 11, Figure 12, and Figure 13 attempt to wrap some of this up and portray the ideas graphically. Figure 9 portrays the idea that consumers have a certain level of experience that they expect in return for what they spend...that creates a price-experience curve. If something is above or to the left of that line, a consumer will likely pass on it. Figure 9 shows two companies at the extreme of the value spectrum, wal\*mart, and Tiffany’s, as representative of what the market has conditioned consumers to expect as a baseline of consumer experience. A straight line may not accurately, and the line is likely different for each person, so this is just a notional representation of the “average” price-experience trade-off the market expects at a point in time.

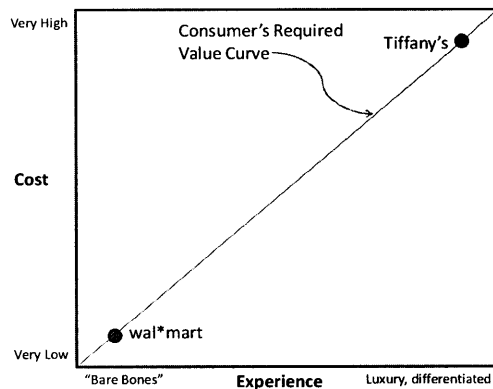


Figure 9: Price-Experience Curve, Part I

Figure 10 shows three companies able to meet the price-experience frontier of the market – Best Buy, Blockbuster, and Circuit City – at a point in time. Likely, when they were new firms, they exceeded that frontier (below and to the right of the line) or they never would have made it. In a mature, stable market, we would expect to find that most competitors were along this line, perhaps at different point based on how they differentiate their products, but along the line.

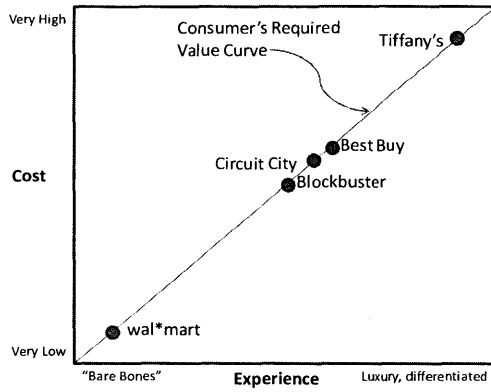


Figure 10: Price-Experience Curve, Part II

Figure 11 shows what it would look like as two firms do not keep up with the ever-increasing expectations of the market and begin to fall behind the price-experience frontier that consumers expect. Maybe they don't re-invest in the look of the stores. Maybe they begin to open at lesser locations to save on rent or perhaps get rid of their most capable (and therefore most expensive) sales staff which depletes the quality of the interaction with consumers. Maybe they outsource their web presence while competitors generate a higher level of integration between the brick-and-mortar and online experiences by developing it in-house. Maybe they fail to innovate in new services. Somehow, they fall behind what the market expects and drift above and to the left of the line.

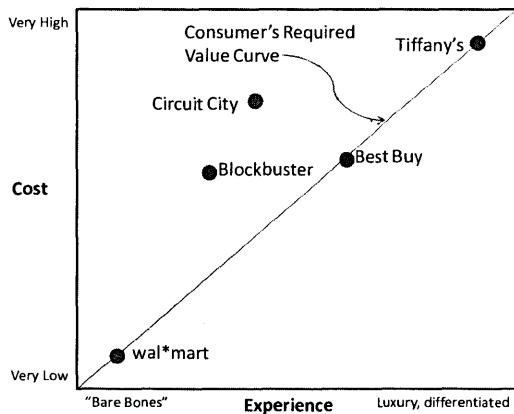


Figure 11: Price-Experience Curve, Part III

Figure 12 shows two possible reactions by competitors to a firm with a deteriorating price-experience proposition:

- Redbox creates a drastically different consumer experience from the incumbent Blockbuster with an experience that may be slightly lesser in quality (usually through a combination of automation and consumers doing a little more of the work) but markedly different in price structure. Users migrate.
- Best Buy attacks Circuit City not by focusing on price but on an improved experience, moving ahead of the price-experience frontier to have a differentiated experience from the competition. Users migrate.

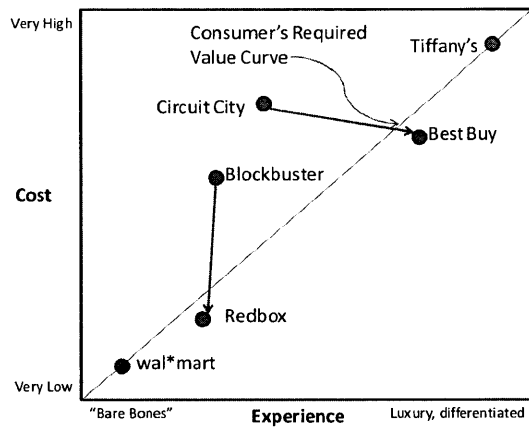


Figure 12: Price-Experience Curve, Part IV

Figure 13 shows the market re-calibrating its expectations and Redbox and Best Buy now just good enough, and ripe for attack themselves.

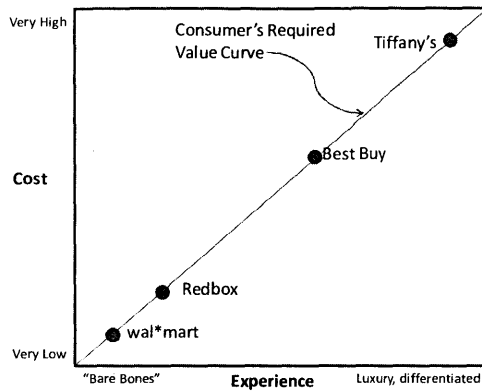


Figure 13: Price-Experience Curve, Part V

## 2.6 – Some Other Important Examples – Beyond Consumers and Retail

Beyond these trends and how they are impacting the consumer-centric, retail side of product-based services, it is useful to observe a few other notable companies in product-based services. In the remainder of this chapter, we will look at three of the greatest companies in American business: John Deere<sup>46</sup>, GE, and IBM<sup>47</sup>. Each are iconic innovators that have defined and redefined their respective fields over the last century<sup>48</sup>.

Additionally, studying the services strategy of either IBM<sup>49</sup>, or GE<sup>50</sup> – would be a thesis-worthy project unto itself. That, however, is not the spirit of this thesis. These two particular companies represent much of the best thinking of what companies with roots in products can do with services. With that in mind, I will address each of them briefly, pointing out what is special about their approaches, and not cataloging what they offer.

<sup>46</sup> For more information on John Deere, please see Appendix A.

<sup>47</sup> As I was finishing up my thesis, I saw an interesting show on CNBC about franchising called “Behind the Counter: The Untold Story of Franchising” that mentioned Procter & Gamble’s new franchising efforts with Tide Dry Cleaning and Mr. Clean Car Washes. As another great American business, I considered adding them to this section as well, but after studying the offerings a bit from what information is available, I think it is more a story of leveraging a recognizable brand than anything else because I don’t believe there is much overlap in the actual consumer products and their industrialized counterparts that would be required. Over time, it may prove that they are adopting what we would describe here as the IBM model and are ceding commoditized products in favor of higher-value services.. It is too early to tell. For more information about the P& G franchise businesses, please see <http://www.tidedrycleaners.com> and <http://www.mrcleanwash.com>. Both observed December 23, 2010. For more information about the show on CNBC, please see [http://www.cnbc.com/id/39911155?\\_source=vty|franchising|&par=vty](http://www.cnbc.com/id/39911155?_source=vty|franchising|&par=vty). Observed December 23, 2010.

<sup>48</sup> For John Deere, it’s actually closer to two centuries.

<sup>49</sup> For more information about IBM, please see Appendix A.

<sup>50</sup> For more information about GE, please see Appendix A.

## 2.6.1 – John Deere

Before we look at GE and IBM, it is important to contrast what they are doing with traditional supply chain integration: acquiring the vertical elements of an existing supply chain. At the most basic level, a company acquires either forward (toward the customer and the end-product) or backward (toward the suppliers and ultimately raw materials). We can point to two examples of forward supply chain integration in the recent history of John Deere. We'll use those as a baseline before looking at more advanced strategies.

### 2.6.1.1 – John Deere Construction and Nortrax

In 1999, John Deere acquired Neff Machinery Inc. from the Neff Corporation. That acquisition was the first (of many) for the Nortrax division of Deere. According to a New York Times article that reported the acquisition, the purpose of Nortrax is “to run Deere’s construction equipment dealers.”<sup>51</sup> Of the 402 locations that sell John Deere construction equipment today, Deere’s 2009 SEC 10-K report indicates that Deere owns “some” of those locations. A Google maps search finds 194 locations in North America with the name, “Nortrax.”<sup>52</sup>

Here we have a basic example of forward supply chain integration. While Deere does not hide their ownership of Nortrax, they do not advertise it (For example, there is no mention on the Nortrax website of Deere ownership<sup>53</sup>) and their plans for the on-going acquisitions<sup>54</sup> are not publically discussed. While there may be deeper plans, from externally available evidence, it appears to be a straightforward effort to capture more of the revenue between Deere and their customers by internalizing a part of the services value chain to capture existing value. That is the most basic kind of services integration, and it can deliver value to shareholders (and other stakeholders), especially in markets where the service delivery footprint is stable and not growing.

Best Buy’s extended warranty program and house-brand products – both mentioned earlier – are examples of the same approach. With house-brand, private-label products, they are exhibiting backwards integration, and with the extended warranties, they are integrating forward.

### 2.6.1.2 – John Deere Landscapes and LESCO

As another example of forward supply chain integration, in 2007, John Deere acquired the landscape concern, LESCO. According to a New York Times article at the time<sup>55</sup>, LESCO operated “more than 300 stores, selling products including seeds, chemicals and fertilizer for professional lawn maintenance companies like golf course operators. LESCO was rolled into John Deere Landscapes and Deere’s “One Source” strategy to meet all the needs of golf course maintenance professionals. One Source brings together products from the Ag & Turf division, services from John Deere Landscapes, and financial services from John Deere Financial into one integrated offering.

---

<sup>51</sup> Source: November 13, 1999 New York Times, Section C; Page 3; Column 1; Business/Financial Desk. Byline: Dow Jones.

<sup>52</sup> See <http://maps.google.com>. Observed October 22, 2010.

<sup>53</sup> See <http://www.nortrax.com>. Observed December 5, 2010.

<sup>54</sup> A Google or Lexis-Nexis search shows that it has been on-going.

<sup>55</sup> Source: February 20, 2007 New York Times, Section C; Column 5; Business/Financial Desk; Pg. 2. Byline: Reuters.



Beyond “just” capturing value as Deere is doing with Nortrax here, you see Deere trying to create new value for customers by creating new synergies and eliminating interface inefficiencies through stronger integration than is evident with Nortrax.<sup>56</sup> It is important to note that these visions to create new value are not easy, and very often do not meet initial expectations. In this case, John Deere’s 2009 Annual Report lists \$289.2M write-off as from recognizing a goodwill impairment related to the above-mentioned LESCO acquisition.

## 2.6.2 – IBM Global Services

IBM’s roots are as a machine company, as the name implies. They commercialized business computing in the 1960s and 1970s, the heyday of the mainframe. Since the PC revolution of the 1980s, IBM has had to take a different approach and diversify its business model. According to their 2009 Annual Report<sup>57</sup>, IBM Global Services (IGS) now represents 42% of IBM’s revenue. That business unit did not exist until the 1990s (Chesbrough and Spohrer, 2006) as IBM had to evolve their business model to cope with a radically different price-performance curve and type of user needs in the PC world that IBM had commercialized. It is important to note the services are the least profitable (when considering gross margins) of the IBM divisions, as shown in Table 5. Even hardware has a higher gross margin. That is primarily because IBM has shed much of the commodity hardware business. Services (between Global Technology Services and Global Business Services) represent well over 50% of total revenue and 42% of income. Just nine years ago, IBM hardware sales were 24% of income. IBM’s direction is clear.

Table 5: 2009 Performance of IBM Divisions

IBM Division	Gross Margin	Revenue (\$M)	Revenue (%)	Income (%)
Global Technology Services	35.0%	\$37,347	39%	42%
Global Business Services	28.2%	\$17,653	18%	
Software	86.0%	\$21,396	22%	42%
Systems & Technology	37.8%	\$16,190	17%	7%
Global Financing	47.5%	\$2,302	2%	9%
Other		\$869	1%	

As a computer systems company, IBM built exceptional knowledge of how business is done; in order to automate business processing, it first had to be understood before it could be digitized. In their near-monopoly status of the 1960s, 1970s, and early 1980s for industrialized data processing, they were able to bundle that knowledge with the products. The massive shift in pricing structure since the PC era began in the early 1980s made it no longer possible to make those consultative services a part of the hardware. To be clear, IBM still takes good care of their customers and is generous with their expertise, but in building the world of business computing, they had developed a hugely valuable asset around business process knowledge. Now, they have un-bundled it and market it as a very successful product-based service business.

<sup>56</sup> See [http://www.deere.com/en\\_US/golfturf/index.html](http://www.deere.com/en_US/golfturf/index.html) for more information about John Deere One Source. Observed December 4, 2010.

<sup>57</sup> All financial data in this paragraph, even for other years, is from IBM’s 2009 Annual report.

What is special about IBM is that they are able to sell these product-based services even when it is someone else's product. The information of a particular computing platform is relatively simply to pick up and learn compared the knowledge of how business is done. They will implement their software on someone else's hardware, or even implement someone else's software. IBM is actually divesting themselves of their traditional products in favor of services, and growing while doing it.

### 2.6.3 – GE

I am aware of no company's annual report where services are featured so prominently in their strategy as GE. As its 2009 annual report points out, over one-third of GE's revenue comes from product services (their term) and – more significantly – nearly three-fourths of their industrial earnings comes from services as well. Even more impressive than the \$35B in product services revenue is the backlog of \$129B, which points to the stability of services as a revenue stream. GE also positions services – value- and product-based – around their products and their customers:

- “Financing for the products we know with the people we know” (page 20)
- “Our competitive advantage in services is a deep understanding of our customers’ productivity based on how they use our products.” (page 6)

That makes them in some ways the opposite of IBM in that regard; they use their services to – in a sense – protect their products. That is the more common approach. While perhaps best-in-class, GE's service emphasis is representative of companies in their sectors (IBM is not...most “computer” companies have traditionally avoided services (Cusumano, 2010)). A number of providers of power systems, propulsion systems, and air planes are the same in that regard. It has been observed that for at least some of those companies, the end of the cold war forced them to get more creative in revenue sources (Spear, 2009). I would argue that there are other factors that drive that business model as well:

- Nature and complexity of products creates a pre-disposition toward “systems thinking” and taking a holistic approach to solve problems.
- Long product life and relatively few orders creates need to “do something” with expertise between product sales.
- Specialized skills may be in short supply already and cannot be duplicated in separate service and support organization (we'll discuss that idea more in the next section).

## 2.7 – Tying It Together: Generating Measurable Value from Knowledge through Product-Based Services

To use the language and ideas of MIT Sloan Professors Eric Von Hippel and Tom Allen, knowledge (“how” questions and answers) and wisdom (forward-looking, or “why” questions and answers) are very sticky, when compared to data and information<sup>58</sup>. That is to say that since they are tough to reduce completely to symbols and therefore encode onto paper or digital media, they tend not to travel very

---

<sup>58</sup> I defined the terms, “Data”, “Information”, “Knowledge”, and “Wisdom” and described how they related to each other and to services in Chapter 1.

far, very fast. They take very high-bandwidth environments to communicate well. Even today, that often means people traveling in order to be face-to-face. What GE is doing with their product-based services is breaking down traditional barriers on knowledge that cause it to be duplicated or perhaps “over-built” when a separate service organization has to build similar competencies to deliver product-based services, and in efficient markets, that’s not tolerated forever (or even for long, in some cases). In a traditional organization, we could portray it as in Figure 14. Within the walls of a traditional company – where the “conceive”, “design”, and “implement” activities occur – boundaries tend to be more porous and D-I-K-W flows more easily, making it generally more additive. Because of the greater impedance, the operational knowledge around installing, maintaining, repairing, upgrading, etc. is much more separated, and more differentiated.

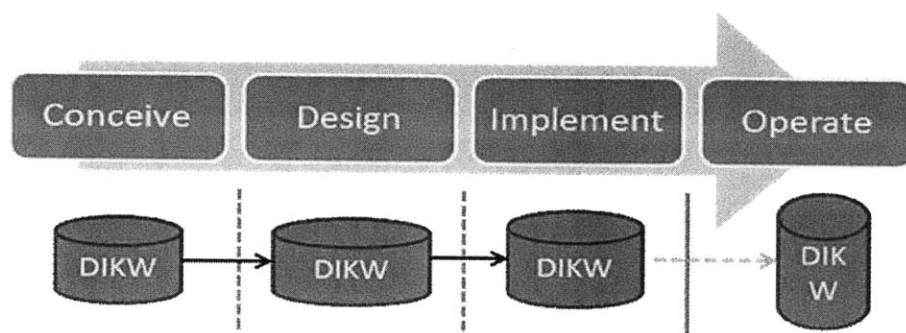


Figure 14: D-I-K-W transmission in traditional organizations

Figure 15 shows a conceptualization of how that works in the GE model. The same repositories (or, in practice, much closer to the same) are able to exist in all places because of the reduced impedance, organizational and otherwise.

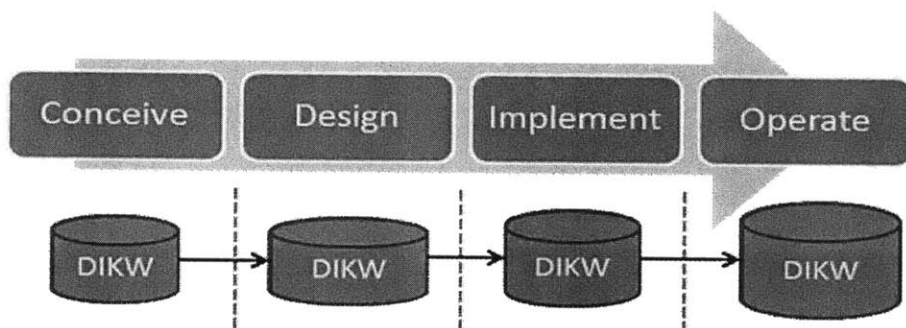


Figure 15: D-I-K-W transmission in a company like GE

As efficient markets force products seek the cost of capital, justifying that duplicated efforts to create knowledge becomes tougher (impossible) to justify and therefore maintain. This “knowledge over-build” of sorts will ultimately be eliminated in efficient markets. By making D-I-K-W flow more freely, smart companies eliminate the over-build by making the same D-I-K-W available where it’s needed. Without that ability, it will be eliminated by a competitor simply re-producing a product’s specifications

without the knowledge and wisdom (which is not tolerated if it is not creating adequate value). That can cause lesser products, but efficient, “invisible hand” markets don’t know how to do anything else.

By tying the D-I-K-W stores from “conceive-design-implement” organization to the “operate” organization(s), its value creation is not only clear, it is now a source of differentiation and services revenue for a product company. We’ll see later in Chapter 4 how the Rolls Royce Group takes that notion a step further.

# Chapter 3 – Information-Based Services

---

It is difficult (impossible?) to find an area of the modern economy un-impacted by the advanced of information technology. This thesis will not (could not) attempt to address all of those areas. Very specifically, I narrowed my gaze to product-service systems that require the automatic processing of information because of either the speed of delivery or volume of data to process required. Within that boundary, four potential areas to study came to mind:

- Online retail/e-tailing
- Social networking
- Ubiquitous computing/the Internet of Things
- Telematics.

I was particularly attracted to telematics in the automotive space. As with e-books and the long, static history of media for reading, the relatively long and relatively static history of the automobile itself provides an interesting backdrop to study any new trend<sup>59</sup>. Having the product itself less dynamic means less noise which needs to be filtered in the study. Focusing on the telematics surrounding cars and similar systems (like tractors and backhoes) also makes it possible to take a very different approach to product-service systems than was taken in Chapter 2, focusing here on the product-service systems themselves and working from the specific to the general.

## 3.1 – Defining Telematics

Like other ideas around information technology and information processing, the state of the art of telematics is quickly advancing, and as with all modern IT systems, the costs of processing, storage, and I/O are driven by Moore's law, and therefore declining while both the economy of scale is improving and the associated scientific and engineering body of knowledge is improving. It seems that Moore's law is treated to be almost as proven and established of a "law" as gravity.

Numerous definitions of telematics exist, and as with the definition of services itself, to find one that is complete and satisfactory is a difficult endeavor. A definition of telematics may be as simple as "an application of wireless networks in automobiles" (Grymek et al., 2007). In a more specific, more complete fashion, the following definition can be used: "Vehicle telematics is the use of computing, sensing and telecommunication technologies to provide services in an automotive environment" (Cassias and Kun, 2007).

Also, as with the nature of services themselves, the enumerations of the types of potential telematics products and services are as numerous and disparate as the definitions. In general, the length and

---

<sup>59</sup> Construction equipment and agricultural equipment, where there are also lots of telematics services evolving have been similarly static in their product evolution – incremental improvements to dominant designs for several decades. The static nature of the auto industry has been well established by others and is presented as a given here.

complexity of both definitions and service enumerations associated with telematics vary inversely with their age. That is to be expected for any emerging field. Going to the vendors themselves, GM's<sup>60</sup> OnStar categorizes its services as follows:<sup>61</sup>

- Emergency & Security
- Vehicle Diagnostics
- Hands-Free Calling
- Turn-by-Turn Navigation

Ford's<sup>62</sup> SYNC, Co-branded with Microsoft<sup>63</sup>, represents a different focus with their list of features:<sup>64</sup>

- Mobile
- Entertainment
- Traffic & Directions
- Driver Assistance

The Ford list represents a broader view of telematics, moving beyond the information-and-security focus of OnStar to include "infotainment" features as well.

### 3.1.1 – A Simple Taxonomy

At the highest level, it seems that perhaps the goals of telematics systems could be broken into five categories, as portrayed in Figure 16.

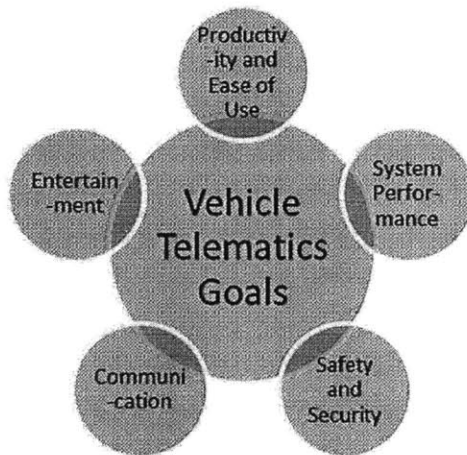


Figure 16: Goals of Vehicle Telematics Systems

<sup>60</sup> For more information about GM, please see Appendix A.

<sup>61</sup> From <http://www.onstar.com/web/portal/plansservices>. Observed October 17, 2010.

<sup>62</sup> For more information about Ford, please see Appendix A.

<sup>63</sup> For more information about Microsoft, please see Appendix A.

<sup>64</sup> See <http://www.fordvehicles.com/technology/sync/features/#page=FeatureCategory1>. Observed October 17, 2010.

To be sure, the individual features available often do not fit tightly into just one of those five categories. For example, hands-free Bluetooth phone support, available with SYNC, OnStar, and many other automotive telematics platforms has value for reasons of both “safety and security” and “ease of use.” Similarly, performance reports about the vehicle itself like those emailed by the OnStar system are “system performance”-oriented, but information like tire pressure and scheduled maintenance reminders have a strong “safety” element as well. Further, the centralized nature of the information also qualifies for “ease of use.” More commercially oriented telematics tools like Ford “Crew Chief” (more later) or’s JDLINK (again, more later) are more focused on “productivity and ease of use” and “system performance,” and not much at all on entertainment.

It is worth noting that “informational” itself is a potential category, and is often used in other descriptions of telematics systems, but I am aware of no telematics functions that are purely informational; the information seems not an end unto itself. As an example, even something as simple as providing basic information like the outside temperature has elements of both “safety and security” and “ease of use.” This attempt to organize is at odds with most telematics taxonomies, in that it is an attempt to organize functions around high-level needs that are technology-independent; most systems are organized around more actions which are thinly veiled descriptions of the technologies, like “navigation” as a substitute for “GPS.” In this taxonomy, those functions sit between the needs and technologies used to implement them, with a hope that the needs would be more enduring and technology-independent, and will facilitate broader comparisons across a wide definition of the automotive industry, including heavy equipment like tractors and excavators.

Information can also be classified based on the knowledge domain from which it is derived. As is mentioned in Chapter 1, Product Information comes from one of three primary information domains:

- The operator(s)
- The product
- The operating environment

Taken together, the two simple taxonomies of needs met and knowledge domain used, can be used to organize features into a tabular arrangement as shown below in Table 6. That table can be used to characterize the need and knowledge focus of the system and then compare them. Features are based on those listed on the OEM’s website, and the need and knowledge domain columns represent simple yes/no answers, where “yes” is represented as a “1.” The percentages represent the fraction of features reflecting the need met or knowledge domain used. That makes it possible to total results for a system to determine its focus. Since results are expressed in terms of percentages instead of absolute terms, the granularity of the feature description does not matter.

Table 6: Characterizing the Needs Met and Knowledge Domains Used by GM OnStar and Ford SYNC

System			Needs Met					Knowledge Domain Used			
OEM	P-S-S	Feature	Safety & Security	System Performance	Entertainment	Communication	Productivity/Ease of Use	Operator	Product	Operating Environment	
GM	OnStar	Automatic Crash Response	1						1	1	
		Emergency Services	1					1	1	1	
		Crisis Assist	1			1		1		1	
		Stolen Vehicle Assistance	1						1	1	
		Remote Door Unlock	1				1		1		
		Roadside Assistance	1			1	1		1	1	
		Remote Horn & Lights					1		1		
		OnStar Vehicle Diagnostics	1	1			1		1		
		Hands-Free Calling	1			1	1	1			
		Turn-by-Turn Navigation						1		1	1
			<b>80%</b>	<b>10%</b>	<b>0%</b>	<b>30%</b>	<b>60%</b>	<b>30%</b>	<b>80%</b>	<b>60%</b>	
Ford	SYNC	Bluetooth phone support				1	1	1			
		Hands-Free Calling	1			1	1	1			
		Audible Text Messages	1			1	1	1			
		Uninterrupted Connections				1	1	1	1		
		Advanced Calling Features				1	1	1			
		Ringtone Support			1	1	1	1			
		Automatic Phonebook Download				1	1	1			
		Multiple Phone Support				1	1	1			
		Media file format support			1			1			
		Music Search			1			1			
		USB Device Charging			1			1			
		"Play Similar" Feature			1			1			
		Podcast and Audiobook Support			1			1			
		Bluetooth Streaming Audio			1			1			
		Turn-by-Turn Directions						1		1	1
		Traffic Alerts						1		1	1
		Business Search						1		1	1
		Personalized Daily Info			1			1			
		Travel Services						1	1	1	1
		Send to SYNC						1	1	1	1
911 Assist	1						1	1	1		
Vehicle Health Report	1	1				1	1	1			
			<b>18%</b>	<b>5%</b>	<b>36%</b>	<b>36%</b>	<b>68%</b>	<b>86%</b>	<b>36%</b>	<b>27%</b>	



Since the purpose of the table is to represent the capabilities of the product-service system, different packages (e.g. “Safe and Sounds” vs. “Directions and Connections” for GM OnStar) are not differentiated here, although they could be for a more exhaustive treatment or a study of market positioning of different offerings. It would also be possible to include other features like Ford “Crew Chief” (discussed more later), but unless the OEM has chosen to classify them with the offering, they are not listed here. Features like XM radio where it is primarily just the one-way reception and decoding of data, and DVD systems where not remote connectivity is required, and sensor networks within the vehicle themselves, are also not considered.

Summarizing the table results and placing them on a radar chart graphically portrays the emphases of the different product-service systems. Figure 17 portrays the different focus in needs met. While ease of use is a clear goal for both systems, the marketing value proposition of the respective systems is clearly reflected in the features: Ford SYNC focuses on communication and entertainment, while GM OnStar, beyond ease of use, is almost entirely focused on safety and security.

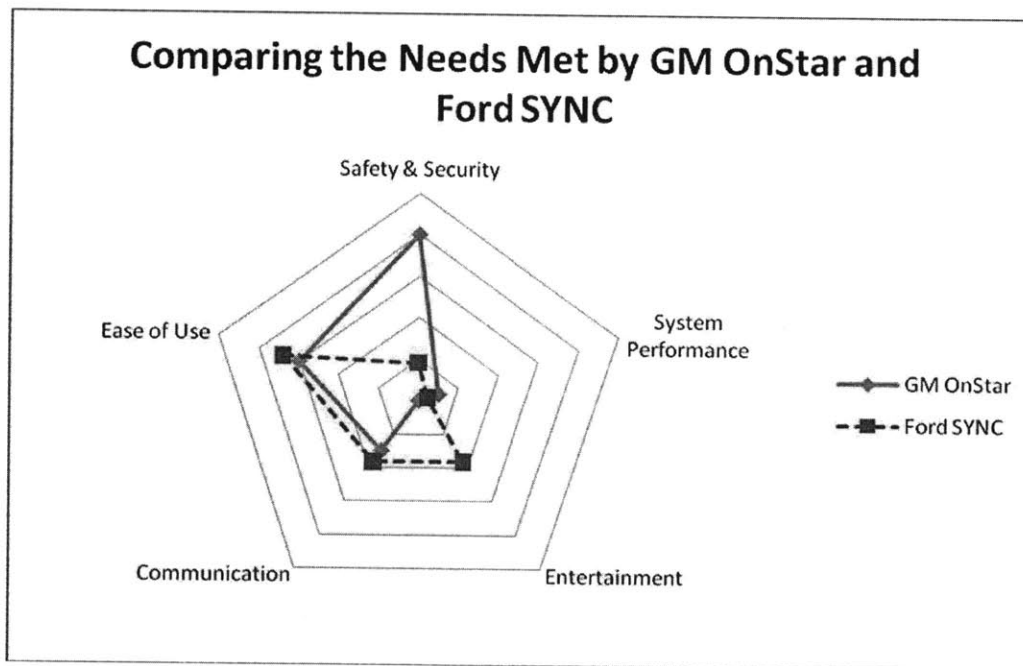


Figure 17: Comparing the Needs Met by GM OnStar and Ford SYNC

Using the same radar chart approach, Figure 18 shows the biases of the knowledge domains as well. The limited integration of Ford SYNC into the automotive subsystems and its focus on the customer experience are immediately evident. GM OnStar and its much deeper integration with the vehicle is apparent as well.

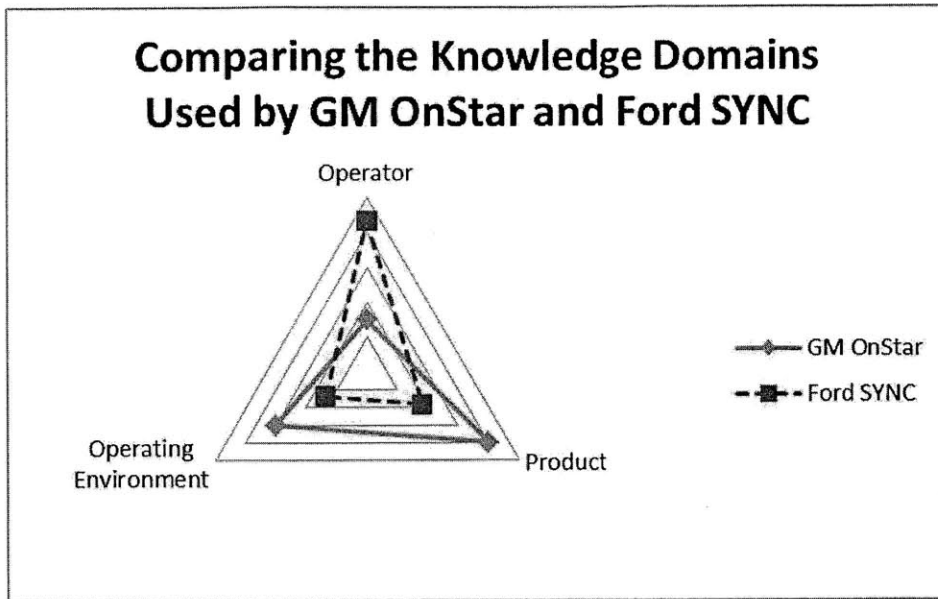


Figure 18: Comparing the Knowledge Domains Used by GM OnStar and Ford SYNC

### 3.2 – A Tale of Two Systems: Ford SYNC and GM OnStar

A brief look at the On-Star and SYNC approaches to vehicular telematics also quickly reveals one other major difference in approaches between the two companies: GM's OnStar is presented as a GM service, marketed and developed by GM for GM cars<sup>65</sup>. Ford's SYNC is "Powered by Microsoft" and clearly marketed and developed cooperatively.

As will be discussed more later in the thesis, this same dichotomy is quickly apparent in other related industries featuring powered, mobile, complex electro-mechanical "car-like" systems as well. Caterpillar<sup>66</sup> and Case-New Holland<sup>67,68</sup> are clearly aligned with Trimble<sup>69</sup> in their construction (Caterpillar) and agricultural (Case-New Holland) telematics systems<sup>70</sup>, while John Deere appears to have gone it primarily alone with JDLINK<sup>71</sup> for construction equipment and JDLINK<sup>72</sup>/GreenStar<sup>73</sup> for agricultural equipment.

<sup>65</sup> More on this in a few pages.

<sup>66</sup> For more information about Caterpillar, please see Appendix A.

<sup>67</sup> For more information about Case-New Holland, please see Appendix A.

<sup>68</sup> See <http://www.putyourfarmonthemap.com/>. Observed October 17, 2010.

<sup>69</sup> For more information about Trimble, please see Appendix A.

<sup>70</sup> See <http://www.trimble.com/news/release.aspx?id=091001a>. Observed October 17, 2010.

<sup>71</sup> See [http://www.deere.com/en\\_US/cfd/construction/deere\\_const/service\\_support/jdlink.html](http://www.deere.com/en_US/cfd/construction/deere_const/service_support/jdlink.html). Observed October 18, 2010.

<sup>72</sup> See

[http://www.deere.com/servlet/com.deere.u90785.productcatalog.view.servlets.ProdCatProduct?tM=FR&pNbr=idl\\_select](http://www.deere.com/servlet/com.deere.u90785.productcatalog.view.servlets.ProdCatProduct?tM=FR&pNbr=idl_select). Observed October 18, 2010.

<sup>73</sup> See [http://www.deere.com/en\\_US/ProductCatalog/FR/category/FR\\_GREENSTAR.html](http://www.deere.com/en_US/ProductCatalog/FR/category/FR_GREENSTAR.html). Observed October 18, 2010.

### 3.2.1 – A Brief History of GM’s OnStar

OnStar’s history is very well documented. OnStar grew out of an IBM Extreme Blue<sup>74</sup> internship as a vehicle location system in the mid-1990s (Held, 2008). From there, the idea grew into a joint venture between GM, Hughes Electronics, and EDS: Project Beacon (Holstein, 2009). The layer of the World Wide Web over the previously academic Internet was proving that information could become ubiquitous and that anything could be made available to drivers; to do so was very tempting to the OnStar team – traffic reports, stock prices, any information could be presented. Early on, OnStar leader Chet Huber and his team made some basic choices that still influence/govern OnStar today: minimal distractions to drivers – hence the simple, three-button interface usually integrated into the rearview mirror – and a focus on safety and security.

GM created OnStar as a separate division initially with a view towards selling OnStar on non-GM cars as well, which they did with some success early on. Lexus’s “Link” (started in 2000 and discontinued in 2008 just before Toyota released their own, limited, very similar service) was a re-branded OnStar offering (Webb et al., 2010). Acura, Isuzu, Audi, and Subaru cars also offered OnStar (Bowens, 2005) but all have stopped. The interface standard that GM created, AMI-C<sup>75</sup>, never really caught on either. Ultimately – in a situation that feels similar to PepsiCo and their fast food subsidiaries before they were spun off that pushed fast-food beverage business to Coca-Cola – the automotive companies felt that the close tie to GM was a detriment to their businesses. In its 2007 Annual Report, GM themselves began to recognize OnStar as “a competitive advantage” which strongly implies that – despite early attempts to position it as such – they recognize that it is not OEM-neutral. It is a part of GM.

The re-born GM finds itself again in the situation of selling the service on non-GM brands simply because of the state of brands like Saturn and Hummer. The future for those brands is not clear and the decision is in the hands of the new management (Huber and Dorfstatter, 2009). GM is also interested in again developing arrangements for brands that have never been in the GM family and is hinting that it will happen (Huber and Dorfstatter, 2009) in the next couple of years.

The most significant decision<sup>76</sup> GM made was not around architecture or features, but how to position and sell it: product or service. In the mid-1990s, services for cars meant either ways that the dealers made money or ways that GMAC<sup>77</sup> made money – not GM itself. The most natural and safest choice would have been to position it as a feature or a product. Considering that the telematics industry really did not yet exist, it would not be too strong to describe that decision to position it as a service offering as visionary.

---

<sup>74</sup> See <http://www-01.ibm.com/employment/us/extremeblue/>. Observed October 23, 2010.

<sup>75</sup> AMI-C: “Automotive Multimedia Interface Collaboration” or “Automotive Multimedia Interface Consortium.” Website <http://www.ami-c.org> is no longer available. At one point, the Detroit three and others belonged, but it appears to have been abandoned. Microsoft is proposing a competing standard for their embedded auto architecture.

<sup>76</sup> What Barabba et al call the “fundamental decisions.” Source: Barabba V., Huber C., Cooke F., Pudar N., Smith J., Paich M. (2002) A multimethod approach for creating new business models: The General Motors OnStar project. Interfaces 32:20.

<sup>77</sup> GMAC – General Motors Acceptance Corporation - was the finance division of GM.

### 3.2.2 – Is OnStar Profitable?

On several occasions over the last several years, GM has claimed OnStar to be profitable, but it is difficult to know. Their annual report does not break out financial performance for OnStar separately, and it is not clear from publically available documents whether OnStar internally recognizes revenue from the car divisions for that first year of subscription that comes with the vehicle purchase price or not. Looking across a variety of articles, you can start to construct some snapshots of different statistics in different years. Table 7 shows spotty statistics culled from a number of sources (those footnoted here). Table 8 represents an attempt to do that, and Table 9 tries to infer all of those values for 2010, making a number of assumptions. See Moore’s Law in action in Table 7 as the hardware price cuts in half every two years and goes from \$800 to \$100 in a six-year period.

Table 7: Spotty OnStar Statistics

Year	Total Subscribers	Revenue	Employees	Call Center Operators	Other Contractors	HW Cost	Cars Sold with OnStar	Ad Spending	IT Budget	Renewal Rate
1996						\$800				
1999	200,000									
2002	2,000,000		400	1,000		\$100				
2006										60%
2008								\$ 95M		
2010	6,000,000	\$1B			500		2,500,000		\$ 250M	

Table 8: Inferring Some 2010 Statistics for OnStar

<b>Subscribers</b>	6,000,000
<b>Revenue</b>	\$1,000,000,000
<b>Employees</b>	800 (est.)
<b>Contractors</b>	3,500 (est.)
<b>HW Cost/car</b>	\$50 (est.)
<b>Cars Sold</b>	2,500,000
<b>Ad Spending</b>	\$50,000,000
<b>IT Spending</b>	\$250,000,000
<b>Renewal Rate</b>	60%

Table 9 could be a breakdown of major expenses and potential profitability<sup>78</sup>. While most of these numbers are estimates, as a simple sanity check, OnStar could easily be making money for GM, and a very nice margin at that, well exceeding anyone’s cost of capital or hurdle rate in their manufacturing operations, and a profit of 30% certainly exceeds their margins on automotive or automotive credit operations even in very good years.

<sup>78</sup> Assuming an average cost of \$40,000/contractor and \$80,000 per employee.

Table 9: Potential 2010 Profitability for OnStar

<b>Estimated Revenue</b>	\$ 1,000,000,000
<b>Non-IT Employees</b>	\$ (53,600,000)
<b>Non-IT Contractors</b>	\$ (120,000,000)
<b>Other Admin</b>	\$ (100,000,000)
<b>Advertising</b>	\$ (50,000,000)
<b>IT Costs</b>	\$ (250,000,000)
<b>HW Cost for new cars</b>	\$ (125,000,000)
<b>Estimated Income</b>	\$ 301,400,000

What if OnStar were able to offer its services to all passenger cars on the road? According the Bureau of Transportation Statistics, the total passenger car market in the United States is over 137M vehicles<sup>79</sup>. Assuming the same 60% renewal rate and the same level of profitability per car, OnStar’s gross revenue could be over \$13B/year with potential income of over \$4B/year. Based on the same BTS data, expanding beyond passenger cars to all vehicles almost doubles the market size.

### 3.2.3 – A Brief History of Ford’s SYNC

SYNC is not Ford’s first foray into the telematics space. OnStar was actually a fast-follower to RESCU (Remote Emergency Satellite Cellular Unit), a joint effort between Motorola and Ford for the 1997 Lincoln Continental. It offered Automatic Collision Notification (ACN) and (analog) cellular phone service. RESCU was discontinued in 2001 (Webb, 2010). WingCast, developed with QUALCOMM<sup>80</sup>, was its next attempt, but as Ford switched from the Jacques Nassir era to the William Clay Ford Jr. era, the plug got pulled on it before it went live (Unknown, 2002).

Ford was silent in the telematics space for the next few years until Ford SYNC was released in 2008. Ford and Microsoft<sup>81</sup> developed the platform together, based on the Microsoft Auto platform, giving Ford exclusivity until 2009. Kia will soon be releasing UVO and Fiat has released Blue & Me – both based on Microsoft Auto as well<sup>82</sup>.

Just as OnStar is focused primarily on safety and security, SYNC is focused primarily on Infotainment. There are other major differences as well. SYNC is a \$395 product feature, instead of a service<sup>83</sup>. Additionally, SYNC does not include native mobile telephony. Instead, it interfaces with the drivers’

<sup>79</sup> See [http://www.bts.gov/publications/national\\_transportation\\_statistics/html/table\\_01\\_11.html](http://www.bts.gov/publications/national_transportation_statistics/html/table_01_11.html). Observed October 22, 2010.

<sup>80</sup> For more information about QUALCOMM, please see Appendix A.

<sup>81</sup> It is assumed that the reader is familiar with Microsoft. For more information, please see <http://www.microsoft.com/about/en/us/default.aspx>. For a more neutral, but potentially less rigorous summary of the firm, please see <http://en.wikipedia.org/wiki/Microsoft>. Both observed October 21, 2010.

<sup>82</sup> See <http://www.microsoft.com/windowseembedded/en-us/products/windows-embedded-automotive/default.mspx> for more information. Observed October 19, 2010

<sup>83</sup> After three years, some SYNC functionality requires a \$60/year subscription, so while primarily positioned as a product, there is a small service element as well, from a financial perspective.

mobile phone. The primary differences between Ford SYNC and GM OnStar are summarized below in Table 10.

Table 10: Summary Comparison of GM OnStar and Ford SYNC

Aspect/Telematics System	GM OnStar	Ford SYNC
Needs-Met Focus	Safety and Security	Infotainment
Knowledge Domain Focus	Product	Operator
Mobile Telephony (Network Architecture)	Native	Provided by consumer
Business Model	Subscription-based Service	Product Feature
Product Positioning	Competitive Advantage for GM	Co-branded ("Powered by Microsoft"). At arm's length from company's core product.

### 3.2.4 – Ford's Related Offerings

Ford also has several other related offerings focused on productivity for construction sites in pick-up trucks that were also released in 2008 and based on the Microsoft Auto platform, but not as well marketed as SYNC<sup>84</sup>. They have since been expanded to Ford E-Series and Transit vans.

- In-Dash Computer (developed with Microsoft using a wireless keyboard, optional mobile printer and an in-dash computer to access office files, remotely control a PC, or do other basic functions from the field.)
- Tool-Link (in partnership with DeWalt and ThingMagic<sup>85,86</sup> using UHF passive RFID tags and readers to track tools).
- Crew Chief (GPS-based Fleet optimization and management).

While not branded as a part of SYNC, there are shared architectural components, and show another difference between the approaches of GM and Ford, with Ford branching out into productivity applications, and starting to treat telematics as a platform. As with SYNC, these are positioned as

<sup>84</sup> For more information, see <http://www.FordWorkSolutions.com>. Observed October 19, 2010.

<sup>85</sup> While DeWalt is mentioned on the Ford page, ThingMagic is not, likely because it is not a brand familiar to the typical Ford audience. See ThingMagic's announcement here: <http://www.thingmagic.com/applications-overview/toollink-by-dewalt>. Observed October 21, 2010.

<sup>86</sup> During the writing of this Thesis, ThingMagic got acquired by Trimble, a company about which we will read more later in this chapter. Since – at this point – it does not materially change anything, there is not a need to address it further.

product features. The network connectivity – while not assumed to be provided by the customer as with SYNC – is contracted separately with Sprint.

### 3.2.5 – Total Sales

In its three model years in the market place, SYNC has already topped 2M in sales and Ford reports that it is now sold in 70% of new cars. It is too early to assess whether SYNC is profitable or to compare the approaches of SYNC and OnStar as business models, but Ford CEO Alan Mulally has been quoted as saying that “these features set us apart.”<sup>87</sup> As a concrete measure of that assertion, Ford’s product development chief Derrick Kuzak and CEO Mulally have both been variously quoted as saying that the infotainment system was crucial to 32% of buyers in 2009.

### 3.2.6 – Why Such Different Approaches?

It is not possible to definitely answer the question of why Ford and GM have such different approaches, but there are some observations that can be made.

#### 3.2.6.1 – Different Architectures

Architecturally, what the two companies are doing is similar, but there are some important differences that are reflected in their strategies. Kevin Baughey’s 2007 MIT thesis presents ostensibly the OnStar (based on the AMI-C “standard”) architecture and a commercial OS architecture (as with Microsoft’s embedded Auto OS) as containing the same elements with different interfaces and layering. Figure 19 portrays that where the Standards-Based Architecture, which represents AMI-C/OnStar and the more integrated than the commercial OS, which represents SYNC (Baughey, 2007).

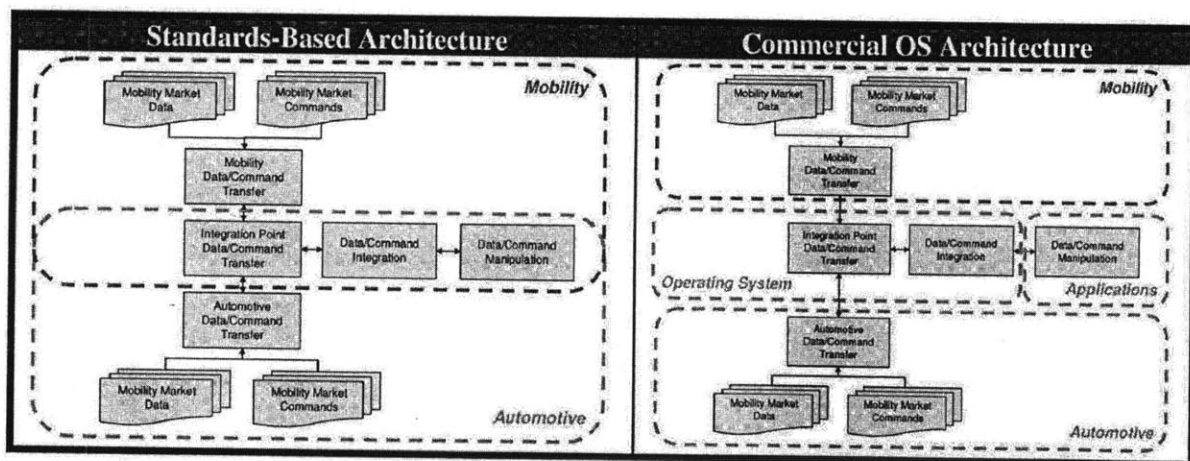


Figure 19: Comparing a Standards-based and Commercial OS Telematics Architecture (Baughey, 2007)

It seems unlikely that a single architecture will emerge at this point as AMI-C is already waning in support. In 1999 Ford was among the automotive manufacturers that supported it (Lappin, 1999). In fact, in 1999 manufacturers representing more than half the cars on the road were behind AMI-C, but once support for a standard fractures, it is hard for them to re-gain traction, and the market is now

<sup>87</sup> At the 2010 Las Vegas Consumer Electronics Show in his keynote speech.

mature enough that existing companies are trying to protect their territories, and they are unlikely to “give away” ground. As with CDMA and G3 mobile phone networks, unified standards that work across entire industries are seldom put back together once companies start making real money and competitive barriers are believed to be required. Consider – as two examples of successful standards work unifying an industry – the work of MIT Professor Sanjay Sarma and MIT’s Auto-ID Lab to lead the development standards for UHF passive RFID before the industry became highly profitable, or the development of standards like DNS and TCP/IP that drive the Internet and the World Wide Web and were created long before Netscape’s IPO.

### 3.2.6.2 – Different Times

The first factor to consider in explaining the different approaches is the time difference of the birth of these ideas. Ford’s RESCU – conceived in the same time period – was very similar to OnStar at the time. In the mid-1990s, more robust offerings were not possible. SYNC, conceived in a much different era knew that more could be done. The biggest competitor for the original OnStar and RESCU was a 1996 cell phone, which – in today’s mobile phone terms – did not do much.

Ten years later, the systems competed with a much richer ecosystem of personal devices, each of which could provide some of the potential services that an automotive telematics platform can provide. In 2006, as Ford SYNC was being conceived and developed, the competitors for automotive telematics could be thought of as portrayed in Figure 20. Figure 20 also portrays the fact that smart phone was competing with the same collection of devices. That is still true, but the smart phone is winning. Between 2006 and 2010, the smart phone has begun to eliminate the categories of personal music systems, and personal navigation systems. For example, the category of personal digital assistants has been completely consumed, and smart phones are the primary web browser for many younger Americans, and perhaps the only web browser for many in some emerging economies.

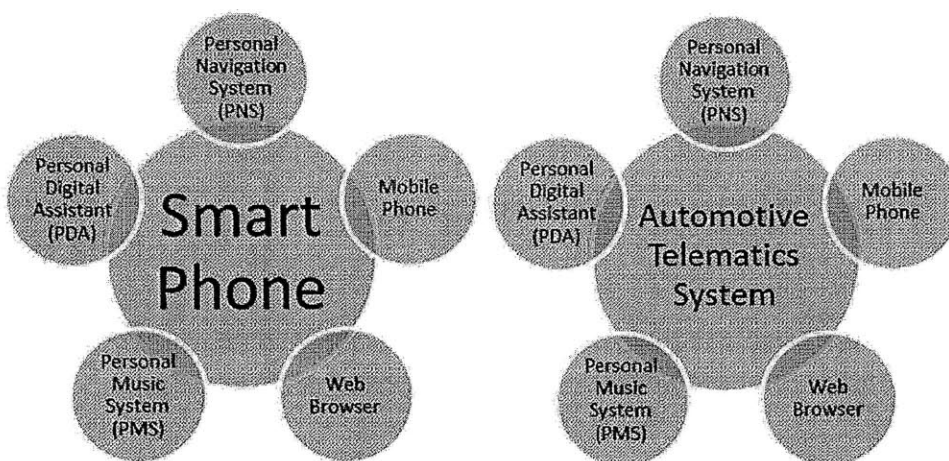


Figure 20: The 2006 competitive landscape for Automotive Telematics Systems, for Smart phones



Ten years earlier, the same idea held true, OnStar and RESCU competed with the state of the art in mobile phones, which wasn't much. Said differently, the metaphor for SYNC is a smart phone. The metaphor for OnStar is (for lack of a better term) a "dumb" mobile phone. That is not to say that the OnStar architecture or value proposition is outdated. With a renewal rate reported at 60%, it is clear that the simple and straightforward "safety-and-security" message resonates with customers, and the simplicity and maturity of the components likely make it very cost-effective to implement.

The different times are also reflected in the different development models. The relatively financially healthy GM of the mid-1990s (compared to the last few years) was able to marshal the capital required largely to "go it alone" while the Ford of 2006 was already "chips all in" on their own future<sup>88</sup> and needed partners not just to move quickly, but to keep the capital requirements outside of the company. SYNC was also developed in a world where the notions of open innovation exhibited there are much more broadly accepted and understood than they were a decade earlier.

What is toughest to explain from the externally observable evidence, and what is most salient to this thesis, is why OnStar is positioned more as a service and SYNC more as a product feature. Two potential explanations are evident. The first most obvious suggestion is that Ford – as an automotive manufacturer – is a product company and thinks in product terms. That is consistent with the way they have positioned SYNC, "Crew Chief", the snazily named In-Dash Computer, and Tool-Link. In all cases, the most obvious servitizable element – the connectivity – is either customer-provided (as with SYNC) or sold by a third-party. Even with presented with obvious opportunities for subscription-based service revenue, they have avoided or minimized it. One can only assume that they see that as outside of their core value proposition and/or perhaps somehow a threat to their dealer network.

The second potential explanation, which is related to the "chips all in" comment earlier in the thesis, is that the immediate benefit of a sellable product feature was more attractive when compared to the slower benefit of the service. With SYNC now chosen as an option in 70% of sales and the infotainment option crucial to 32% of buyers, it is impacting sales and increasing market share today. For the only of the Detroit Three that did not receive government aid, it was already feeling the urgency for a more immediate return in 2006 through 2008 as SYNC was being designed and rolled out.

A more complete explanation would include both of those factors and also recognize that Ford can still develop or acquire OnStar-like capabilities and add them to the existing platform. Doing so still gives them the benefit of all of the "buzz" around SYNC while still eliminating the competitive advantage that GM presently enjoys in the area of safety and security. The converse is true as well; GM can add more infotainment features over time. The challenge for Ford, though, is that a deep level of integration like GM now has takes years to develop, and can impact and be impacted by very slowly evolving components like data buses.

---

<sup>88</sup> In late 2006, Ford borrowed \$23B for restructuring. Please see <http://www.bloomberg.com/news/2010-07-01/ford-debt-payment-means-dividend-possible-in-2012-a-year-before-forecast.html> for more information. Observed October 20, 2010.

### 3.2.7 – How Do We Interpret the Industry?

As was mentioned above, it seems possible, if not likely, that OnStar and SYNC will continue to converge in features. If GM takes on the infotainment side of the equation more directly and more fully, it will likely do so with partners as well, for many of the reasons that drove Ford to do so (scarce capital, tight development cycles, uncertain future).

To be clear, it is not that GM vehicles are without infotainment options, like XM radio<sup>89</sup>. They are just delivered outside of their telematics platform, and they lag behind newer offerings like Internet radio, Twitter integration and iTunes integration as with Ford SYNC. Similarly, Ford SYNC does support “911 Assist” but it does it using the driver’s cell phone, which must be present, charged, and connected, as opposed to OnStar that has its own cellular connection built in.

While they do so with varying emphases, it seems that both of the telematics offerings reviewed here, whether implemented as product features or services, whether they are sold from the automotive OEMs or partner companies, whether they are one-time charges, or subscription-based, are converging on a similar set of features. As discussed above, those features all center on the same customer needs:

- Ease of use
- Safety and security
- System Performance
- Productivity
- Entertainment

That does not mean, however, that the systems all support the same features packaged in the same manner. If that were true, then we would be beginning to enter the era of what MIT Sloan Professor Jim Utterback would call the dominant design (Utterback, 1994). In his seminal book, “Mastering the Dynamics of Innovation”, Professor Utterback discusses the trajectory of products and industries. Professor Utterback asserts – and supports with extensive examples from his research – that you can measure the maturity and life cycle of a product and its industry by watching the flow and allocation of resources as indicators of value migration, whether those resources are financial capital or intellectual capital.

There are some minor caveats that must be given regarding the applicability of that body of knowledge to this situation, however. First, the major players in this field are primarily the automotive OEMs and their tier-one suppliers. That makes it much more difficult to measure the flow of financial resources into the industry. Secondly, the applicability of Professor Utterback’s work to services, or product-service systems with strong service elements, is not yet well-established, but that concern is of limited value since the academic papers and patents that can be searched are focused on the product – not service – side of the product-service-system.

While we cannot watch the flow of capital assets easily into divisions like GM’s OnStar or Microsoft’s Auto embedded system, it is possible to watch other signals like patents and academic papers. Figure

---

<sup>89</sup> See <http://www.gm.com/vehicles/services/xmradio/>. Observed October 20, 2010.

21 portrays the number of scientific and academic papers done in the area of vehicle telematics since 1983, the first year of recorded activity<sup>90</sup>. While 2008 seems to have been the peak, macro-economic factors would strongly influence this field, so it is not possible to know whether we are truly declining or not.

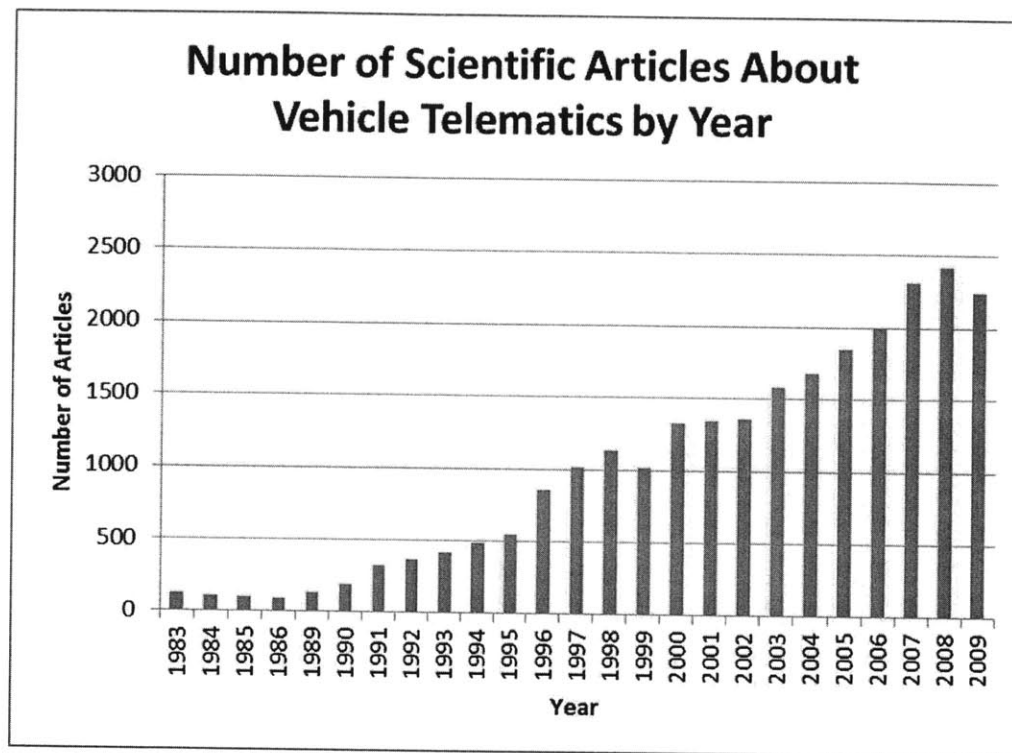


Figure 21: Scientific and Academic Publications about Vehicle Telematics, by Year

In other cases, patents could also be reviewed to evaluate the commercialization of technology, but academic and scientific work always leads patent activity, so it would not provide any further clarity. Patent searches are also as much art as science and can be inexact to begin with. Reviewing the number of firms in a given industry can also give an indication of resource and value migration, but there is no appropriate NCAIS code to track vehicle telematics and much of the work is being done by existing firms.

Referring to Professor Utterback’s research again, it is also tough to recognize where vehicle telematics represents the evolution of an existing, mature field (automobiles) migrating its value – and therefore resources – to services, or whether it represents a new industry. Figure 22 (Utterback, 2010) shows that there are three value migration points in an industry lifecycle. The first value migration is at the birth of an industry. More and more firms and more and more resources enter a field until a dominant design is reached. Until then, the nature of competition is based on building the best product. After that point, the competition is centered on building essentially the same product in the most effective manner. That is represented by the shift in focus from product to process. There is another shift of value (and therefore resources) as it becomes no longer possible for firms to distinguish themselves based on

<sup>90</sup> Compiled using ISI Web of Knowledge with the following search: Topic=(automotive OR vehicle telematics).

process. At that point, services become the basis of competition. It could be that telematics are just like vehicle financing and represent the servitization of a mature industry where all product differentiation and process efficiency has been wrung out. The strong role of the OEMs, the maturity of the industry, and the OnStar business model would support that view.

It could also be that the vehicle telematics industry is not really best viewed as a part of the auto industry, but instead as a part of the consumer electronics/personal communication industry, and that we are better suited to view the industry as a parallel to the smart phone. Ford's business model and the prominence of tech companies like Microsoft would support that view. It is simply too early to know, but the best answer, to quote Forrest Gump, is most likely "It's both."

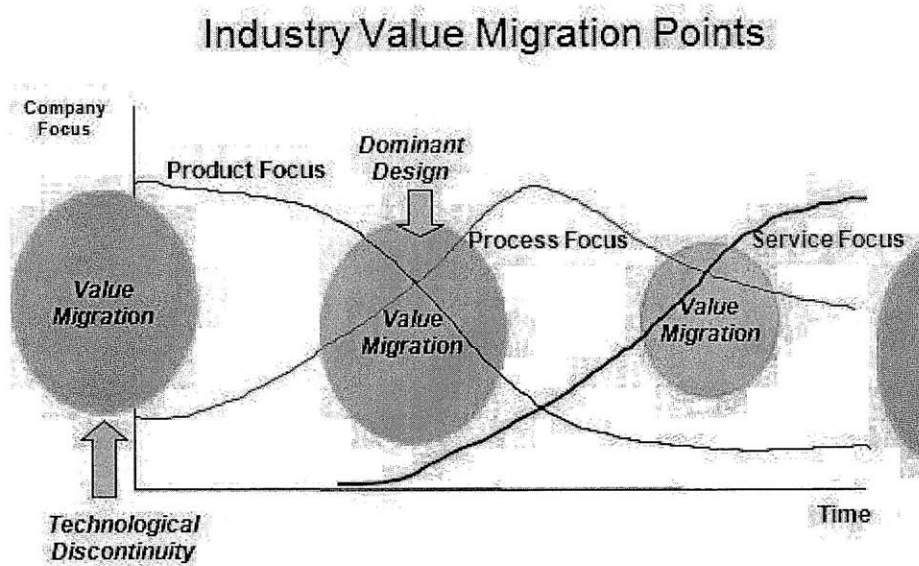


Figure 22: Dominant Design and the Migration of Resources

### 3.2.8 – GM OnStar & Ford SYNC – Some Observations and Conclusions

Part of what is so appealing about GM and Ford's offerings as opportunities for study, as with Redbox, Netflix, and Blockbuster in the previous chapter, is their different business models to deliver similar product-service systems to customers. Here, the firms also have very similar histories, scale, and structures, and are a part of a large, mature, global, and exceptionally well documented industry. "GM vs. Ford" is about as close to controlled lab experiments as the real world of business is going to give us. What have we learned that can be generalized?

- Product-Service Systems can have different emphases on the product and service components, depending on the wants, needs, and capabilities of the stakeholders involved. Ford has chosen a product feature-based approach, which seems to act as a catalyst for vehicle sales, which provides short-term cash. GM has focused on the subscription-based service approach which

provides a long-term, stable stream of fees. The choices can be understood when placed in the context of the eras in which each firm made those choices.

- While it is too early to tell with SYNC, there is strong evidence that OnStar has a very profitable business model. GM could consider making OnStar a separate company, which would increase the likelihood of expanding the service to non-GM cars.
- Ford seems almost to be avoiding the services element of the product-service systems they are deploying, despite an apparent willingness for customers to consume services from automobile providers.
- The approach of GM's OnStar and Ford's SYNC are largely complementary to each other. Ford has developed a good model for how to interact with smart phone and personal music systems by co-developing and moving quickly. GM has found a way to position safety & security features using a native cellular connection in a way that requires deeper vehicle integration but provides a value proposition more clearly separate from that of a mobile phone. It seems likely that the products will continue to converge, moving toward an obvious dominant design in the next few years. At that point, the industry will move from a war on features to a war on process and therefore price. At that point, it will also become more obvious whether to view this as a part of the automotive industry or a part of personal communication.
- Just as integration and/or adaptation of the paradigm of the mobile phone and its services is applicable to a wide list of transportation platforms, can it be applied to other product-centric systems? Part of what makes the United States such a strong market for telematics – beyond our collective love affair with cars – is how much time we spend in them. What opportunities for telematics services exist in other places where we spend time? Most obviously, what about homes?
- According to Professor Utterback's work on innovation and value migration, if this the next era for the automotive industry, then GM's approach to OnStar is more consistent with where value capture is occurring. As the product focus and process focus phases have ended, what are left behind are mature, efficient markets where products are valued simply at the cost of capital. If that is the case, the Ford may be giving away more of their future than they should with their present approach.

Based on what can be observed about GM and Ford, can those same patterns be observed in similar industries? We found that Ford and GM differed on six major aspects:

- Focus of Needs Met (safety and security, ease of use, entertainment, communication, system performance)
- Focus of Knowledge Domains Used (operator, product, operating environment)
- Telephony – or more broadly, network – architecture (native vs. customer-provided)
- Go-to-market strategy (early offering, consistent message vs. false starts and later arrival)
- Business Model (Product feature vs. Subscription Service)
- Brand Positioning (competitive advantage for OEM vs. co-branded, co-developed, and at arm's length)

Of those, for our purposes, the last two are the most important.

To answer that question, the paper will now turn to the construction equipment industry and look at telematics there. As with the automotive sector, there are two obvious firms to compare, each with telematics product-service systems in the marketplace. As with automotive, they are not the only two, but they are the best candidates for comparison: Caterpillar (Cat) and Deere & Company (John Deere, or Deere).

### 3.3 – Construction Equipment Telematics

#### 3.3.1 – About the United States Construction Equipment Industry

The United States construction market which these equipment sales support peaked in 2006<sup>91</sup>. As indicated in Figure 23, 2009 spending of \$935.6B is down 19.9% from 2006 levels. As is evident in the chart, the biggest driver of that change is the decline in residential construction spending. The decline would have been much larger without increases in public spending in the years since the peak. It seems that the housing industry has finally stabilized, and 2010 may indicate the beginning of a recovery.

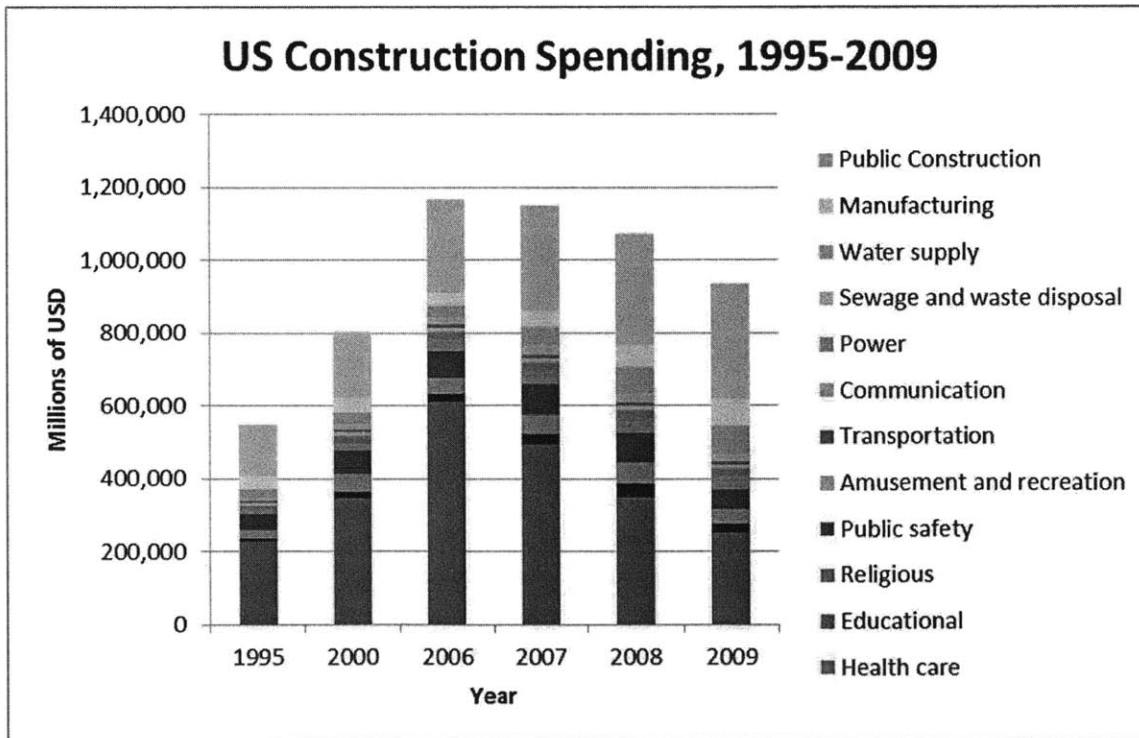


Figure 23: US Construction Spending by year and sector. Source: Standard & Poor's

<sup>91</sup> Source for this paragraph: Standard & Poor's Industry Survey: Heavy Equipment & Trucks - June 17, 2010

The total market for US construction equipment for 2010 is estimated to be \$33B<sup>92</sup>. Besides Caterpillar (33% of market) and John Deere (8%), other players in the US construction equipment market are:

- Terex (6.4%)
- Case-New Holland (6.1%)
- Komatsu (5.4%)

### **3.3.1 – About Caterpillar & Trimble**

In September of 2001, after working together for six years already, Caterpillar and Trimble announced<sup>93</sup> a 50/50 joint venture research & development company, Caterpillar Trimble Control Technologies, LLC (CTCT) to develop position-based products for the construction and mining industries. CTCT is based in Dayton, Ohio. In October, 2008 they also formed a 65/35 (Trimble/Cat) second joint venture called VirtualSite Solutions that is based in Westminster, CO – home of Trimble’s Engineering & Construction product development and marketing organization<sup>94</sup>. Caterpillar & Trimble’s relationship started roughly the same time that GM began pursuing OnStar.

### **3.3.3 – Caterpillar’s Telematics**

The role of telematics in construction equipment is more than novel, entertaining, and convenient as it is in world of passenger cars. Efficiency in this segment, whether from labor savings, fuel savings, or more efficient use of capital assets, is converted directly into dollars, and since so much of construction work goes to the lowest bidder, there is a strong financial incentive to be more efficient than the competition.

Product Link<sup>95</sup> is the heart of Caterpillar’s Fleet Management Solutions<sup>96</sup>. It provides both location services and networked connectivity to the products. It delivers GPS-based location with communication over LEO satellites or (not both) GSM cell networks in order to provide a wide variety of location- and product-based information to the fleet manager. The types of information it provides are broken into three different offerings: Asset Watch, Maintenance Watch, and Health Watch. Asset Watch is subset of Maintenance Watch and Health Watch. Product Link was developed by Trimble and available on competitive equipment as well. The web-based Client, VisionLink, is also developed by Trimble. Hardware is standard equipment on new Caterpillar equipment, can be retro-fitted on older equipment, and is available from Trimble for competitive equipment with more limited integration. It is sold as a subscription-based service.

---

<sup>92</sup> According to IBISWorld Industry Report 33312 - Construction Machinery Manufacturing in the US, September 2010, by Steven Connell

<sup>93</sup> See <http://www.ctct.com/news/release.aspx?id=091001a>. Observed October 21, 2010.

<sup>94</sup> See [http://www.trimble.com/about\\_history.shtml](http://www.trimble.com/about_history.shtml). Observed October 21, 2010.

<sup>95</sup> See <http://www.cat.com/PL>. Observed October 22, 2010.

<sup>96</sup> See <http://www.cat.com/technology/fleet-management-solutions>. Observed October 22, 2010.

### 3.3.4 – John Deere’s Telematics

JDLink<sup>97</sup> is John Deere’s telematics platform. As with Caterpillar’s Product Link, there are levels of service as well: Express, Select, and Ultimate – where each is a superset of the previous. JDLink is now standard equipment on practically all of John Deere’s construction equipment. JDLink is also available for to be placed on competitive equipment (JDLink Express only for all-makes). JDLink was developed with QUALCOMM<sup>98</sup> and supports cellular connectivity. QUALCOMM provided not just development expertise but hosting expertise as well<sup>99</sup>. Deere construction equipment comes with a complimentary subscription for JDLink Ultimate for one year. While the marketing message is more strongly John Deere than the Cat-Trimble message, QUALCOMM appears to have had a strong roll in development as well as the on-going support of the system. JDLink is also the telematics platform for John Deere’s agricultural equipment.

Fleet Care<sup>100</sup> works with JDLink, and Preventative Maintenance Schedule and vehicle fluid analysis to generate proactive machine health information. The service is sold and administered by the Dealer. As discussed in Chapter 2, it is worth noting that does own part of its construction dealer network. Caterpillar does not appear to own any of its dealerships.

### 3.3.5 – Comparing the Approaches of Caterpillar and John Deere

Using the same method for comparing the telematics offerings between Caterpillar and JDLink as was used between GM OnStar and Ford SYNC, as is shown in Table 11, Table 12, Figure 24 and Figure 25, we find that the needs focus and knowledge domains used are very consistent with each other. Unlike GM OnStar and Ford SYNC, their coverage on the radar charts is nearly identical. Equally as striking as their similarity with each other is their difference from the consumer telematics products featured in Figure 17. While – collectively – the consumer systems are very oriented on the user/operator information domain and their safety, communication, and entertainment needs, the (commercial) construction telematics systems are focused almost entirely on product information productivity (manifested in system performance and ease of use). As before, percentages in the table represent the fraction of features meeting the need or using the knowledge domain.

---

<sup>97</sup> See [http://www.deere.com/en\\_US/cfd/construction/deere\\_const/products/jdlink\\_nextgen.html](http://www.deere.com/en_US/cfd/construction/deere_const/products/jdlink_nextgen.html). Observed October 22, 2010.

<sup>98</sup> See [http://www.deere.com/en\\_US/cfd/construction/deere\\_const/newsroom/071219\\_jdlink.html](http://www.deere.com/en_US/cfd/construction/deere_const/newsroom/071219_jdlink.html). Observed October 22, 2010.

<sup>99</sup> From John Deere-produced “JDLink Overview” video available at <http://www.plasterer.com/>. Observed October 22, 2010.

<sup>100</sup> See <http://nortrax.com/service/fleet-care/index.html>. Observed October 22, 2010.



Table 11: Caterpillar Product Link Product Attributes

		System	Need Met					Knowledge Domain Used		
OEM	P-S-S		Safety & Security	Sys. Performance	Entertainment	Communication	Ease of Use	Operator	Product	Op. Environment
Cat	PL	Feature								
Cat	PL Asset Watch	Machine Location		1			1		1	1
		Machine Location Mapping		1			1		1	1
		Machine Location History		1			1		1	1
		Non-reporting Machine Identification	1	1			1		1	1
		Machine Hour Reading		1			1		1	1
		Machine Hour History		1			1		1	1
		Time and Geo-Fencing	1						1	1
		Time and Geo-Fencing Alerts	1						1	1
		<b>Asset Watch Distribution %</b>	<b>38</b>	<b>75</b>	<b>0</b>	<b>0</b>	<b>75</b>	<b>0</b>	<b>100</b>	<b>100</b>
	PL Maint. Watch	Planned Maintenance History		1			1		1	
		Planned Maintenance (PM) Notes		1			1		1	
		Next PM Due		1			1		1	
		PM Alerts		1			1		1	
		PM Checklist		1			1		1	
		PM Parts List		1			1		1	
		Customized PM Checklist		1			1		1	
		PM and Repair Planner		1			1		1	
		On-line Parts Ordering		1			1		1	
		Manage Major Repairs		1			1		1	
		Repair History		1			1		1	
		PM or Repair Request for Quote		1			1		1	
	<b>Maintenance Watch Distribution %</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>0</b>	
	PL Health Watch	Event and Diagnostic Codes		1			1		1	
		Event and Diagnostic Troubleshooting		1			1		1	
		Event and Diagnostic Code Alerts	1	1			1		1	
		Event and Diagnostic Code History		1			1		1	
		Fuel Level		1			1		1	
		Fuel Used		1			1		1	
		Fuel Used History & Graphic Display		1			1		1	
		Refueling History		1			1		1	
	<b>Health Watch Distribution</b>	<b>13</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>0</b>	
	<b>Totals</b>	<b>Product Link Totals %</b>	<b>14</b>	<b>93</b>	<b>0</b>	<b>0</b>	<b>93</b>	<b>0</b>	<b>100</b>	<b>29</b>

Table 12: John Deere JDLink Product Attributes

System			Need Met				Knowledge Domain Used			
OEM	P-S-S	Feature	Safety & Security	System Performance	Entertainment	Communication	Ease of Use	Operator	Product	Operating Environment
John Deere	JDLink Exp.	Machine Hours (daily reports)		1			1		1	
		Geofence (daily reports)		1			1		1	1
		Location (daily reports)		1			1		1	1
		Curfew (daily reports)		1			1		1	1
		Maintenance (daily reports)		1			1		1	
		<b>JDLink Express Distribution %</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>60</b>
	JDLink Select	Machine Hours (real-time)		1			1		1	
		Geofence (real-time)		1			1		1	1
		Location (real-time)		1			1		1	1
		Curfew (real-time)		1			1		1	1
		Maintenance alerts (real-time)		1			1		1	
		Additional Sensors		1			1		1	
		Equipment Utilization		1			1	1	1	
		Work-vs-Idle		1			1	1	1	
	<b>JDLink Select Distribution %</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>25</b>	<b>100</b>	<b>38</b>	
	JDLink Ult.	Machine Hours (real-time)		1			1		1	
		Geofence (real-time)		1			1		1	1
		Location (real-time)		1			1		1	1
		Curfew (real-time)		1			1		1	1
		Maintenance alerts (real-time)		1			1		1	
		Additional Sensors		1			1		1	
		Equipment Utilization		1			1	1	1	
		Work-vs-Idle		1			1	1	1	
		Dashboard Alerts		1			1		1	
		Diagnostic Codes		1			1		1	
	<b>JDLink Ultimate Distribution = Total %</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>20</b>	<b>100</b>	<b>30</b>	

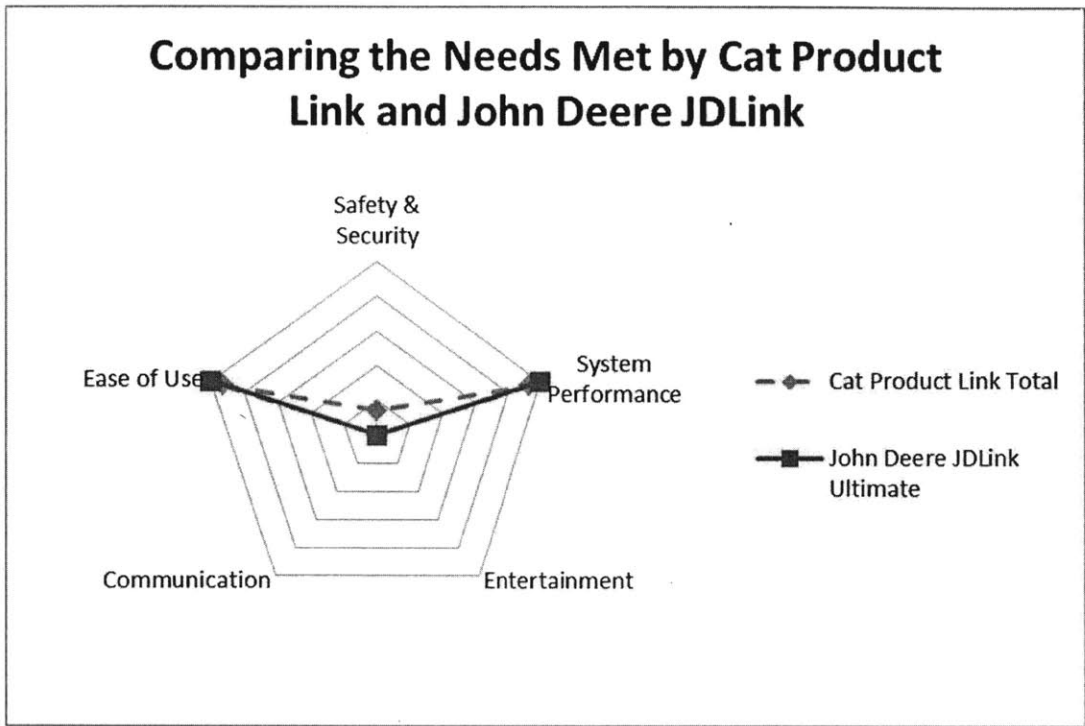


Figure 24: Comparing the Needs Met by Caterpillar Product Link and John Deere JDLink

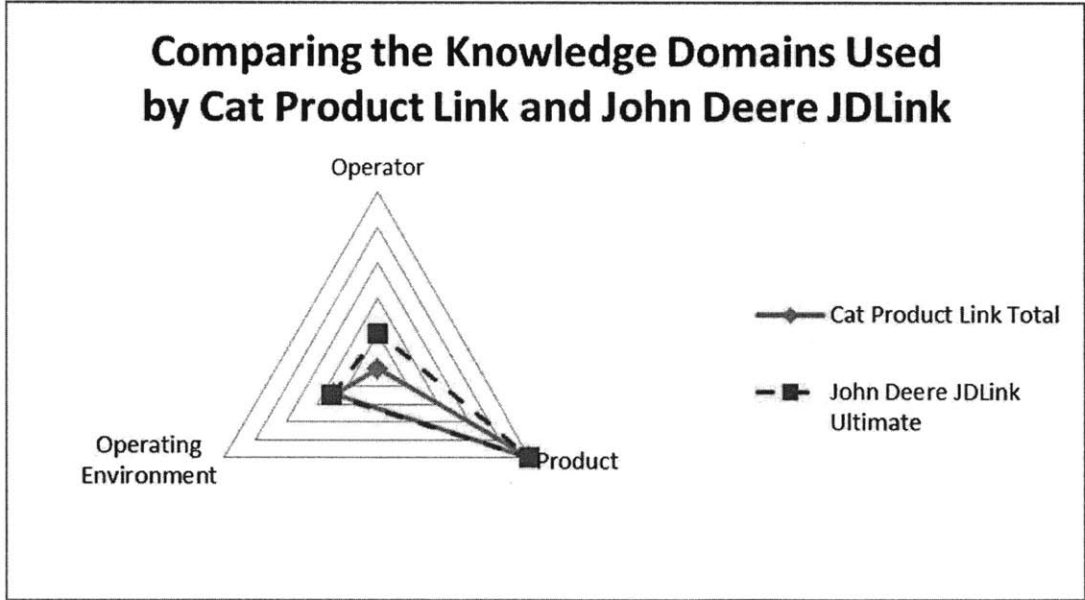


Figure 25: Comparing the Knowledge Domains Used by Caterpillar Product Link and John Deere JDLink

Using the same five attributes discussed between GM OnStar and Ford SYNC, we can compare in Caterpillar Product Link and John Deere JDLink in the following way in Table 13:

Table 13: Comparing Caterpillar Product Link and John Deere JDLinkBusiness Model

Aspect/Telematics System	Caterpillar Product Link	John Deere JDLink
Needs-Met Focus	Productivity: Ease of Use and System Performance	Productivity: Ease of Use and System Performance
Knowledge Domain Focus	Product	Product
Network Architecture	Cellular and Satellite <sup>101</sup>	Cellular
Business Model	Subscription-based service	Subscription-based service
Product Positioning	JDLink by John Deere	Product Link by Caterpillar and Trimble

### 3.3.6 – Some Observations about Caterpillar Product Link and John Deere JDLink

The features between these systems are almost identical. These are both industrial fleet management solutions marketed as services with initial subscriptions bundled in the purchase price. The only major difference is where the development has been done in their respective capability chains. Deere, while leaning on QUALCOMM some, has developed their platform.<sup>102</sup> I would characterize the capability as more integrated than Ford and less integrated than GM. Caterpillar, on the other hand, has kept telematics at arm’s length from its core capabilities and products. Figure 26 says the same thing graphically. In the short-term, that may be an advantage for Caterpillar, but in the long-term, it seems that it could be a major liability. That idea will be explored more, later in the chapter.

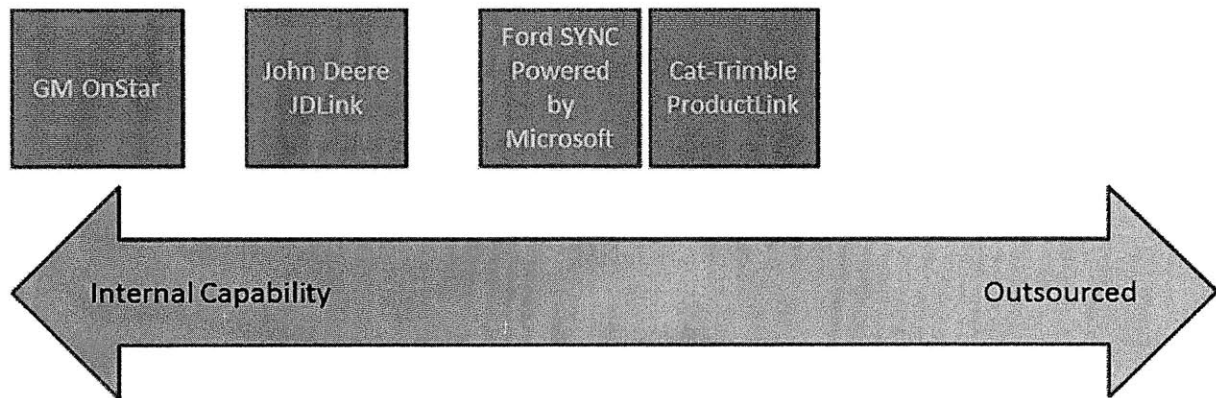


Figure 26: Positioning Telematics in a Company's Capability Chain for Passenger Cars and Construction

<sup>101</sup> Considering that Cat equipment works on a larger scale and in more remote locations, the difference in telematics architectures is not surprising. John Deere’s construction equipment is not large enough to often be in environments without cellular coverage.

<sup>102</sup> Various promotional videos on Deere dealer websites allude to QUALCOMM’s involvement.

Now, let's briefly review agricultural equipment telematics.

### 3.4 – Agricultural Equipment Telematics

#### 3.4.1 – The United States Agricultural Industry

Although not as big as the construction industry, the farm industry in the United States is big business. As is shown in Table 14, the harvesting of corn, soybeans, wheat, and grains will generate \$90B in revenue this year<sup>103</sup>. Corn is the biggest driver, with anticipated revenue that accounts for over half of that number.

Table 14: Estimated 2010 US Crop Revenues

Commodity	2010 Revenue (est.)	2010 Profits (est.)	05-09 Growth	10-14 Growth (est.)
Corn	\$50.8B	\$10.0B	15.40%	3.80%
Soybeans	\$31.3B	\$3.2B	10.10%	-2%
Wheat	\$13.1B	-	7.40%	0.40%
Grains	\$2.6B	\$0.22B	5.50%	0.50%

Figure 27 shows the growth that the corn industry has seen over the last decade<sup>104</sup>. Growth is driven by a number of factors, two of which are increased uses for corn, including ethanol production, and global pressures for more and better food. The rising standard of living puts extreme pressures on crops that can be used as feed sources, because 70% to 90% or more of the energy in the crop is lost in conversion to meat, milk, or egg protein (Manoulian et al., 2008). Said differently, it can take up to ten calories of corn or grain to produce one calorie of meat, so incrementally more people eating (or wanting to eat) meat puts much more than incremental pressure on grain production.

<sup>103</sup> Source: IBISWorld Industry Reports: July - September 2010

<sup>104</sup> Source: IBISWorld Industry Report: Corn - September 2010

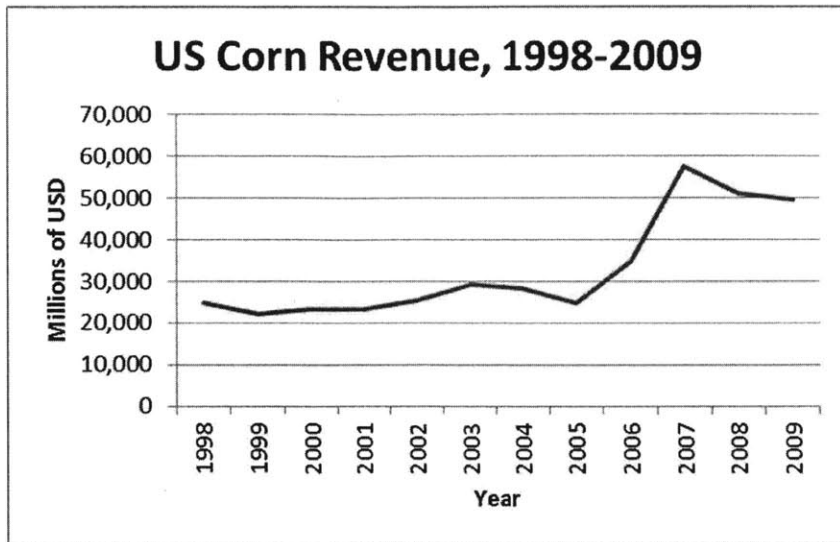


Figure 27: US Corn Revenue, 1998-2009

To meet those kinds of demands, Figure 28 shows that corn yields in the last one-and-one-half centuries have risen over 500%<sup>105</sup> and there is much talk of heading for 300-bushel corn in the coming decades to meet the global need.

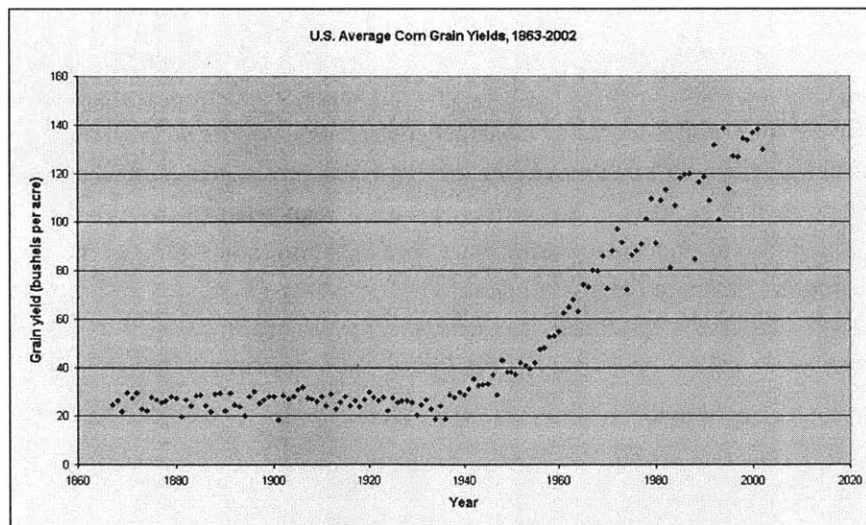


Figure 28: US Average Corn Grain Yields, 1863-2002

In order to do that, the trends of mechanized, industrialized agriculture must continue. At the heart of that systems are tractors and other electro-mechanical equipment for processing commodities in the

<sup>105</sup> Source: University of Nebraska-Lincoln. See <http://plantandsoil.unl.edu/croptechology2005/pages/index.jsp>. Observed October 22, 2010.

field. The tractors and agricultural machinery business in the US is expected to be a \$33.2B business in 2010<sup>106</sup>. It is led by three companies:

- Deere & Company (20.6%)
- CNH (11.0%)
- AGCO Corporation<sup>107</sup> (9.6%)

Those three firms represent the vast majority of the powered equipment portion of the market. Much of the rest of the sector is in attachments, which are pulled and controlled by the powered equipment from these three companies.

As with construction equipment, telematics in this market are not about “infotainment” and peace of mind as they are in the passenger car segment, but instead telematics is about saving labor, reducing inputs, and maximizing yields in a sustainable manner. Vehicle telemetry and GPS are some of the tools not just of fleet management as with construction, but also of the science of precision agriculture. Precision agriculture is defined by the U.S. National Research Council as “a management strategy that uses information technologies to bring data from multiple sources to bear on decisions associated with crop production” (Bouma et al., 1999). A commercially available precision agriculture solution is built on three primary elements:

- Telematics system for automatic or guided steering (for the “where” information)
- Precision agriculture system (for the “what to apply” and “when to apply it” information)
- An office-based software package to manage and interpret the field data

### 3.4.2 – Analysis

Fleet Management and Precision Agriculture together make comparing features more difficult than with construction equipment and passenger vehicles. Here, I won’t repeat the pattern of the last two segments of mapping features, but instead try to build on what we’ve seen. The biggest lesson of the GM-OnStar-vs.-Ford-SYNC discussion was that choosing to develop a platform like this with an outside partner does limit how deeply you can integrate. That fits intuition as well. One way to combat that is to take the approach that Caterpillar took and partner deeply with someone with domain knowledge, like – in their case – Trimble. While that does solve the short-term problem, it appears to be placing a major source of long-term value creation away from the core of the company.

Here, we see that same dynamic play out again. As Table 15 shows, CNH and AGCO have no intrinsic telematics or precision agriculture solutions. They rely on offerings from Trimble, and TOPCON. The Trimble EZ-Guide offerings are marketed for CNH under the slogan<sup>108</sup> “Put Your Farm on the Map.” AGCO offers automatic steering in the form of a product from TOPCON. It offers its own fleet telemetry-

---

<sup>106</sup> Source: IBISWorld Industry Report 33311 - Tractors & Agricultural Machinery Manufacturing in the US - July 2010.

<sup>107</sup> For more information about AGCO, please see Appendix A.

<sup>108</sup> See <http://www.putyourfarmonthemap.com>. Observed October 22, 2010.

based management tool, AGCOMMAND<sup>109</sup>. AGCO also offers a variety of software packages to increase farm productivity, but it appears that AGCO Technology Solutions works with TOPCON<sup>110</sup> in a manner similar to Caterpillar in the construction space. As with the construction segment, Deere uses their JDLink platform for telematics. Here, it is – in a sense – an element of the precision agriculture solution, GreenStar.

Table 15: Elements of Major Precision Agriculture Systems

Company	Telematics/Automatic Steering	Precision Application	Management Software
AGCO	TOPCON	FieldStar – developed with TOPCON	
CNH	Trimble	Trimble	Trimble
John Deere	John Deere JDLink (with some help from QUALCOMM)	John Deere GreenStar	John Deere Apex

If we map all of these telematics players on a continuum and their approach on a continuum, similar to Figure 26 above, it would look this Figure 29 below:

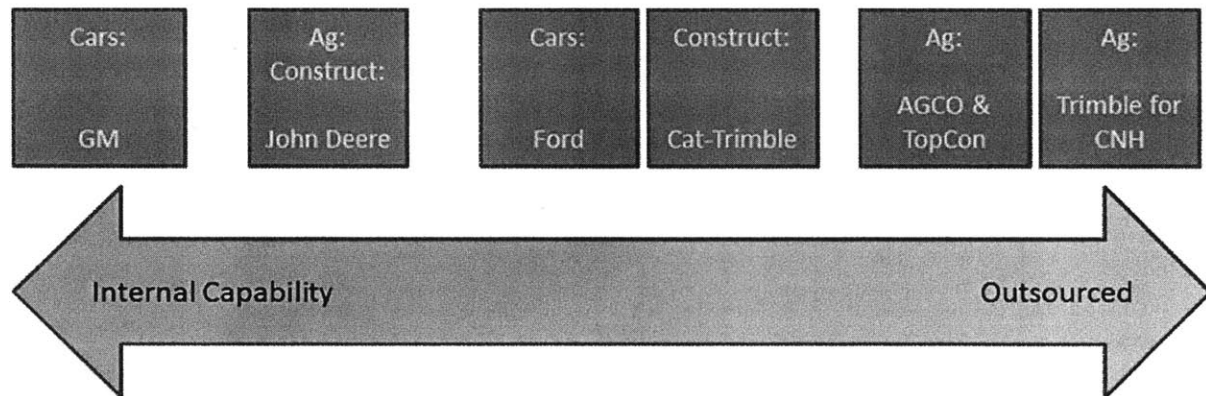


Figure 29: Positioning Telematics in a Company's Capability Chain for Cars, Ag, and Construction

We saw earlier that telematics – even in a market like passenger cars where it is largely a luxury and there is not a business case driving it – can be very profitable. We also heard Ford indicate that it was critical for nearly a third of their consumers in their purchase decision. What does that mean for companies on the right side of Figure 26 and Figure 29? How much revenue and income are they “giving away”? If mature markets seek the cost of capital, what does that mean for their future earnings? Is there any reasonable possibility that backhoes and tractors won’t go the way of cars and have products that are “good enough” disrupting them from below in a Toyota-and-Honda-vs.-the-Detroit-Three-style future? If so, it would seem that these are the features that will (1) differentiate, but (2) generate revenue and income.

<sup>109</sup> See <http://www.agcocorp.com/technology.aspx>. Observed October 22, 2010.

<sup>110</sup> See <http://www.topconpositioning.com/news-events/single/item/topcon-positioning-systems-tps-and-agco-partner-to-help-farmers-become-more-efficient-by-using-i/>. Observed November 30, 2010.



The stakes here may be very high. The mechanized industrial metaphor has governed agriculture and construction for over a century. We could be seeing the land-grab for positioning and market share that defines the next century, and it is happening as markets globalize and much more of the world needs access to equipment for processing food, fuel, and fiber, and for building infrastructure.

### 3.4.3 – Putting Some Numbers to It

As markets mature, margins – without differentiation (which can and often does come in the form of complementary services) – deteriorate, as products – even highly complex ones as these are – approach commodity status. That leaves that leaves the mature companies making the “iron” deploying more capital for lesser returns. Said differently, they have to work much harder to earn less money.

By looking at the appropriate operating divisions within the companies building the equipment and the divisions of the companies providing the telematics services platform, we would expect to see that reflected in their financials. It is not possible in all cases because of the ways divisions are aligned<sup>111</sup> but it is possible to look at CNH’s Ag sales and Trimble’s Field Solutions<sup>112</sup>.

Trimble’s Field Solutions divisions generates products and services that span more broadly than just CNH, but since we are looking at relative numbers, and not absolute, the comparison is valid. We will focus on Operating Profit Percentage as a simple measure of how “hard” a company has to work to generate profit. By using operating profit, we are able to filter out the impact of lots of kinds of leverage that are a part of a firm’s bottom line.

Table 16 shows CNH’s Ag Equipment division vs. Trimble’s Field Solutions division over the last five years. A longer window of time is possible, but five years is already two-to-three Moore’s law generations, and pushing back further than that in quickly evolving, high-tech fields brings its own challenges. Trimble was solidly profitable each year, and their profitability appears to improve as they achieve greater efficiencies and economies of scale. The right-most column shows average performance over the five-year period, and Trimble’s operating profit percentage over that period is over four times that of CNH’s Ag Equipment operations. Figure 30 shows their performance relative to each other graphically.

---

<sup>111</sup> Deere, for example, does not break out its telematics services platform from the equipment divisions. While that shows a more advanced understanding of services, it makes comparison more difficult. TOPCON is really best thought of as a precision optics company that makes telematics as well, so all of the GPS “stuff” is lumped into one division, making it tougher to tease out the relevant portions. That leaves us Cat, AGCO, CNH as equipment providers and Trimble on the telematics side. Since AGCO does their work with TOPCON, we are down to looking at Trimble, Cat, and CNH.

<sup>112</sup> This information from the Annual Reports and SEC 10-K’s for CNH and Trimble.

Table 16: Comparing Trimble and CNH Ag Operating Profit 2005 - 2009

Measure/Year	2009	2008	2007	2006	2005	Total
<b>CNH Ag: Revenue (\$M)</b>	10,683	12,902	9,984	7,809	7,843	<b>49,221</b>
<b>CNH Ag: Operating Profit (\$M)</b>	712	1,371	813	427	340	<b>3,663</b>
<b>CNH Ag: Operating Profit (%)</b>	6.66%	10.63%	8.14%	5.47%	4.34%	<b>7.44%</b>
<b>Trimble Field Solutions: Revenue (\$M)</b>	292	301	201	139	127	<b>1,060</b>
<b>Trimble Field Solutions: Operating Profit (\$M)</b>	104	109	61	37	32	<b>343</b>
<b>Trimble Field Solutions: Operating Profit (%)</b>	35.62%	36.21%	30.35%	26.62%	25.20%	<b>32.36%</b>

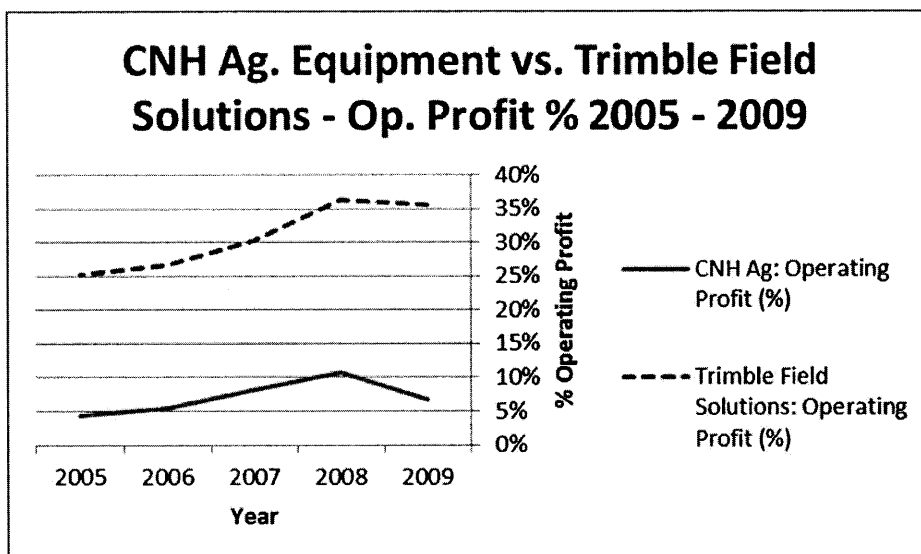


Figure 30: CNH Ag vs. Trimble Field Solutions Operating Profit % 2005-2009

It is very difficult to isolate data adequately to perform a more thorough analysis, but results support the notion that the premium that the market will bear for the advanced products and services that complement and extend the product is greater than that of the equipment itself. While this does not prove the idea, it certainly supports it.

### 3.5 – Tying It Together

We can extend the same notion of what we have seen with CNH and Trimble in section 3.4.3 to Cat, CNH, and Trimble. Caterpillar reports three operating segments: machinery, engines, and financing. We'll focus here on machinery sales and ignore engines and financing. Those data are presented below in Table 17. Here, there are four sections: CNH Equipment, Cat Equipment CNH & Cat Equipment

totaled, and Trimble's Construction & Engineering division. As before, the right-most column shows totals for the five-year period.

The first thing that is noticeable in Table 17 is that both equipment operations lost money in 2009 while Trimble was profitable. In 2005 through 2008, while all were profitable, the equipment division had to deploy a great deal more capital for a much smaller (in relative terms) return. The same notion is more obvious when portrayed graphically as in Figure 31. While the macro-economic trends are clearly evident, much more so than in the ag industry, the relative "ease" with Trimble makes money in the same sector is evident as well. The equipment performance at their best in 2006 is barely better than Trimble's worst in 2009.

Table 17: Comparing Trimble, CNH Construction, and Cat Operating Profit 2005 - 2009

Measure/Year	2009	2008	2007	2006	2005	Total
<b>CNH Construction Equipment: Revenue (\$M)</b>	2,120	4,464	5,023	4,306	3,963	<b>19,876</b>
<b>CNH Construction Equipment: Operating Profit (\$M)</b>	(339)	116	412	373	265	<b>827</b>
<b>CNH Construction Equipment: Operating Profit (%)</b>	-15.99%	2.60%	8.20%	8.66%	6.69%	<b>4.16%</b>
<b>Caterpillar Equipment Operations: Revenue (\$M)</b>	18,148	31,804	28,359	26,062	22,931	<b>127,304</b>
<b>Caterpillar Equipment Operations: Operating Profit (\$M)</b>	(1,007)	1,803	2,758	3,027	2,431	<b>9,012</b>
<b>Caterpillar Equipment Operations: Operating Profit (%)</b>	-5.55%	5.67%	9.73%	11.61%	10.60%	<b>7.08%</b>
<b>Cat &amp; CNH Construction Equipment: Revenue (\$M)</b>	20,268	36,268	33,382	30,368	26,894	<b>147,180</b>
<b>Cat &amp; CNH Construction Equipment: Operating Profit (\$M)</b>	(1,346)	1,919	3,170	3,400	2,696	<b>9,839</b>
<b>Cat &amp; CNH Construction Equipment: Operating Profit (%)</b>	-6.64%	5.29%	9.50%	11.20%	10.02%	<b>6.69%</b>
<b>Trimble Construction &amp; Engineering: Revenue (\$M)</b>	579	742	743	637	524	<b>3,225</b>
<b>Trimble Construction &amp; Engineering: Operating Profit (\$M)</b>	58	126	174	136	118	<b>612</b>
<b>Trimble Construction &amp; Engineering: Operating Profit (%)</b>	<b>10.02%</b>	<b>16.98%</b>	<b>23.42%</b>	<b>21.35%</b>	<b>22.52%</b>	<b>18.98%</b>

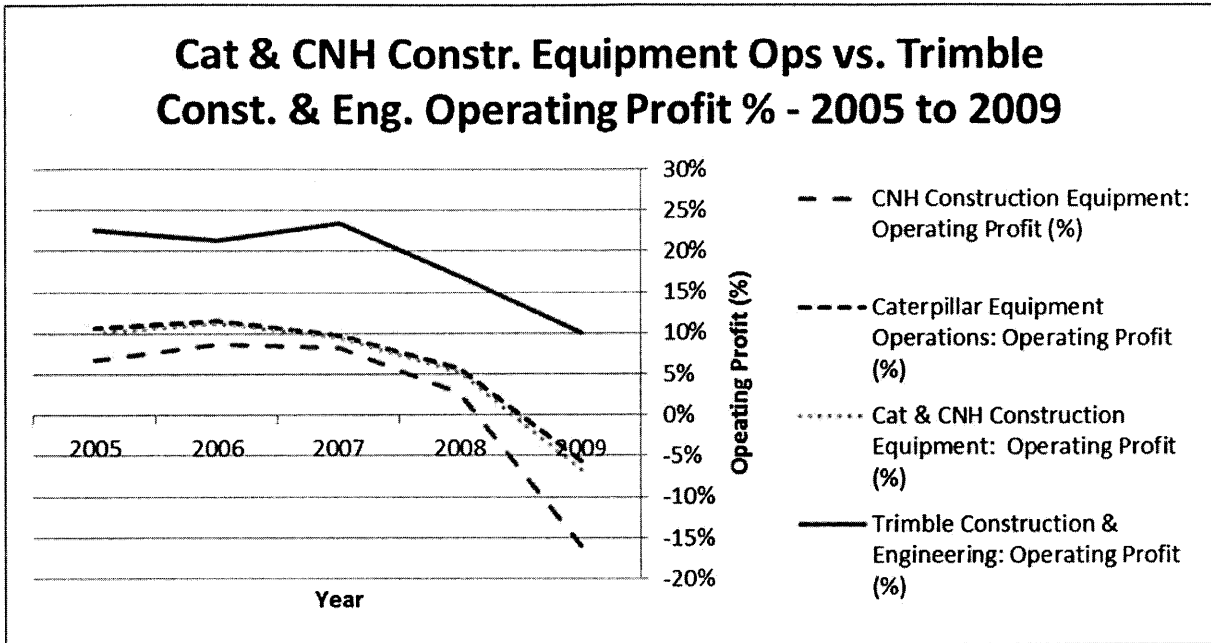


Figure 31: CNH & Cat Construction vs. Trimble Constr. & Eng. Operating Profit % 2005 - 2009

Looking at the idea a little differently, as an investor, if you had placed \$100 each in Caterpillar, Trimble, and an S&P 500 index fund in December of 2004 and re-invested all of the dividends for the five-year period, Figure 32 shows how you would have fared. It is important to note that this is at an aggregate level...not just the operating divisions presented in Table 17. While both out-performed the broader market, Trimble out-performed Caterpillar by nearly 50%.

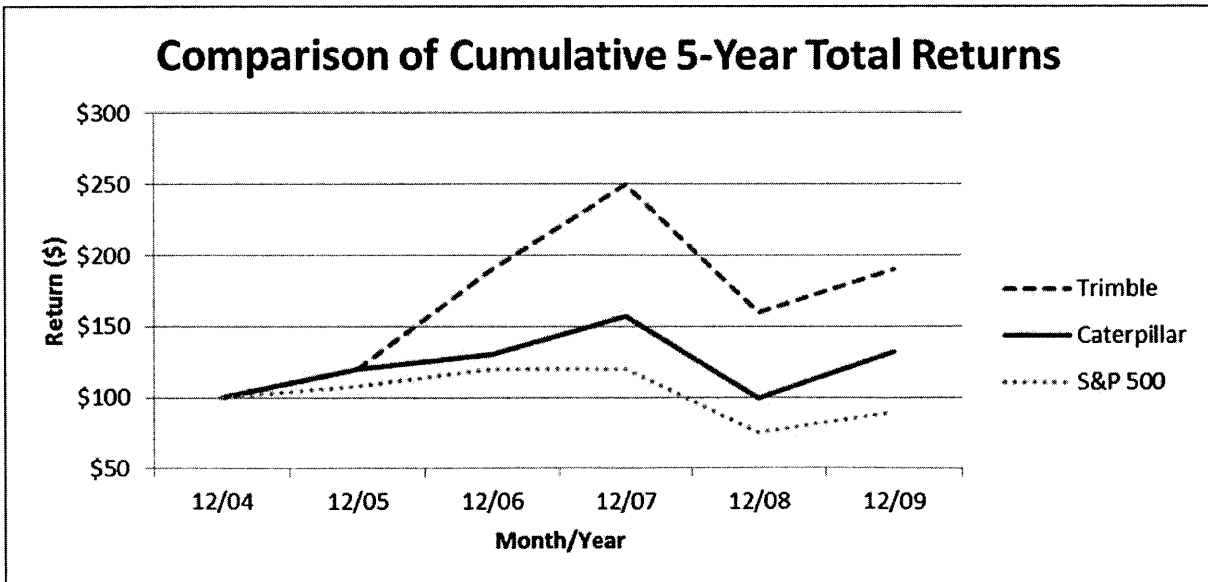


Figure 32: Comparing Total Market Returns for Caterpillar and Trimble

One could argue that perhaps this is a false dichotomy because someone has to make the equipment. While that is true, the point here is that the services revenue is too attractive to leave to someone else, and since margins on the iron seem to erode over time, it becomes more important when we look at longer time windows. Additionally, we saw in the last chapter that a company can successfully de-emphasize its hardware strategy over time as IBM has and still hold credibility (and generate revenue) in services<sup>113</sup>.

### **3.6 – Telematics Systems as Platforms**

Tractors are the CPUs of industrial agriculture. That is to say, you don't buy a tractor for what it does by itself; you buy it to power a system. It powers your operations around seeding, crop care, and other utility operations. That means that there is a platform play here. While the tractor makes it the most obvious, it is true for other agricultural and construction equipment as well. A combine does nothing without a (crop-specific) header. Construction equipment creates value with buckets, blades, and other attachments.

---

<sup>113</sup> We'll see that trend with IBM even more in Chapter 4 when we look at their telematics solution and how it enables them to deliver vehicle telematics services and solutions.

# Chapter 4 – Value-Based Services

---

Based on the framework for complex systems proposed by de Weck and Magee presented in Chapter 1, the last type of services for product-service systems this thesis will present is value-based services. Value-based services – as they will be defined here – are in many ways different from the other types of services presented and discussed in this thesis. Value-based services are defined – for our purposes – in *how* they are structured more than *what* they represent. That is to say value-based services will have elements of product-based services, information-based services, and other value-based services. What defines them is their “service-ness” over “product-ness.” We call them value-based services, because they are focused on the value created by the collection of services that surround the product itself. In the extreme cases, the product fades away and all the consumer sees is the service. Value-based services are primarily about how the product-service system is packaged.

## 4.1 – Value-Based Services – a Framework

Value-based services are those where the “product-ness” disappears and the service element of the product service system is front-and-center in the measure of value.

In the most basic form, value-based services are what are traditionally thought of as financial services, where the payment is more tuned (even if slightly) to consumption.

In more advanced forms, value-based services completely servitize the product, and the job for which the product was needed is the focus and the measure of the service. In the cases I have observed of services that fit this definition, those two attributes tend to be additive. That is to say, first comes the payment model and then the transformation of the products to focus on the related services. That is more a heuristic than a rule.

In some of the most advanced cases of value-based services, that service bundle that surrounds the product is able to exploit under-utilization of the product on the consumer side, as well as potentially generate economies of scale and/or scope on the service product side to create utilities, the extreme of value-based services.

As a simple example, a car is primarily a product, a taxi is a value-based service, and a subway is a utility Figure 33 portrays the idea graphically

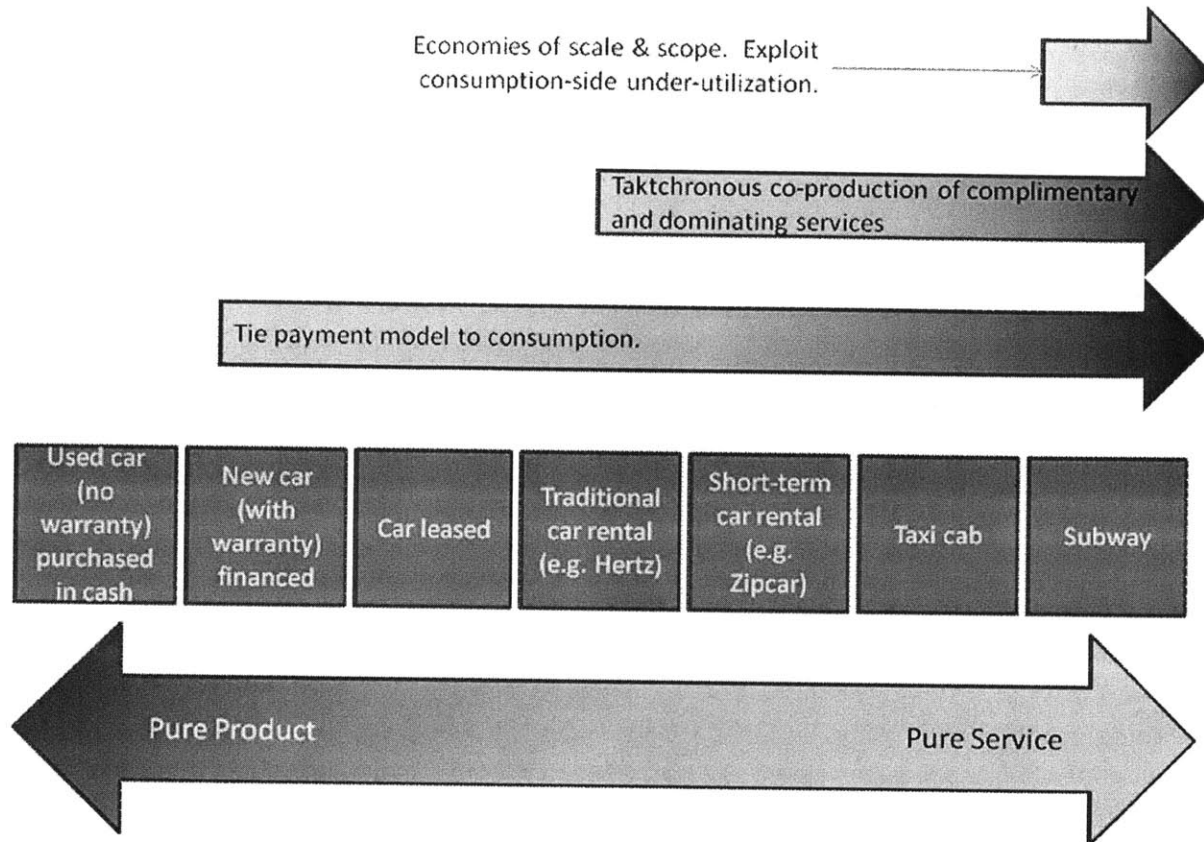


Figure 33: Value-based Services in terms of a passenger car

## 4.2 – The Product-Service Spectrum of Cars for Value-Based Services

While not exhaustive, the following examples – as portrayed in Figure 33 above– illustrate the product-service continuum for cars and associated value-based services. On the left side of the figure, there are pure products; on the right, pure services. As we move from the left to the right, and the “product-ness” starts to fade, we begin to focus on the “service-ness”, which is the value proposition we are seeking from the product – what HBS Professor Clay Christensen might call the job we hired the product to do<sup>114</sup>. That right side of the diagram is what I am calling value-based services. We value them based on the service attributes of the product-service system, not the product attributes. The degree to which we do that is the degree to which it is a value-based service.

### 4.2.1 – Cash Purchase

At the pure product end of the spectrum exists a used car purchased in cash. I give the example of a used car because it is more likely to simply be “caveat emptor” and without warranty, which can itself be thought of as a value- and/or product-based service, depending on how you consider it and how you pay for it. While the driver will likely carry insurance, the purchase transaction of the car itself is almost

<sup>114</sup> See “What Customers Want from Your Products: <http://hbswk.hbs.edu/item/5170.html>. Observed December 28, 2010.

a pure product<sup>115</sup>. The consumer will own the car indefinitely – until he or she finds someone else to buy it or until it is disposed at end-of-life and the payment stream has no correlation to the consumption. Additionally, there are almost no services packaged or co-produced. It's just a car. As has been discussed throughout this thesis, that is in many ways a conceptualized ideal at this point with warranties, extended warranties, tire warranties, XM, telematics, oil change and routine maintenance service, and the like.

#### **4.2.2 – New Car – Warranty & Finance**

For most car purchases, there are two obvious financial services attached to the product at the time of purchase: financing, which makes the payment for the product a financial service, and warranty<sup>116</sup>. For a warranty, either the base warranty that comes with a car or an extended warranty purchased for an extra fee, parts and knowledge about them that would be needed for failures are turned into a financial stream of payments. This financing is the “traditional” value-based service. We start to see the payment stream match the consumption model. In that sense the payments begin to be a co-produced service with the product.

#### **4.2.3 – Car Lease**

A car lease extends the “service-ness” of the product by allowing the consumer to align the payment even more closely with the consumption than a loan. At the end of the lease, the vehicle will have value that could actually be sold as a product, but it will be owned by the leasing company, and the consumer will be “off the hook.” In a perfect lease, the lessee has paid for the amount of product value they received – no more and no less- and they are left with no product either. Here, the focus is still on the product, but it is beginning to be transformed to a service.

#### **4.2.4 – Car Rental**

Rental more closely aligns consumption with the financial transaction, but is still centered on the product. Elements of the product, not a service, are still evident as the renter re-fuels, worries about navigation, pays for parking, and keeps possession of the car while not using it during the rental period. The smallest unit of rental is normally one day, and it often sits unused much of that time. The payment model is matched at a much more granular level to the consumption of the product, but the consumer stills thinks of it in product terms. When I get back from a business trip, my wife or kids will often ask, “what kind of rental car did you have?” That is a product question, not a service question.

#### **4.2.5 – Car Sharing**

With car sharing services like Zipcar<sup>117</sup>, a little more of the product starts to go away as insurance, parking, and re-fueling are generally bundled with the rental/consumption, and consumption periods can be as short as one hour. With most car sharing services, the focus is on simplicity and there are

---

<sup>115</sup> Even here, there are “lemon laws” of one form or another, depending on the state, that protect that buyer and are most easily understood as a sort of financial service...there are no pure products, and there are not pure services...only product-service systems.

<sup>116</sup> There is also automotive insurance, but that just muddies the waters, so we are not considering it here. It will be discussed briefly later in the chapter when we look at IBM “Pay as You Drive”.

<sup>117</sup> For more information please see <http://www.zipcar.com>. Observed September 12, 2010.



pricing plans aligned with the consumption model. The consumer is really just worried about navigation and driving, and is not paying for the asset (the product component) when it is not needed. Here, the service starts to become more evident and the product starts to fade.

#### **4.2.6 – Taxi**

On the other end of the spectrum from a car purchase is a taxi cab, which is available simply to fulfill the job of taking you from one place to another at a moment's notice for a usage-based fee. The cab driver handles navigation and driving as well as insurance, licenses, tolls, etc. The consumer pays for exactly what is needed, exactly when it is needed. Here, you have a product acting as a platform for bundling a series of taktchronously co-produced services that leverage product-based and information-based services to create a rich product-service system that is paid for as it is needed. Unless it is something novel, like a hybrid car, we are likely not even to notice what kind of car the cab driver was driving, because we engaged him for the service, not the "naked" product.

#### **4.2.7 – Subway**

Beyond the taxi, a subway completely hides the product-ness as does a taxicab, but also adds a notion of centralization that allows it to create an economy of scale that enables the service to be delivered for much less than a taxi. In doing so, consumers sacrifice some flexibility, but they also have even less to worry about.

All of these options, of course, exist in a much larger and more diverse ecosystem of transportation options which includes walking, biking, as well as non-consumption, and substitution (e.g. telecommuting). Those, while interesting, are not to be considered here.

### **4.3 – Product-Service Spectrum in Different Language**

In the example above (in Figure 33) as we move from the product end of the continuum to the service end, the focus becomes less on the car and more act of transit – the underlying service or need. On the product end, you are buying a car. On the service end, you are consuming a ride, and the "car-ness" becomes much less important and much more transparent.

Said another way, on the product end, you are buying a form, but on the service end, you are consuming a function (i.e., form = car, function = transportation). For English majors, on the product end you are buying the subject of a sentence, but on the services end you are consuming the verb and direct object (i.e., subject = car, verb + direct object = moves passengers). For MIT Engineering Systems Division students, an operand performs processing on an object (i.e., car = operand, transporting = process, passenger = object). For an accountant, the product is a capital expense (CapEx), and the servitization converts it to an operational expense (OpEx). Those various expressions of the same idea are captured in Figure 34 below.

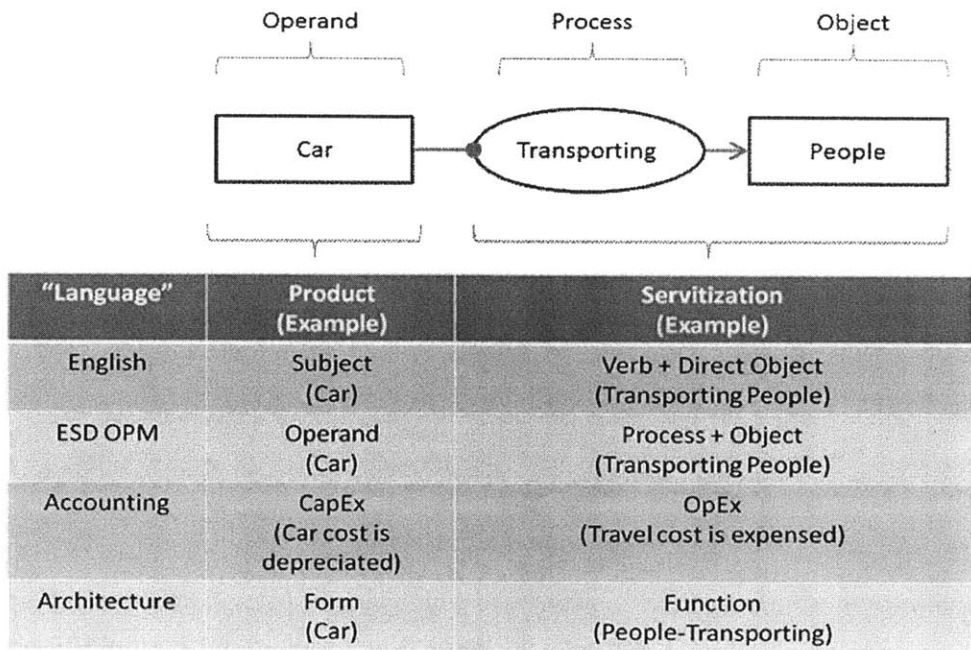


Figure 34: Various Expressions/Languages of the Servitization of Products

#### 4.4 – Financial Services in the Heavy Equipment Industry

The most basic value-based services, financing, do not completely align the payment model to the consumption of the product and the production of the related services, but they begin to do so.

Financing is important to the product providers for two main reasons:

- They enable product sales
- They generate stable, long-term revenue streams.

In most cases, companies do it for both reasons, but those can be separate motives, separate strategies. In terms of product-based services discussed in Chapter 2, “enabling product sales” could be equated to GE’s approach to using services to extend their products. Simply generating stable revenue streams could be equated to Deere’s Nortrax. It captures value, but creates no new synergies.

As a pure example from another industry of using financing as an enabler of product sales, a privately held department store chain based in the Midwest, Von Maur, offers an interest-free charge card<sup>118</sup>. It is a revolving line of credit where you pay of a minimum of about 20% of your outstanding balance each month. Since they are based in the heartland and cater to an upscale clientele, it is reasonable to assume that their risk of default is very low, but they still are taking on a cost for not getting their money as soon. Doing so “protects” the products. Contrast that approach with many big-box furniture stores that almost sell the furniture at a loss in order to provide financing.

<sup>118</sup> See <http://www.vonmaur.com/Default.aspx?PagelD=13&nt=4>. Observed December 26, 2010.

As has been mentioned elsewhere in this thesis and discussed extensively in other works, financing can be relatively easy money to make compared to the scale of capital required to build products. In a manner similar to how we compared Trimble to the equipment makers in Chapter 3, Table 18 compares the Finance Operation of Caterpillar and Deere to the Equipment Operation of Caterpillar and Deere over the last seven years<sup>119,120</sup>.

Table 18: Comparing Operating Profit of Equipment Sales to Financing Activity for Cat and Deere 2003-2009

Statistic/Year	2009	2008	2007	2006	2005	2004	2003	Total
<b>Cat Equip.: Revenue (\$M)</b>	18,148	31,804	28,359	26,062	22,931	18,844	13,678	159,826
<b>Cat Equip.: Operating Profit (\$M)</b>	(1,007)	1,803	2,758	3,027	2,431	1,756	1,199	11,967
<b>Cat Equip.: Operating Profit (%)</b>	-6%	6%	10%	12%	11%	9%	9%	7%
<b>Deere Equip. Revenue (\$M)</b>	20,756	25,803	21,489	19,884	19,401	17,673	13,349	138,355
<b>Deere Equip.: Operating Profit (\$M)</b>	1,365	2,927	2,318	1,905	1,842	1,905	708	12,970
<b>Deere Equip.: Operating Profit (%)</b>	7%	11%	11%	10%	9%	11%	5%	9%
<b>Deere &amp; Cat Combined Equip.: Revenue (\$M)</b>	38,904	57,607	9,848	45,946	42,332	36,517	27,027	298,181
<b>Deere &amp; Cat Combined Equip.: Operating Profit (\$M)</b>	358	4,730	5,076	4,932	4,273	3,661	1,907	24,937
<b>Deere &amp; Cat Combined Equip.: Operating Profit (%)</b>	1%	8%	10%	11%	10%	10%	7%	8%
<b>Cat Finance: Revenue (\$M)</b>	2,856	3,280	2,996	2,648	2,333	1,970	1,759	17,842
<b>Cat Finance: Operating Profit (\$M)</b>	381	579	690	670	531	470	393	3,714
<b>Cat Finance: Operating Profit (%)</b>	13%	18%	23%	25%	23%	24%	22%	21%
<b>Deere Finance: Revenue (\$M)</b>	2,178	2,447	2,370	2,035	1,687	1,492	1,556	13,765
<b>Deere Finance: Operating Profit (\$M)</b>	223	478	548	520	491	466	474	3,200
<b>Deere Finance: Operating Profit (%)</b>	10%	20%	23%	26%	29%	31%	30%	23%
<b>Deere &amp; Cat Combined Finance: Revenue (\$M)</b>	5,034	5,727	5,366	4,683	4,020	3,462	3,315	31,607
<b>Deere &amp; Cat Combined Finance: Operating Profit (\$M)</b>	604	1,057	1,238	1,190	1,022	936	867	6,914
<b>Deere &amp; Cat Combined Finance: Operating Profit (%)</b>	12%	18%	23%	25%	25%	27%	26%	22%

<sup>119</sup> AGCO was not included here because it does not do its own financing. It works through Rabobank. As such, it was not possible to isolate that portion of the Rabobank portfolio. CNH was not included here because they did not report in a basis consistent with Cat and Deere making a direct comparison more difficult.

<sup>120</sup> Deere includes their engine sales as a part of equipment operations, whereas Cat breaks it out. These numbers do not include Cat's, but do include Deere's. Deere is primarily and engine provider to itself. Beyond supplying to itself, Cat's engine division makes much, much larger engines that are sold through a separate channel.

When the combined results are presented graphically as they are in Figure 35, as in the previous chapter with Trimble and the equipment companies, the worst years of financing are comparable to the best years of equipment operations – even with the strongest and healthiest firms in the heavy equipment industry, Cat & Deere.

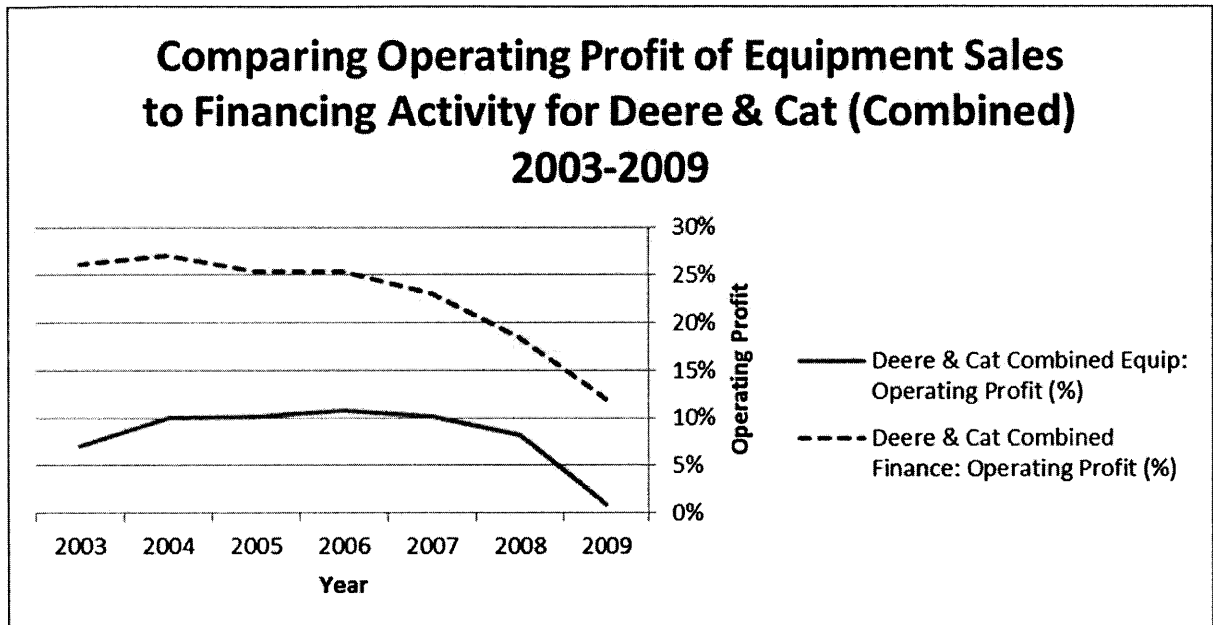


Figure 35: Comparing Operating Profit of Equipment to Financing for Cat and Deere 2003-2009

#### 4.5 – IBM Pay as You Drive (PAYD)

As was observed in Chapter 2, IBM’s essential skill is understanding complex processes and develop and marshal product knowledge for anyone’s products. They have long ago abandoned their roots as simply a provider of computing machines and that is now the smallest part of their business in terms of revenue, and even smaller yet when seen in terms of income.

In 2007, IBM was contracted by Norwich Union – the largest car insurance provider in the UK – to develop a model where insurance was based not on probabilities derived from demographics but on actual, telemetrically provided, vehicle performance data<sup>121</sup>. IBM puts it this way:

IBM will provide the hardware, software, and the actual in-car "black box" for Norwich Union. The box will use telematics—combining wireless communications and global positioning satellite (GPS) technology—to measure vehicle usage and transmit data through a mobile phone

<sup>121</sup> See <http://www-935.ibm.com/services/fr/index.wss/summary/igs/a1005608?cntxt=a1003234> for more information. Observed November 30, 2010. Unless specified otherwise, all information in this section is from the article available at that link.

network from Orange Communications. The customer's monthly bill will be calculated based on his or her individual driving data.

The article goes on to say that “Norwich Union is also researching ways to leverage the technology behind Pay as You Drive to offer additional services such as on demand driving directions, stolen-vehicle tracking and direct connection to emergency services—a natural progression of the on demand technology.”

“Pay as You Drive” is a slight twist on other value-based services, in that the item of which payment is being scaled to consumption is not a product, but another financial service – here, car insurance. Reflecting back on the examples from Chapter 3, there is also a strong telematics component here as IBM actually built the “black box” to provide that functionality.

#### **4.6 – Rolls Royce TotalCare**

About half of Rolls Royce’s revenue comes from services. The most interesting service in the Rolls Royce portfolio offers consumers of their aero engines the option to bundle all the operational aspects and buy simply “power by the hour.” They have – in essence – completely servitized the engine through their TotalCare service<sup>122</sup>. In their words, “[a]gainst an agreed cost per flying hour, TotalCare offers the opportunity to remove uncertainties from engine management and provides greater financial confidence from managing predictable costs.” This value-based service exhibits all three “layers” that we have discussed earlier in the chapter:

- Payment tied to consumption: Pay-as-you-go for the service of the jet engine.
- Packaging of novel product-based or finance-based services to generate a premium over the product. Those include:
  - Operational Support
    - Technical support
    - Asset management
    - Line support
  - Repair & overhaul
    - Planned shop visit
    - Unplanned off-wing maintenance
    - Accessory repair & overhaul
  - Information management
    - Engine Health monitoring
    - Engine management
    - Technical publications
- Exploiting an economy of scale on the production side of the service and an underutilization on the consumption side or both through some sort of centralization: here, the under-utilization is the equipment and staff required to support a jet engine.

---

<sup>122</sup> See <http://www.rolls-royce.com/civil/services/totalcare/>. Observed November 26, 2010.

We again see – perhaps even more so than with the IBM PAYD example – not just the product-based services enumerated above, but all of the types of services we have discussed in this paper because telematics capabilities are required to measure the systems. While they give no other details about the telematics capabilities, they do say this:

Our aerospace operations centres are a good illustration of this capability. In dedicated facilities serving airline, corporate and defence customers, these Rolls-Royce centres collect real-time data from our engines as they are operating around the world, 24 hours a day, 365 days a year. By analysing, sharing and acting upon this information we can optimise the performance of our engines in service. The centres are a focal point for service delivery, assessing the condition of the fleet and directing logistics and field maintenance.

Extending the GE model – as discussed in Chapter 2 – here we have the performance data not just reporting failures sooner, but – in a virtuous cycle – potentially getting it directly to the design engineers to improve the product. Figure 36 extends the ideas of Figure 14 and Figure 15 in Chapter 2 to portray the notion graphically. Here, Rolls Royce is using services not just to protect or increase product sales, but to enhance the product itself.

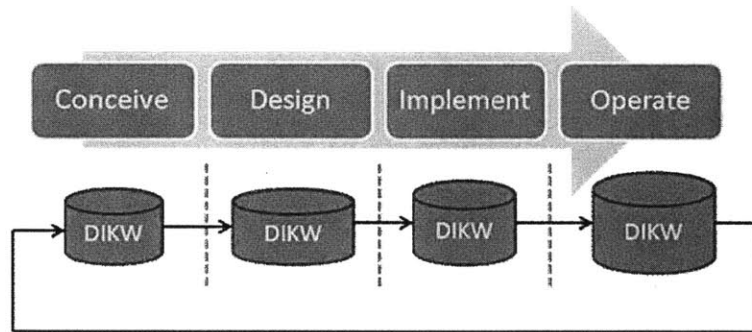


Figure 36: How D-I-K-W Flow at Companies like GE: Use Services to Enhance Products

One of the best measures of success of the TotalCare service is that, according to their 2009 Annual Report<sup>123</sup>, 45% of their civil fleet is enrolled for at least some of those services enumerated above. A good measure of its importance to Rolls Royce management is its appearance in the KPI's ("Percentage of Civil Fleet under Management" and "Underlying Services Revenue" – 59%).

Additionally, while Rolls Royce is continuing to globalize their manufacturing footprint (20 countries) and service footprint (over 50 countries), they are not "hollowing out" their UK base as they do it. They have invested £1.8B (\$2.8B) in the UK over the last decade and £300M (\$470M) in the last year. Information-based services like the telematics offerings from the Rolls Royce Group leverage deep product knowledge. By getting operational data directly to the design and manufacturing engineers, they are able to improve future designs, but they are also able to diagnose and prognosticate (prognose?) problems. Doing so has some significant impacts on knowledge management and value creation.

<sup>123</sup> Unless specified otherwise, information in this section is from the Rolls Royce Group 2009 Annual Report.

For the civil aero operating division of Rolls Royce, 59% of revenue came from services. Although this is an exaggeration, as with the birthday cake example in Chapter 1, they are moving toward giving away the engine, in a sense, as a part of the total solution.

Rolls Royce also provides extensive design services for the engines that they sell of all sizes – in the marine, aero, and oil & gas platform divisions. They are also extending the TotalCare business model to the other divisions as well.

## 4.7 – Bombardier FlexJet

Bombardier<sup>124</sup> takes value-based services one step further and servitizes not just the engine, but the entire jet through their FlexJet program for fractional ownership.<sup>125</sup> FlexJet allows customers to pick whether they want:

- Fractional ownership where “users pay predictable monthly management and usage fees, while FlexJet manages aircraft maintenance, flight crews, hangars, fuel, and insurance on their behalf.”
- Jet card – allowing users to use craft on a per-use basis across the FlexJet fleet.
- Whole aircraft management, where FlexJet handles all the maintenance costs for an owned craft.

In all cases, again we see the three elements of the most compelling value-based services:

- Payment tied to consumption
- Value-creating service production tied to consumption
- Economy of scale and underutilization leveraged.

Additionally, by making ownership and usage easier, they are also expanding the pie, and enablement is the most basic purpose of value-based services. For their jet division, services accounted for over 14.5% of their revenue. They accounted for a comparable percentage for their rolling stock (train and subway) division.

## 4.8 – Microsoft: Cloud on the Horizon, Storm Brewing Ahead

If you are a taxi cab driver, as presented earlier, the services bundle that you are able to package with a passenger car allow you to charge a premium over the cost of the product at the core of the product-service system. That is, of the 30-plus dollar cab fare to get from Logan airport to MIT’s campus, the actual cost of the car for those minutes is small. In that case, value-based services are attractive to the provider. In that case, taxi cabs actually extend the market for passenger cars as well, because buying a car to get me from Logan to MIT and then selling it is not a practically alternative, so in that sense, the

---

<sup>124</sup> For more information about Bombardier, please see Appendix A.

<sup>125</sup> Unless specified otherwise, information in this section is from the Bombardier 2009 Annual Report.

whole car ecosystem wins. If there are losers, they are in related ecosystems, like the Boston's "T" mass-transit system where it really is an either-or scenario: either I will take a cab or I will ride the T.

In other markets, value-based services do not present such an obviously attractive alternative to the sale of the naked product for the product providers. Commercial software may be one such field. In the end, commodity prices and expanding markets tend to create more value, but it's not always (not often?) for the incumbents in a market in transition. The history of Information Technology is littered with winners from one era being the losers of the next. Three decades ago, Microsoft was the up-and-comer leading (at IBM's anointing) the PC revolution. Today, they are battling the transition to cloud-based computing which very much fits our definition of a value-based service, and the transition ahead for them will be very bumpy.

Conceptually, cloud computing can be thought of on the same continuum as passenger transportation in Figure 33 earlier in this chapter. It is expanded here for those purposes below in Figure 37. Just as with a car, a traditional computer can be purchased or leased. Those are not fundamentally different products...just a different financial instrument packaged around it that may help enable the purchase and that begins to tie payment to consumption.

The more interesting examples are on the "Pure Service" end of the continuum. Grid computing, similar to car sharing services like Zipcar or traditional car rental discussed earlier in this chapter, allows you to rent processing (or storage or bandwidth) as needed. As with a rental car, you are still responsible for directing the resource usage, but it is an operational expense sized to the usage and many of the maintenance activities are no longer yours to handle. Sun – now a part of Oracle – is perhaps the best-known grid provider<sup>126</sup>.

---

<sup>126</sup> See <http://www.oracle.com/us/products/tools/oracle-grid-engine-075549.html> for more information. Observed November 21, 2010.



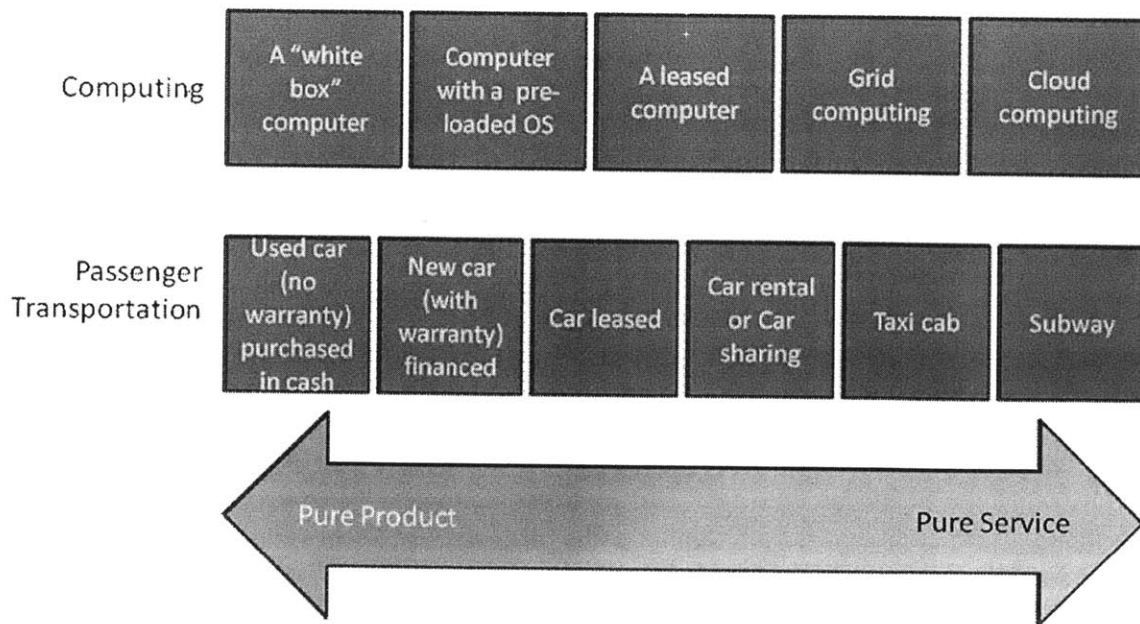


Figure 37: The Product-Service continuum for Passenger Cars and Computers

Cloud computing pushes that notion much further. Just as you simply consume the services of a subway by choosing where to let it take you, you simply consume the services of the cloud – a complete application architecture available through a browser that scales on demand. Here, you also make the sacrifices in accepting standards as you would with a subway, but it has the benefits of giving the consumer much less about which to worry...that's why you can read on the subway – because so much is being taken care of for you.

Michael Armbrust has written some of the clearest academic work on cloud computing. He defines a cloud as a computing platform that exhibits three attributes (Armbrust et al., 2010):

- the appearance of infinite computing resources on demand
- the elimination of an upfront commitment
- the ability to pay for (roughly) usage-based consumption

Others have described it as follows: "A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level agreements established through negotiations between service providers and consumers." (Buyya et al., 2009).

Said more succinctly, cloud computing appears infinite, immediate, and elastic to its consumers – like a utility.

This is much more than just re-packaging the financial transaction as with leasing a server. New data centers on the scale of companies like Google, Microsoft, and Amazon (50,000 to 100,000 servers) are able to achieve efficiencies of five to seven times that of traditional, mid-sized data centers (5,000 to 10,000 servers) (Armbrust et al., 2010). Coupled with system utilization of 5% to 20% in traditional,

existing data centers, the potential for order-of-magnitude overall efficiency improvements is with reason. Very different applications architectures are required to take advantage of the cloud, which will throw away much of the investments in legacy systems, but the economics are so compelling that many will not be able to (and should not) resist.

As Nicolas Carr points out in a compelling manner in “The Big Switch – Rewiring the World from Edison to Google,” the similarities between the cloud revolution and the electric revolution about a century earlier are significant<sup>127</sup>. In the late 1800s, power was based on the water: a local, custom-built system where physical proximity was very important because of limits in transmission capabilities. In a few years, steam power (still derived from water) generated more power with limited ability to transmit locally, but centralization was still not practical.

As with all systems based on what economists call General Purpose Technologies (Carr, 2008), the ability to stop building to meet a localized peak utilization and consume on-demand creates compelling scale economies. That’s what makes a great value-based service: the ability to exploit inefficiencies on either the production or consumption side (here, both) and sell the technology at the right quantization. Leasing a car or a server is okay, but it does not cause a massive disruption. This does.

To be clear, services are absolutely not a bad thing for an information technology company. They are an important part of the revenue mix, and they provide long-term stability that product sales cannot. For Microsoft, the challenge is that the margin on traditional, shrink-wrapped commercial software is simply staggering and that the cloud as a service model is a shot to the heart of their two largest products: Windows and Office.

In the last five years, Salesforce.com has become a stronger and stronger player in the cloud computing/software-as-a-service business. Some say that they were the first to commercialize it. They offer a customer relationship management (CRM) system (and a growing list of other services) for a simple monthly fee. No servers, no software...just launch a browser and get to work. That is very, very threatening to the Microsoft model. An exhaustive study is beyond the scope of this paper, but simply put, if Microsoft represents the way software companies have done business in the past and Salesforce.com represents the way that business will be done in the future, the transition ahead for Microsoft is tough. Table 19 shows the operating profit for each company for the last five years, and Figure 38 portrays it graphically. While the Cloud will certainly create a much larger pie, it’s hard to get excited about 6% when you are used to 37%.

---

<sup>127</sup> Beyond specific citations, this section is influenced strongly by two works. Both are excellent reads. The first compares the cloud to electric power. The second tells the story of the electrifying the world: (1) Carr N.G. (2008) *The big switch : rewiring the world, from Edison to Google*. 1st ed. W. W. Norton & Co., New York. (2) Jonnes J. (2003) *Empires of light : Edison, Tesla, Westinghouse, and the race to electrify the world*. 1st ed. Random House, New York.

Table 19: Operating Profit - Microsoft vs. Salesforce.com

Statistic/Year	2010	2009	2008	2007	2006	Total
Microsoft: Revenue (\$M)	62,484	58,437	60,420	51,122	44,282	276,745
Microsoft: Operating Profit (\$M)	24,098	20,363	22,271	18,438	16,380	101,550
Microsoft: Operating Profit (%)	39%	35%	37%	36%	37%	37%
Salesforce.com: Revenue (\$M)	1,305,583	1,076,769	748,700	497,098	309,857	3,938,007
Salesforce.com: Operating Profit (\$M)	115,272	63,742	20,369	(358)	20,102	219,127
Salesforce.com: Operating Profit (%)	9%	6%	3%	0%	6%	6%

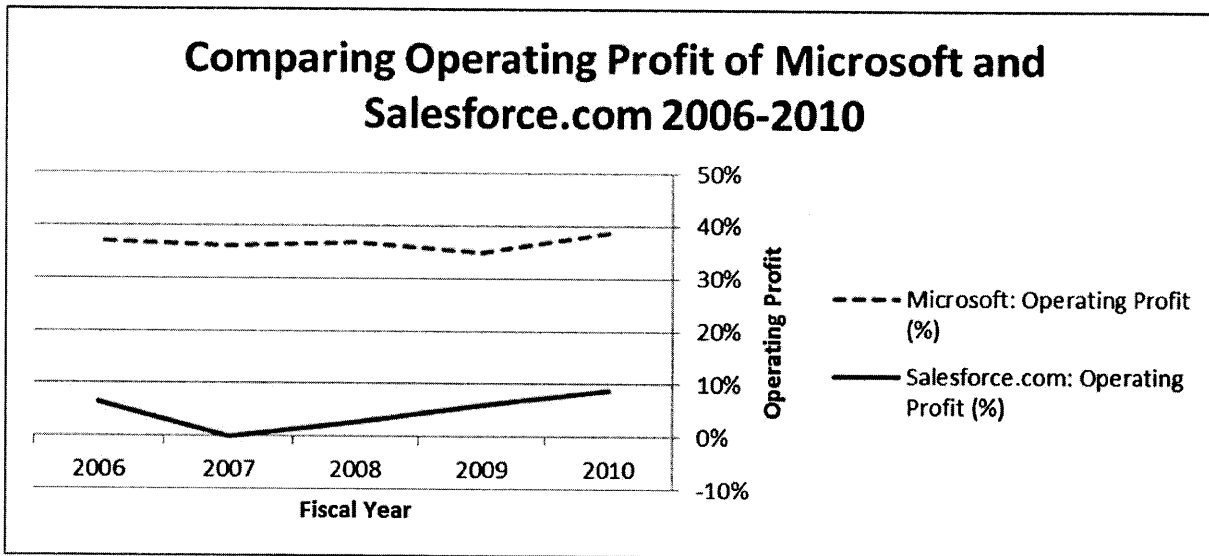


Figure 38: Comparing Operating Profit of Microsoft and Salesforce.com 2006-2010

As Table 20 shows, when it comes to the Cloud, no matter how tough the coming change, Microsoft is clearly taking on all comers. Microsoft has done the right thing making sure that they are involved in practically all the emerging online, cloud-centric markets<sup>128</sup>. They are even beginning to turn around their terrible (absent) strategy around mobile devices that drive access to the web, with Windows Mobile 7 and the recent announcement of developing Windows for ARM processors<sup>129</sup>.

<sup>128</sup>Besides some basic aggregation tools, Microsoft has not yet made a significant attempt in social media.

<sup>129</sup> See [http://news.cnet.com/8301-13924\\_3-20026354-64.html](http://news.cnet.com/8301-13924_3-20026354-64.html). Observed December 26, 2010.

Table 20: Microsoft vs. the World in the Cloud

Microsoft Offering	Competitive Offering
Dynamics CRM	Salesforce.com
Bing (including Yahoo! search)	Google Search
Azure	Google App Engine
Hotmail	Google Gmail
Office 365	Google App Engine
Bing Maps	Google Earth
MSN	Yahoo!

For the online businesses of Microsoft, a utility computing model will be profitable, but it will mean the death of Windows as a PC and server operating system and Office as a PC application. It is hard to beat the gross margins of commercial software. While we will almost certainly see a less profitable Microsoft in the future, utilities like what the Cloud is building can be exceptionally stable and highly profitable companies. Just as IBM turned the corner to become a very different but profitable company in the product services world, Microsoft faces the chance to do the same in the utility world. As they have shown for decades, they are an amazing and tenacious competitor.

#### 4.9 – Tying It Together

We’ve seen in Chapter 4 that value-based services are about how you package the product-service system: focus on the product or focus on the service that consumers want the product to provide. For the cab driver, it creates an opportunity. For Microsoft, a threat.

# Chapter 5 – Conclusions

---

*“Digital Technology is to the service revolution as steam was to the industrial revolution.”*

- Dr. Irving Wladawsky-Berger, Visiting Lecturer at MIT Sloan and MIT’s Engineering Systems Division<sup>130</sup>

## 5.1 – A Brief Review

Before drawing some conclusions about the best way to approach services for product-centric companies, let’s review what we’ve discussed so far.

*Chapter 1* briefly reviewed the troubled attempts to categorize and even define services from Scottish economist Adam Smith forward and ultimately concluded that to define products and services apart from each other is a false dichotomy. We leaned on the language of Teboul to put things in terms of “front stage” and “back stage” and pointed toward the definition from Tang & Zhou: “a solution performed for consideration with a taktchronously co-produced product-IHIP solution to create a stream of benefits.” There are no pure products and there are no pure services. Each thing that is consumed is a balance of the two. Then, we looked briefly at how to categorize services and proposed that it could be useful – based on the work of de Weck and Magee – to talk about product-based, information-based, and value-based services as elements of product-service systems. Those three types defined the study of the next three chapters. There is not a consistent methodology on how the services and their related products are analyzed and presented. Chapters 2 – 4 then each briefly looked into those different types of service offerings, each shamelessly acknowledging that it is a snapshot into an element or two of the totality of services and product-service systems.

*Chapter 2* focused on product-based services. The first part of the chapter focused on leading indicators and trends that fewer and fewer product-based services need the brick-and-mortar world. Companies that accept that reality, like Best Buy, Netflix, and Redbox appear to thrive. Companies that ignore it, like Blockbuster and Circuit City, perish. The chapter points out that product-based services must be progressively more experiential to merit the transactional costs of brick-and-mortar environments, and that consumers in more-and-more markets want – or perhaps demand – multi-channel delivery models, letting them choose based on the product and the overall transaction. We boiled all that down to the idea that successful companies exceed customer expectations for trade not in the quality of the product and what will be paid for it, but in the totality of the experience including product and services, and that the frontier of customer expectations is not at all static.

The last part of the chapter was less consumer-service-oriented. We looked at Deere and a couple of on-going supply chain integration efforts:

---

<sup>130</sup> From Dr. Wladawsky-Berger’s presentation at the 2010 MIT SDM Systems Thinking Conference, held at the MIT Media Lab, October 21 & 22, Cambridge, MA.

- John Deere's Nortrax captures existing value by acquiring Deere's construction equipment dealers.
- LESCO became a part of the John Deere Landscapes to support Deere's "One Source" strategy which creates value by integrating across previous boundaries in the supply chain between products, retail services, financing, and installation.

We also looked at GE and IBM where we saw what appear as more advanced approaches toward services:

- We saw that GE uses its services business to re-enforce and in some ways protect their product business. They recognize their service capabilities as a competitive advantage.
- We saw that IBM has de-emphasized their traditional product business (hardware) in favor of services. While they certainly also sell lots of software very profitably, services is the largest piece of the business.

*Chapter 3* focused on telematics as one interesting example of information-based services and showed that there are two primary approaches: integrate like GM and John Deere, or partner (with varying strengths of partnership), like Ford, Caterpillar, AGCO, and CNH. The approach chosen appears to have near-term impacts on product architecture and the knowledge domains from which the telematics system can most effectively draw that should impact the choice.

We saw, first, that telematics can be a very profitable business based on what we could infer about GM's OnStar. Further, we observed that where companies are choosing to keep telematics services far from the product core, they could be giving away their future. We are treating as axiomatic that products seek the cost of capital in efficient markets, and that these services are where the value creation can come as the core product's value proposition declines. To illustrate, we looked at Caterpillar and CNH and their advanced technology partner Trimble and compared their financial performance in recent years. We saw that, while both Cat and Trimble beat the S&P 500 over the last five year a and both were financially solid companies, Trimble beat the S&P by a whole lot more and Caterpillar had to deploy lots more capital per unit of profit than Trimble. From that, I questioned whether it was good for Cat to give away the really profitable stuff, especially in the long-term.

We also mentioned the notion that products like tractors and backhoes are platforms and that there is an opportunity to develop there. We see Ford starting to develop that notion with their family of related products.

*Chapter 4* proposed that there are three different levels, or layers, of value-based services:

- Enable: Make the payment model more closely match the consumption model. This can and normally is profitable, but it is best thought of as just an enabler to get a company's products to their customers (think, "car financing").
- Servitize: Package the product with novel services (generally product-based, but in some cases finance-based and IT-based) and tie the production of those services to the cadence of

consumption. That novel packaging of services is what enables the service provider to charge an attractive premium over the “rent” of the core product alone (think, “taxi”).

- Utilitize: Exploit an economy of scale or scope on the production side and/or an underutilization on the consumption side to create what is essentially a utility. If the price-performance curve is adequately disruptive, customers will take lesser performance for the standardized services (think, “subway”).

It was also shown how cloud computing fits that model and what the emergence of a new utility (a “fifth utility” (Buyya et al., 2009) along with water, gas, electricity, and telephone) appears to be doing to that ecosystem by looking at its impact on other companies, both suppliers to the utility, creators of the utility and consumers of the utility.

We also reviewed more transportation sector finance-based utilities and saw that same trend from Chapter 3 to protect and extend knowledge assets with services.

All that leads us to here. So what?

## **5.2 – The Problem with Products**

When taken in context, there are two recent product manufacturing processes that have staggering implications for product-centric systems: commercial-grade Linux and the Boeing 787 Dreamliner. Let’s look briefly at each of them.

### **5.2.1 – Linux**

Linux is an open-source, commercial-grade operating system. A decade ago, that would have sounded like an oxymoron. In this context, I mean “commercial-grade” in the sense that more than hobbyists are using it and that it is being used as a replacement for what would have been previously purchased operating systems. With all due respect to Linus Torvalds, nobody really “owns” Linux. It develops by the wisdom of the crowd. There have certainly been some very key contributions by the commercial world to make it viable for production workloads on multi-processor systems, and the motives behind those “contributions” were business-driven, and not altruistic, but it has been done. Linux is significant here for two reasons.

- First, product complexity used to be one of the barriers to entry into markets. There are few things designed and implemented by people than robust, commercial operating systems, and they no longer require profit-driven corporations to make them happen. “Why” is a fascinating subject that I would argue has much common ground with the issues and trends observed in Chapter 2 that are assaulting brick-and-mortar-centric product-based services, but for our purposes, I am hoping we can leave the “why” question alone and just recognize the trend.
- Second, even something that complex has a tough time recovering the cost of capital. Competition is so stiff that companies will help give away products to get into the services business that surrounds it. That sounds bad for product companies.

## 5.2.2 –787 Dreamliner

The Boeing<sup>131</sup> 787 Dreamliner is another example of complexity in the built world. Just as operating systems can be thought of as the apex of digital product complexity, so can the same be said of airliners for the commercial, build-to-order electro-mechanical world. As has been the case for decades, the manufacturing of Boeing’s latest commercial jet is highly distributed. When the dollars are as large as they are for commercial jets, countries prefer to buy from a supplier where there is some local content. Boeing has taken it a major step further, though. They did not just outsource fabrication and assembly around the world; they outsourced design<sup>132</sup>. This approach has not been without issues, but to consider doing so means that those capabilities exist outside of their “walls,” and – in some sense – means that it has been commoditized. The impact on integration testing, assembly, and agility – just to mention a few capabilities – is also fascinating, but our focus here is on the fact that they could go outside of the boundaries of their company to design major sections of the one of the most complex products in the built world.

## 5.2.3 – Products Are Not Enough

Together, I am extrapolating a commercial-grade, open-source operating system, and outsourcing major design elements of an airliner to point to a problem with being just a product company. When the item for consumption can be completely described, it can be completely compared, and in efficient markets, its price will seek the cost of capital and no more, leaving no economic value created for shareholders on the product alone. For Western nations, with higher labor costs, that will always end poorly for a “pure” product offering. There was a time when services could be a differentiator, and that is still true, but at the same time, I am arguing that they are now a part of survival. Simply put, products are now – in many cases – just the price of admission.

## 5.3 – How Then to Approach Services?

Pulling what we have seen together, perhaps a services strategy starts with three questions. We’ll consider these questions at the company level here. In practice, the decisions are made at a much lower level – in some cases perhaps even product-by-product, and even there, there are likely regional differences in how and when the approach is implemented. The three questions:

- How involved does as a company want to be the services that surround their products?
- If a company chooses to be involved in services, how deeply do they want to be involved?
- Whether the services are provided by the product company or others in their capability chain, how should the financial transactions for the product-service system be bundled and structured?

We’ll un-pack those three questions, and tie them to the examples we have seen.

---

<sup>131</sup> For more information on Boeing, please see Appendix A.

<sup>132</sup> See [http://www.industryweek.com/articles/boeing\\_787\\_a\\_matter\\_of\\_materials\\_--\\_special\\_report\\_anatomy\\_of\\_a\\_supply\\_chain\\_15339.aspx?Page=2?ShowAll=1](http://www.industryweek.com/articles/boeing_787_a_matter_of_materials_--_special_report_anatomy_of_a_supply_chain_15339.aspx?Page=2?ShowAll=1). Observed December 1, 2010.



## Question 1: How Involved Does a Company Want to Be in the Services that Surround their Products?

Figure 39 shows the four options related to level of service involvement that we have seen, and some of the companies we have seen exhibiting that strategy:

- **Leave services to others.** In general, this is not the approach that healthy, forward-looking companies will take, except perhaps in very young or extremely technical markets, but companies and markets mature. It does not seem likely that a successful company can stay here for long.
- **Partner on services** with companies with deep skills in services or products that support services related to your core products. This has been the approach of Ford and Caterpillar with their telematics platforms, leveraging Microsoft and Trimble. This approach likely has smaller capital requirements and a shorter runway than the approach the next two choices we'll see, but as the mature core products seek the cost of capital, what is left for Ford and Caterpillar? This seems to be a great transitional approach, but if that is the case, then there are some important issues of intellectual property to be handled up front.
- **Invest deeply in services.** We saw in Chapter 2 that it can be a way to capture or create value. Best Buy, GM, John Deere (to a lesser extent), GE, and Rolls Royce exemplify this approach – Best Buy and GE in product-based services, GM and John Deere in information-based services (specifically in telematics), and Rolls Royce in value-based services. While highlighted in Chapter 4, Rolls Royce is really an excellent example of how the most compelling product-service-systems fire on all cylinders.
- **Divest of commodity products to focus on services.** If your core product market is no longer a viable business, or you can see a time when it will not be, then this may be the best approach. The pain of the transition will vary inversely with the foresight involved in making the transition. In a sentence, that was the IBM approach after their near-death experience in the PC era. As we saw in Chapter 2, while they still design and make some physical things, they are really a services company and a software company (i.e., higher-value products) and they have intentionally de-emphasized commodity hardware<sup>133</sup>.

---

<sup>133</sup> This is likely where we would put P&G's Dry-cleaning and car-washing franchising business if we thought of them in product terms instead of branding terms.

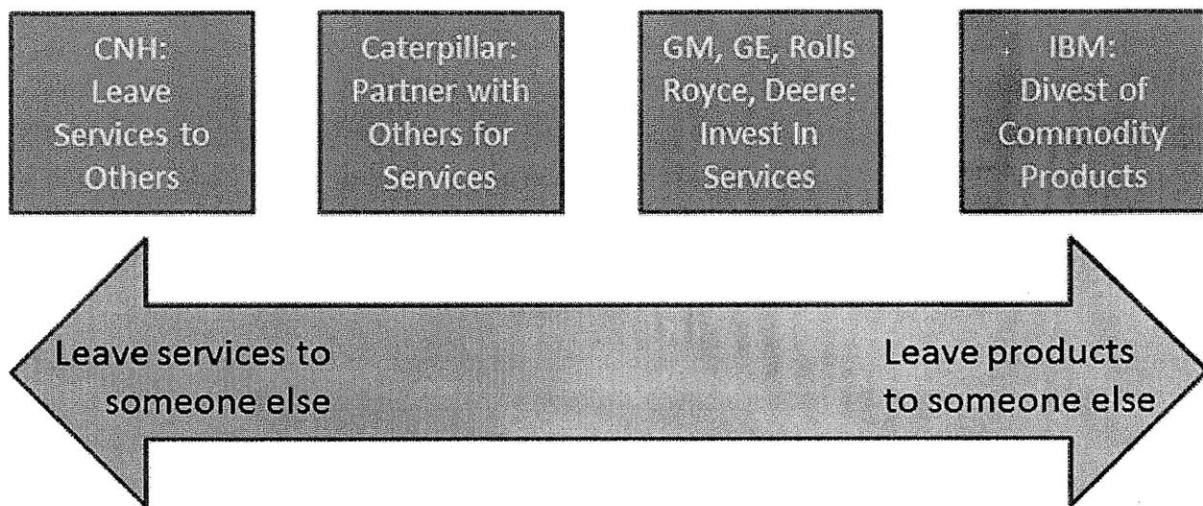


Figure 39: Four approaches to the Product-Service Relationship

It may be that these four, in the order they are presented, present more of an evolutionary approach to services than a choice or decision, and that each one is in fact a natural progression from what came before it, but if that is true companies can perhaps influence the pace of evolution at the very least.

For those companies that are content to leave it to others or to partner, there is little else to do, except to continue to re-assess that fundamental question and determine when doing more with the services that surround their products makes sense or write their own obituary. Even in those cases, however, choices need to be made on the financial structure of value-based services, which are presented in Question 3.

For those like IBM that chose to leave products behind (or, more rightly, perhaps managed to adapt and prosper when they had to leave the product behind), there is not enough information available on how that unfolds in order to articulate a strategy. They appear to be near or at the frontier of that business model.

For those that invest in services, there is another choice to make. That leads us to Question 2.

### Question 2: If You Are Investing in Services, How Deeply Do You Invest?

Here we have seen four levels as well. They are portrayed in Figure 40:

- In Chapter 2, we saw John Deere exhibit the most basic level in their acquisition and consolidation of a part of the channel for their construction products into Nortrax. There, they are *capturing value* from services that previously went to other companies.
- In Chapter 2, we also saw John Deere take it a little further in the LESCO acquisition and “One Source” strategy to more tightly *integrate* products and (a variety of ) services *to create new value*.
- In Chapter 2, we saw GE take it another level and *use services to protect their product* strategy. We looked at how they broke down some of the boundaries that enable D-I-K-W to

flow more freely between their “conceive”/”design”/”implement” organizations and their “operate” organization, as in Figure 15.

- In Chapter 4, we saw Rolls Royce show what seems to be the most advanced service strategy, using them to create a feedback mechanism to actually *enhance the product core* as in Figure 36.

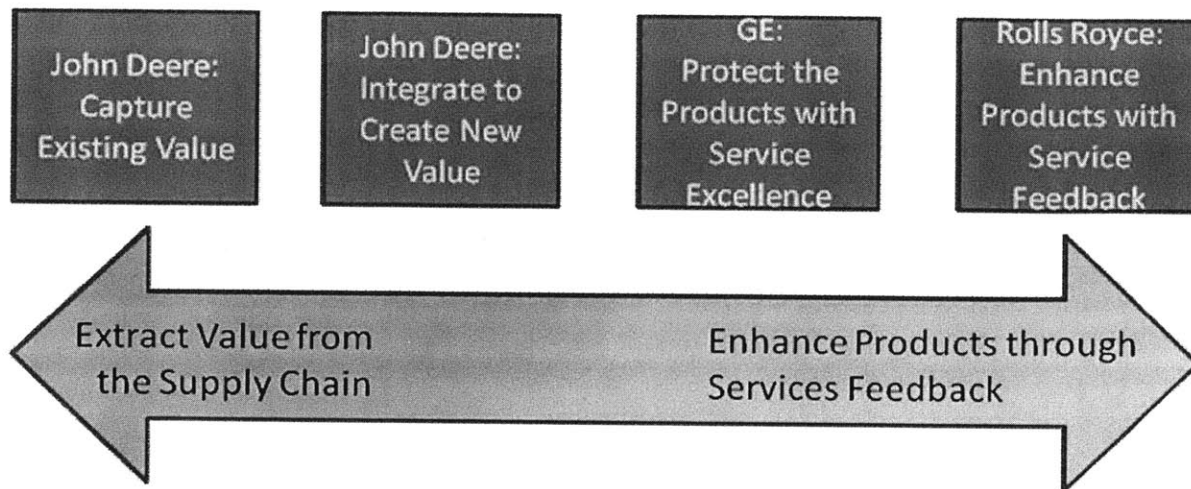


Figure 40: Four Levels of Product-Services Integration

### Question 3: How to Package the Product-Service System

In Chapter 4, we saw three possible levels in packaging the product-service system. There are a total of four options/levels here as well. While we saw them played out in a number of companies in a number of industries, they are most succinctly told in terms of passenger transportation. They are presented here in Figure 41.

- Pure product: no financing. Focus entirely on the product and its features (think “car”).
- Tie payment to consumption (think “car lease”).
- Package other services with the core product in a novel way and match their production with the consumption and payment (think “taxi cab”).
- Leverage either economy of scale in production, or underutilization in consumption or both, to create a utility. Customers will trade some flexibility for the exceptional value created (think “subway”).

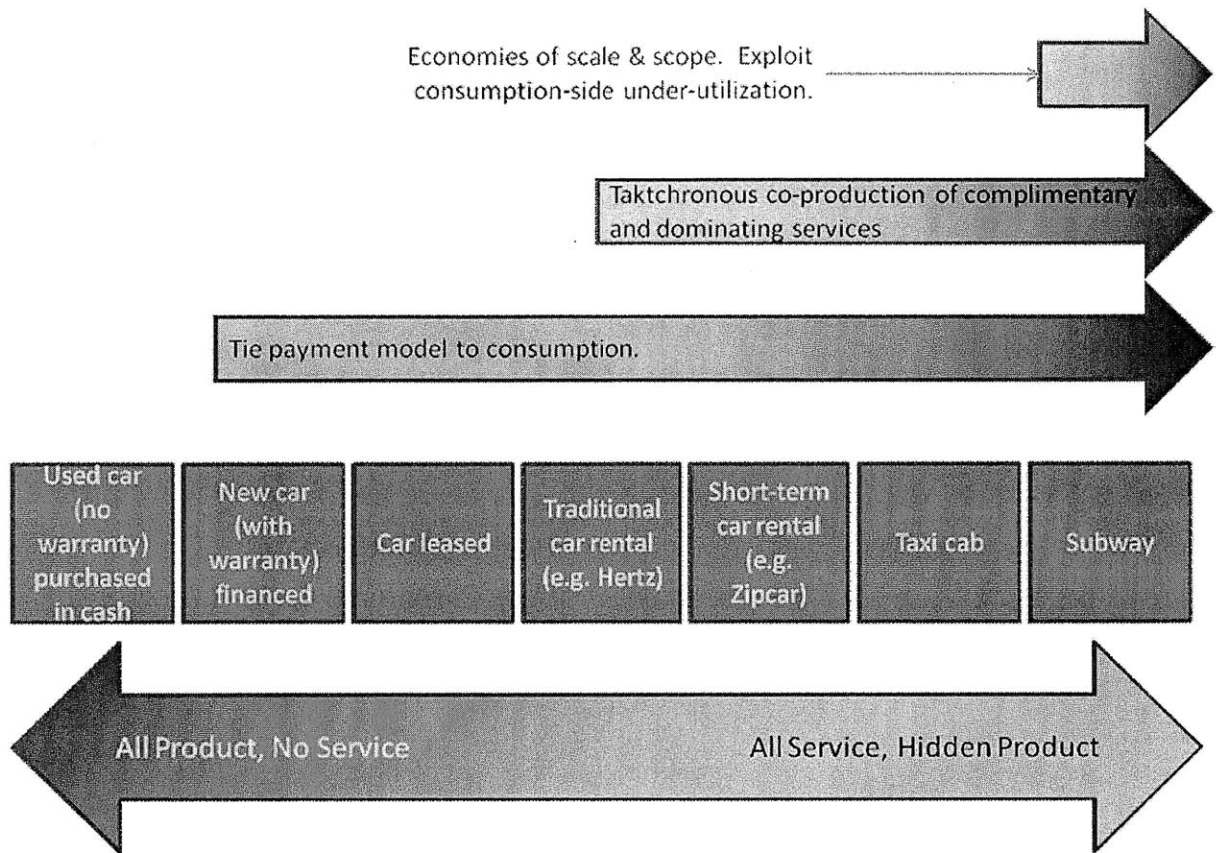


Figure 41: How to Structure the Financial Transaction - All Product to All Service

It is important to note that this third question is not additive to the second question. Whether services are delivered separately, through a partnership, or in an integrated manner, questions around bundling and pricing come into play.

It is also important to remember that for the cab driver, the value-based service model allows him to charge a premium over the core product, but for Microsoft, value-based services are destroying the premium they have enjoyed.

As companies come to terms with those three questions, they will start to understand their approach to product-service systems.

## 5.4 – For Further Study

Although all of the content herein was prepared specifically for the thesis, this thesis is in many ways almost a collection of related papers by the same author. Most of the topics presented here, as Services Science evolves, are worthy of much more consideration than I was able to give them. The following are some of areas I would study further.

## **A Rigorous Definition and Consistent Classification**

Probably the most important research to be done in this space is settling on a definition and classification framework. I feel strongly the taxonomy of complex systems by de Weck and Magee in Table 1 is an excellent basis for that. It would be interesting to extend the work here which is focused on the operand to the processes as well. Work to tease out the nature of energy-based services would be interesting as well...I struggled to find those.

## **D-I-K-W for Services**

I think the applicability of the Data-Information-Knowledge-Wisdom hierarchy toward services could help as a basis for classification and insight as well. A more thorough treatment of that idea could yield real insight. In general, business and academia would benefit from more crisp and consistent use of those four terms as well.

## **Services and the Double Helix.**

I would like to see the work of Professor Fine and Dr. Piepenbrock from MIT Sloan applied to services. Extending the work of Professor Fine, Dr. Piepenbrock writes about the four core markets of a business (capital, labor, supplier, and customers) becoming integral and modular over time. I have wondered if a similar lifecycle could be observed in the classifications of services that we see here. The pendulum trend that I discuss briefly in chapter one between products and services for things like music seems to fit in this space of ideas. Earlier versions of Chapter 4 attempted to wrestle with those notions, but that ended up on the cutting room floor as it was a distraction from the core message of the thesis. Professor Fine's view of a capability chain is great language for discussing services outside of the "walls" of the product company as well.

## **Product-Based Services: Logistics as a Competitive Advantage**

In Chapter 3, I spent a good deal of time on consumer- and retail-centric notions, and then some time discussing other fairly customer-facing services, but in a more industrial setting. For industrial companies, services around logistics are a huge part of what they do. Studying those in this context could be very useful. While there is an excellent body of knowledge around logistics, I am wondering if it would be seen differently when thought of in terms of product-service systems and not services to move products.

## **Advanced Products and Services in Mature Product Markets**

In Chapter 3, I briefly look at the financials of Caterpillar, CNH, and Trimble and propose that Caterpillar and companies like that are deploying all the capital so that Trimble and others can scoop up the gravy. Exploring that notion more broadly – specifically around the IT element of advanced, complex build-to-order electromechanical systems (planes, tractors, combines, backhoes, articulated haulers, etc.) – and who is making the money in those industries would be very interesting. That subject caught my attention early on, but as a Deere employee, there was no way I could separate business and academic interests (and sources...for public consumption) well.

# Appendix A – Selected Company Backgrounds

---

Throughout the thesis, a number of companies are discussed. To balance ease of reading with completeness, brief summaries of each company – where appropriate – are presented here instead of in the body of the paper.

In general, where a company was just mentioned in passing, they are not mentioned here. Where the details of the company’s business are useful background to the thesis, they are included.

For more extensive information on these companies or information on the companies not listed, you can consult the Internet. I have tried to make this appendix just supporting information, so that the body of the thesis can be read for people familiar with the companies. Information that can be found in places like the company’s “About Us” or “Company History” or “Investor Relations” pages, or in their most recent Annual Report or SEC 10-K filing are not cited. The reader is assumed to be web-literate.

For institutions, like MIT or DARPA, or newspapers like the Wall Street Journal or the New York Times, I have not listed them here when they are acting like institutions. When they are a part of product development activities, I have mentioned them.

A few more details:

- Companies are listed alphabetically.
- All Market capitalizations are as of November 30, 2010 plus or minus two days.
- All revenue and income statistics are for FY2009.
- Some financial data was obtained at <http://finance.yahoo.com>.
- Financial values throughout are reported as they are denominated by the company, but always expressed parenthetically in United States dollars as well. Currency conversion was done using <http://www.xe.com/ucc/> and the rates were observed November 30, 2010 plus or minus two days. To determine the conversion rate used, you are welcome to do the math. Since currencies move, the dollar values will not be quite right for what they were at the end of the fiscal year. That is why the native denominations are preserved.

In general this is just background information. The “good stuff” is in the body of the thesis.

AGCO Corporation (AGCO)	<a href="http://www.agco.com">http://www.agco.com</a>	NYSE: AG
Revenue: \$6.6B	Net Income: \$0.14B	Market Capitalization: \$4.2B
AGCO is the result of a host of agricultural acquisitions. Its implement brands in the US are the Challenger line (acquired from Caterpillar in 2002) and Massey-Ferguson (acquired in 1995). The Massey-Ferguson brand’s roots go back to 1847, just ten years later than John Deere.		
There are a dozen other brands in the AGCO portfolio, mostly brought about through acquisitions, and not all of which are sold in the US.		

Amazon.com Inc. (Amazon)	<a href="http://www.amazon.com">http://www.amazon.com</a>	NASDAQ: AMZN
Revenue: \$24.7B	Net Income: \$902M	Market Capitalization: \$78.83B
<p>Amazon.com was born in the mid-1990s. Initially, it was focused on being the world's largest bookstore, but in years since, it has moved on to sell almost everything. They are an online discount retailer with an incredible logistics network and an obsessive customer focus.</p> <p>Their Kindle e-reader has defined its market.</p>		

Best Buy Co. Inc.	<a href="http://www.bestbuy.com">http://www.bestbuy.com</a>	NYSE: BBY
Revenue: \$49.690B	Net Income: \$1.3B	Market Capitalization: \$17B
<p>Best Buy is an electronics and media retailer with a strong US presence and a growing presence in Europe. They are the last one standing in what used to be a very crowded sector. They continue to diversify the product and service offerings but are most focused on electronic gadgets, home entertainment systems, and PCs. Much more is said about them in the thesis.</p>		

Blockbuster Inc.	<a href="http://www.blockbuster.com">http://www.blockbuster.com</a>	
Revenue:	Net Income:	Market Capitalization:
<p>Blockbuster declared bankruptcy early this year. Their aging brick-and-mortar video rental business is seeking protection to re-structure their debt obligations. They are the largest movie rental chain store in America but that is starting to sound like being the biggest buggy whip maker in the 1920s. They have experimented with other distributions channels to compete with Netflix and Redbox, but it may have too little, too late.</p> <p>Since they are in the midst of re-capitalization effort, FY 2009 financial statistics are omitted as they will not accurately portray their present condition.</p>		

Boeing Co.	<a href="http://www.boeing.com">http://www.boeing.com</a>	NYSE: BA
Revenue: \$68.28B	Net Income: \$1.3B	Market Capitalization: \$46.78B
<p>Boeing is one of two large commercial jet liner producers left, along with the European company, Airbus.</p>		

Bombardier Inc.	<a href="http://www.bombardier.com">http://www.bombardier.com</a>	TSE: BBD
Revenue:	Net Income:	Market Capitalization:
<p>Bombardier has two operating divisions: Jets and Rolling stock. Bombardier is one of three manufacturers of regional (business) jets, along with Saab and Embraer</p>		

Circuit City Inc.		
Revenue:	Net Income:	Market Capitalization:
<p>Circuit City was Best Buy's main competitor in the highly competitive consumer electronics business. Increased competitive pressures and the macro-economic condition of 2008 and 2009 drove it to bankruptcy, but it had been struggling for years before that. Since it is out of business, no financial data is provided</p>		

Caterpillar Inc. (Cat)	<a href="http://www.cat.com">http://www.cat.com</a>	NYSE: CAT
Revenue: \$32.4B	Net Income: \$895M	Market Capitalization: \$53.7B
<p>Caterpillar was founded in 1925 as the Caterpillar Tractor Co. but has roots in collaboration between its founders dating back to the 1890s. Caterpillar is a global firm whose products are focused primarily on construction</p>		

equipment, forestry equipment, mining equipment and engines. Those core product offerings are supported by a strong dealer network, financial services, and a host of other supporting brands and businesses to amplify those core assets. Caterpillar is one of the largest construction equipment companies in the world. Its 2009 revenue was markedly down from previous years as a result of the global recession, but it still stayed profitable. Caterpillar offers a full line of construction equipment, featuring 28 different product types and over 300 different machine models.

Caterpillar is headquartered in downtown Peoria, Illinois.

CNH Global N.V.	<a href="http://www.cnh.com">http://www.cnh.com</a>	NYSE: CNH
Revenue: \$13.76B	Net Income: - \$190M	Market Capitalization: \$9.86B
<p>CNH Global N.V. (more commonly known as Case-New Holland or CNH) is result of the 1999 merger between Case-IH and New Holland. (<a href="http://www.cnh.com">http://www.cnh.com</a>) Case-IH was the result of a previous earlier merger between Case and International Harvester. The Italian company, the Fiat Group owns 90% of CNH. Fiat Group (Milan: F.MI) is the home to iconic car brands like Fiat, Alfa Romeo, Maserati, and Ferrari. It is also the parent company of Chrysler after the 2009 government bail-out.</p>		

Coinstar Inc.	<a href="http://www.coinstar.com">http://www.coinstar.com</a>	NASDAQ: CSTR
Revenue: \$1.14B	Net Income: \$53.6M	Market Capitalization: \$2.04B
<p>Coinstar operates vending machines. Their core business in coin-counting machines along the fourth wall of retail establishments that will count coins for a fee or pay out in gift cards for no fee. They are also the parent company of Redbox, which they acquired from McDonald's. Redbox is well more than half of their revenue. There are now over 25,000 Redbox movie kiosks. They rent DVDs for \$1/day.</p>		

Deere & Company (John Deere, Deere)	<a href="http://www.deere.com">http://www.deere.com</a>	NYSE: DE
Revenue: \$23.1B	Net Income: \$874M	Market Capitalization: \$31.66B
<p>John Deere was founded by the eponymous blacksmith in 1837. Deere is organized into three operating divisions: Ag &amp; Turf equipment, Construction &amp; Forestry equipment, and Financial Services. Within both of the equipment divisions are supporting business, like John Deere Parts, John Deere Water, John Deere Landscapes, and the Intelligent Solutions Group. As did Caterpillar, John Deere spread from its Midwestern roots in the last half of the 20<sup>th</sup> century to become a global firm. Also like Caterpillar, its robust dealer network is a key advantage and differentiator.</p> <p>John Deere is often second to Caterpillar for sales in earth-moving equipment markets where they compete directly. John Deere is usually largest where the firms compete on forestry equipment. While John Deere's total construction offerings are not as wide as Caterpillar, it is one of a few companies – along with Caterpillar – to offer a full line of earth-moving equipment.</p> <p>John Deere is the world's largest manufacturer of agricultural equipment. They are headquartered on a bucolic, 1,400-acre campus in Moline, Illinois.</p>		

Ford Motor Company (Ford)	<a href="http://www.ford.com">http://www.ford.com</a>	NYSE: F
Revenue: \$118.B	Net Income: \$2.72B	Market Capitalization: \$55.35B
<p>Of the Detroit Three, Ford is the only one that did not need a government bail-out.</p>		

General Electric Co. (GE)	<a href="http://www.ge.com">http://www.ge.com</a>	NYSE: GE
Revenue: \$156.8B	Net Income: \$10.7B	Market Capitalization: \$168.66B



Tracing its roots to Thomas Edison, few companies have GE's pedigree when it comes to product (and services) innovation. While they are known for Lightbulbs and appliances, power generation, industrial automation, and financial services are where they make their money.

General Motors Corporation (GM)	<a href="http://www.gm.com">http://www.gm.com</a>	NYSE: GM (again)
Revenue:	Net Income:	Market Capitalization: \$51.3B
GM had their IPO over the course of writing this thesis. They are back from the dead and re-capitalized. Since they died in 2009, I am not listing revenue or net income since they will not be representative.		

Google Inc. (Google, Google.com)	<a href="http://www.google.com">http://www.google.com</a>	NASDAQ: GOOG
Revenue: \$23.65B	Net Income: \$6.5B	Market Capitalization: \$186.5B
Google is one of many mid-1990s-idea-from-a-couple-of-Stanford-grad-students company. Their simple idea was to make the Internet searchable. Their 2009 Annual Report still describes their ultimate goal as "[c]reating the perfect search engine." While the offerings of Google are impressive, their revenue comes primarily from their AdSense platform, with ads accounting for over 90%, and with over 70% of resources committed to search and ads. Practically speaking, they do not have a traditional product...they are almost pure services.		

In. de Diseno Textil (Inditex)		MCE: ITX.MC
Revenue: €11.08B / \$14.4B	Net Income: €1.32B / \$1.7B	Market Capitalization: €36.19B / \$47.03B
Zara is a global fashion company that competes head-to-head with Benetton, Gap, and the Limited in the 18-35 value-sensitive clothing fashion market (Christopher, 2000). It is headquartered in Spain.		
It is a part of the Inditex Group. They have other brands, but Zara represents about three-fourths of the business. About half of their business is inside of Spain. Half is spread throughout the rest of the world.		

Intel Corporation	<a href="http://www.intel.com">http://www.intel.com</a>	NASDAQ: INTC
Revenue: \$35.127B	Net Income: \$4.369B	Market Capitalization: \$119.3B
In 1968, Bob Noyce and Gordon Moore – of "Moore's Law" fame – left Fairchild Semiconductor to found venture capital-backed Intel. Intel – like Microsoft – was hand-picked by IBM to lead us into the PC era. The success of the x86 processor architecture has been staggering. Its role in the industry has never been to be the best CPU. It has always focused on the best value. While there were RISC systems that outperformed Intel offerings as they began to scale workstation- and server-class systems, their price-performance curve has been largely unassailable.		
AMD has become a legitimate contended in the PC and server market, and Intel was a little slow to the party with mobile devices.		
Intel has two greatest strengths are their rigorous manufacturing processes, and their understanding of the importance of platform architectures.		

International Business Machines Corp. (IBM)	<a href="http://www.ibm.com">http://www.ibm.com</a>	(NYSE: IBM)
Revenue: \$95.758B	Net Income: \$13.43B	Market Capitalization: \$175.74B
IBM is discussed extensively in the body of the thesis. Few if any companies have executed as consistent and robust a services strategy of IBM.		

Rolls-Royce Group PLC (Rolls Royce)	<a href="http://www.rolls-royce.com">http://www.rolls-royce.com</a>	LSE: RR.L
Revenue: £10.414B / \$16.218B	Net Income: £2.217B / \$3.453B	Market Capitalization:

The Rolls Royce automotive brand is now a part of BMW. This Rolls Royce makes jet engines (among other things). They compete with GE and Pratt & Whitney, supplying engines to Boeing, Airbus, Saab, Embraer, and Bombardier in that space. They have four divisions, all focused on power product: civil aero, defense aero, marine power, and oil & gas platform power.

Microsoft Corporation (Microsoft)	<a href="http://www.microsoft.com">http://www.microsoft.com</a>	NASDAQ: MSFT
Revenue: \$62.484B	Net Income: \$18.76B	Market Capitalization: \$216.1B
Microsoft is a fighter and an innovator. The Windows platform is under attack from Apple. The whole PC ecosystem is under attack from Google and the cloud. For 25 years, they have been a money-making machine.		

Netflix Inc.	<a href="http://www.netflix.com">http://www.netflix.com</a>	NASDAQ: NFLX
Revenue: \$1.67B	Net Income: \$116M	Market Capitalization: \$10.39B
Netflix serves about 12M customers with movies in their home delivered via DVD through the mail or streaming over the Internet. By not keeping a store front and centralizing their inventory to a few DCs, they are able to tap into the long tail of viewing interests in a way that brick-and-mortar stores cannot.		

QUALCOMM Incorporated	<a href="http://www.qualcomm.com">http://www.qualcomm.com</a>	NASDAQ: QCOM
Revenue: \$10.99B	Net Income: \$3.247B	Market Capitalization: \$75.74
The CDMA chipset is at the heart of their business as its designer and supplier. They also have substantial intellectual property in the 3G world. No matter who's phone, they are making money. They are fab-less and have sold off their earlier base station and handset businesses and continue to be focused on the chips.		
They were founded in 1985 and are based in San Diego, California.		

Rolls Royce	<a href="http://www.rollsroycegroup.com">http://www.rollsroycegroup.com</a>	LSE: RR.L
Revenue: £10.1B (\$15.7B)	Net Income: £915M (\$1.43B)	Market Capitalization:
Rolls Royce Group (LSE: RR.L) is a premier provider of power systems for land, air, and sea. They provide globally to both civil and military consumers. They characterize their four markets as civil aerospace, military aerospace, marine, and oil & gas (platforms). They boast over 54,000 gas turbines in service. With a firm order book of £58.3B (\$90.9B) at the end of 2009, their future outlooks continue to be positive. They have over 38,000 employees worldwide		
Rolls Royce cars are made by BMW.		

Salesforce.com	<a href="http://www.salesforce.com">http://www.salesforce.com</a>	NASDAQ: CRM
Revenue: \$1.3B	Net Income: \$80.7M	Market Capitalization: \$18.22B
While they may not have been the first, Salesforce.com commercialized cloud computing and SaaS. They offer flat fee, Internet-delivered Customer Relationship Management software-as-a-service. They since expanded to offer a fuller platform as a part of the Force.com API.		

TOPCON Positioning Systems (TPS)	<a href="http://www.topconpositioning.com">http://www.topconpositioning.com</a>	PNK: TOPCF
Revenue: ¥94.86B / \$1.02B	Net Income: ¥133M / \$1.44M	Market Capitalization:
TOPCON Positioning Systems sells precision grading solutions that can be used on both Caterpillar and John Deere equipment. It is a subsidiary of the Japanese Company, TOPCON. The rest of its products are focused on precision optical		

TOPCON Positioning Systems is based in Livermore, CA.

Trimble Navigation Ltd. (Trimble)	<a href="http://www.trimble.com">http://www.trimble.com</a>	NASDAQ: TRMB
Revenue: \$1.1B	Net Income: \$63.5M	Market Capitalization: \$4.47B
<p>Trimble is an important component of the construction and agricultural telematics ecosystems. Charlie Trimble and two of his colleagues stepped out on their own in Palo Alto in 1978 to develop a company expanding on work they had done together at Hewlett Packard (discussed elsewhere) providing location services based on LORAN technology. They acquired that technology from Hewlett Packard, and for over three decades since then, Trimble has stayed focused on location-based products and services.</p> <p>Their growth model has been similar to that of Cisco Systems in that they have grown in part through strategic acquisitions. Those acquisitions have both strengthened their core technical excellence, as well as opened up natural adjacent and supporting markets required to expand or defend their position.</p> <p>Trimble is based in Sunnyvale, California.</p>		

Zipcar	<a href="http://www.zipcar.com">http://www.zipcar.com</a>	
Revenue:	Net Income:	Market Capitalization:
<p>The largest car-sharing company in America. As with most (all?) car-sharing projects, Zipcar is still not profitable. They are discussing an IPO.</p>		

# Index of Companies, Products & Services

---

787 Dreamliner, 107, 108  
Abercrombie & Fitch, 40  
Acura, 27, 63  
AdSense, 117  
AGCO, 83, 84, 85, 95, 106, 114  
AGCOMMAND, 84  
Airbus, 115, 118  
Amazon, 27, 35, 39, 43, 101, 115  
AMD, 117  
Apple, 18  
AT&T, 28  
Atomic Energy Commission, 28  
Audi, 63  
Azure, 104  
Barnes & Noble, 35  
Benetton, 117  
Best Buy, 18, 34, 44, 45, 46, 47, 48, 50, 52, 105, 109, 115  
Bing, 104  
Blockbuster, 33, 34, 43, 48, 50, 72, 105, 115  
Bloomingdale's, 40  
Blue & Me, 65  
BMW, 25, 118  
Boeing, 107, 108, 115, 118  
Bombardier, 99, 115, 118  
Boston Public Library, 28  
Caterpillar, 62, 74, 75, 76, 77, 79, 80, 83, 84, 85, 86, 87, 88, 95, 106, 109, 113, 114, 115, 116, 118  
Caterpillar Trimble Control Technologies, LLC, 75  
Chevrolet Malibu, 25  
Chuck E. Cheese, 22  
Circuit City, 46, 48, 50, 105, 115  
Cisco, 119  
CNH, 62, 75, 83, 84, 85, 86, 87, 88, 95, 106, 113, 116  
Coca-Cola, 63  
Coinstar, 33, 34, 116  
Deere, 18, 51, 52, 53, 59, 62, 74, 75, 76, 78, 79, 80, 83, 84, 85, 94, 95, 96, 105, 106, 109, 110, 113, 114, 116, 118  
DeWalt, 66  
Dynex, 45  
eBay, 28  
EDS, 63  
Embraer, 118  
EZ-Guide, 83  
FedEx, 28  
Fiat, 65  
FieldStar, 84  
FlexJet, 99  
Ford, 20, 58, 59, 60, 61, 62, 65, 66, 67, 68, 69, 70, 72, 73, 76, 79, 80, 83, 84, 106, 109, 116  
Ford "Crew Chief", 59, 61, 66, 69  
Ford E-Series, 66  
Ford In-Dash Computer, 66, 69  
Ford Tool-Link, 66, 69  
Ford Transit vans, 66  
Gap, 117  
GE, 28, 51, 52, 54, 55, 94, 106, 109, 110, 116, 117, 118  
Geek Squad, 44, 45  
GM, 20, 25, 58, 60, 61, 62, 63, 64, 66, 67, 69, 70, 72, 73, 75, 76, 79, 80, 83, 106, 109, 117  
GMAC, 63  
Gmail, 104  
Google, 101, 102, 104, 117, 118  
GreenStar, 62, 84  
Health Care System of France, 28  
Hewlett Packard, 119  
Hollister, 40  
Honda, 25, 84  
Hotmail, 104  
HSBC, 45  
Hughes Electronics, 63  
Hummer, 63  
IBM, 25, 51, 52, 53, 54, 63, 89, 96, 97, 98, 100, 104, 106, 109, 110, 117  
IBM "Pay as You Drive", 97, 98  
Inditex Group, 38, 117  
Init, 45  
Intel, 28, 117  
International Standards Organization, 28  
iPod, 25  
Isuzu, 63  
iTunes, 18, 70  
JDLINK, 59, 62, 76, 78, 79, 80, 84  
Jet card, 99  
John Deere. *See* Deere  
John Deere Apex, 84  
John Deere Financial, 52  
John Deere Fleet Care, 76  
John Deere Landscapes, 52, 106  
John Deere One Source, 52, 106, 110  
Johnson & Johnson, 40  
Kia, 65  
Kindle, 34, 35, 115  
Komatsu, 75  
Kovio, 36  
Lancer Evo X, 40  
LESCO, 52, 53, 106, 110

Lexus, 63  
Lincoln Continental, 65  
Linux, 107  
McDonald's, 24, 116  
Microsoft, 58, 62, 63, 65, 66, 67, 72, 99, 100, 101, 102, 103, 104, 109, 112, 117, 118  
Microsoft Auto, 65, 66, 70  
Microsoft Dynamics CRM, 104  
Microsoft Office 365, 104  
Microsoft Windows, 104  
MIT, 36, 68  
MIT Auto-ID Lab, 68  
MIT Media Lab, 36  
Mitsubishi, 40  
Monkey Joes, 22  
Motorola, 65  
Mr. Clean, 51  
MSN, 104  
Napster, 45, 46  
NASDAQ, 28  
NCR, 33, 34  
Neff Corporation, 52  
Netflix, 33, 34, 35, 39, 48, 72, 105, 115, 118  
Netscape, 68  
Nissan, 21  
nook, 35  
Nortrax, 52, 53, 94, 106  
Norwich Union, 96, 97  
Office, 102  
OnStar, 25, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 75, 76, 79, 83, 106  
Oracle, 100  
Orange Communications, 97  
Pandora, 25  
Panera Bread, 26  
Parker-Hannifin, 36  
PepsiCo, 63  
Pilgrim, 28  
Pratt & Whitney, 118  
Proactiv, 34  
Procter & Gamble, 51, 109  
Product Link, 75, 76, 77, 79, 80  
QUALCOMM, 65, 76, 80, 84, 118  
Redbox, 33, 34, 35, 43, 48, 50, 72, 105, 115, 116  
RESCU, 65, 68, 69  
Reuters News Agency, 28  
Rocketfish, 45  
Rolls Royce, 30, 56, 97, 98, 99, 109, 111, 117, 118  
Rolls Royce TotalCare, 30, 97, 98, 99  
Saab, 118  
Safelite Autoglass, 47  
Salesforce.com, 102, 103, 104, 118  
Saturn, 63  
Sprint, 67  
Subaru, 63  
Sun, 100  
SYNC, 58, 59, 60, 61, 62, 65, 66, 67, 68, 69, 70, 73, 76, 79, 83  
Target, 44, 47  
Terex, 75  
the Limited, 117  
ThingMagic, 66  
Tide, 51  
Tiffany's, 48  
TOPCON, 83, 84, 85, 118  
Toyota, 21, 63, 84  
Trimble, 62, 66, 75, 76, 80, 83, 84, 85, 86, 87, 88, 95, 96, 106, 109, 113, 119  
Twitter, 70  
US Federal Reserve, 28  
UVO, 65  
VirtualSite Solutions, 75  
VisionLink, 75  
Von Maur, 94  
wal\*mart, 44, 47, 48  
Windows, 102, 103  
Windows Mobile 7, 103  
WingCast, 65  
XM, 25, 61, 70, 92  
Yahoo!, 104  
YouTube, 35, 47  
Zagat, 27  
Zara, 38, 117  
Zipcar, 92, 100, 119

# Works Cited

---

- Anderson C. (2010) In the Next Industrial Revolution, Atoms Are the New Bits, WIRED.
- Armbrust M., Fox A., Griffith R., Joseph A., Katz R., Konwinski A., Lee G., Patterson D., Rabkin A., Stoica I. (2010) A view of cloud computing. *Communications of the ACM* 53:50-58.
- Bak D. (2003) Rapid prototyping or rapid production? 3D printing processes move industry towards the latter. *Assembly Automation* 23:340-345.
- Barabba V., Huber C., Cooke F., Pudar N., Smith J., Paich M. (2002) A multimethod approach for creating new business models: The General Motors OnStar project. *Interfaces* 32:20.
- Baughey K. (2007) Multimedia platform framework for the automobile : architectural analysis and proposal evaluation. pp. 107 p.
- Bouma J., Stoorvogel J., Van Alphen B., Bootink H. (1999) Pedology, precision agriculture, and the changing paradigm of agricultural research. *Soil Science Society of America Journal* 63:1763-1768.
- Bowens G. (2005) As GM pushes OnStar, other brands bail out, *Automotive News*, Crain Communications Inc., Detroit, MI. pp. 1.
- Brady M., Darke P. (2008) CONSUMER TRUST IN MULTIPLE CHANNELS: NEW EVIDENCE AND DIRECTIONS FOR FUTURE RESEARCH. *Brick & mortar shopping in the 21st century*:107.
- Bryson J.R., Daniels P.W. (2007) *The handbook of service industries* Edward Elgar, Cheltenham, UK ; Northampton, MA.
- Bryson J.R., Daniels P.W., Warf B. (2004) *Service worlds : people, organisations and technologies* Routledge, London ; New York.
- Buyya R., Yeo C., Venugopal S., Broberg J., Brandic I. (2009) Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems* 25:599-616.
- Carr N.G. (2008) *The big switch : rewiring the world, from Edison to Google*. 1st ed. W. W. Norton & Co., New York.
- Carr N.G. (2010) *The shallows : what the Internet is doing to our brains*. 1st ed. W.W. Norton, New York.
- Cassias I., Kun A. (2007) *Vehicle Telematics: A Literature Review*.
- Chesbrough H., Spohrer J. (2006) A research manifesto for services science. *Communications of the ACM* 49:35-40.
- Christopher M. (2000) The Agile Supply Chain:: Competing in Volatile Markets. *Industrial Marketing Management* 29:37-44.
- Crader S., Zaichkowsky J. (2007) The art of marketing. *Brick & mortar shopping in the 21st century*:87-106.
- Cusumano M., Kahl S., Suarez F. (2008) *A THEORY OF SERVICES IN PRODUCT INDUSTRIES - MIT Sloan School of Management Working Paper*.
- Cusumano M.A. (2010) *Staying power : six enduring principles for managing strategy and innovation in an uncertain world (lessons from microsoft, apple, intel, google, toyota and more)* Oxford University Press, New York, NY.
- de Weck O.L., Magee C.L. (2004) Complex System Classification, Fourteenth Annual International Symposium of the International Council On Systems Engineering (INCOSE).
- DeLaurentis D. (2008) *AAE 590K System of Systems Introductory Lecture*, Purdue University. pp. 16.
- Feitzinger E., Lee H. (1997) Mass customization at Hewlett-Packard: the power of postponement. *Harvard Business Review* 75:116-123.
- Fisher A.G.B. (1952) A Note on Tertiary Production. *The Economic Journal* 62:820-834.

- Grymek L., Singh S., Pattipati K. (2007) Vehicular dependence adds to telematics' allure. *Potentials*, IEEE 26:12-16.
- Held G. (2008) *Inter- and intra-vehicle communications* Auerbach Publications, Boca Raton, FL.
- Hill P. (1977) On goods and services. *Review of Income and Wealth* 23:315–38.
- Holstein W.J. (2009) *Why GM matters : inside the race to transform an American icon*. 1st U.S. ed. Walker, New York.
- Huber C., Dorfstatter W. (2009) *OnStar with OnStar Leadership*, GM Conversations.
- Jonnes J. (2003) *Empires of light : Edison, Tesla, Westinghouse, and the race to electrify the world*. 1st ed. Random House, New York.
- Lappin T. (1999) The New Road Rage - GM's wireless data service is about to turn your car into a four-wheeled vertical portal., *WIRED*.
- Lindström M. (2005) *Brand sense: how to build powerful brands through touch, taste, smell, sight & sound* Kogan Page Publishers.
- Lowrey T.M. (2008) *Brick & mortar shopping in the 21st century* L. Erlbaum Associates, New York.
- Manoulian S., McKenzie M., Schmidt J., Schwindler G., Nies L. (2008) *Industrial Meat Production, CE597D: Global Sustainable Engineering*, Purdue University, West Lafayette, IN.
- Oliva R., Kallenberg R. (2003) Managing the transition from products to services. *International Journal of Service Industry Management* 14:160-172.
- Pfister A., Landers R., Laib A., Hübner U., Schmelzeisen R., Mülhaupt R. (2004) Biofunctional rapid prototyping for tissue-engineering applications: 3D bioplotting versus 3D printing. *Journal of Polymer Science Part A: Polymer Chemistry* 42:624-638. DOI: 10.1002/pola.10807.
- Pine B., Gilmore J. (1998) Welcome to the experience economy. *Harvard Business Review* 76:97-105.
- Potts G. (1988) Exploit your product's service life cycle. *Harvard Business Review* 66:32-36.
- Rosenbloom S. (2008) November 11, 2008, *New York Times*, The New York Times Company, New York, NY.
- Rowley J. (2007) The wisdom hierarchy: representations of the DIKW hierarchy. *Journal of Information Science*:0165551506070706v1.
- Sachs E., Cima M., Cornie J. (1990) Three-Dimensional Printing: Rapid Tooling and Prototypes Directly from a CAD Model. *CIRP Annals - Manufacturing Technology* 39:201-204.
- Scholnik M. (2001) *A study of reading with dedicated e-readers*, Nova Southeastern University.
- Schumpeter J.A. (1942) *Capitalism, socialism, and democracy* Harper & Brothers, New York, London,.
- Shneiderman B. (2000) Designing trust into online experiences. *Communications of the ACM* 43:57-59.
- Smith A. (2004 - Original Publication 1776) *The Wealth of Nations* Barnes & Noble, New York.
- Soubbotina T.P., Sheram K. (2000) *Beyond economic growth : meeting the challenges of global development* World Bank, Washington, D.C.
- Spear S.J. (2009) *Chasing the rabbit : how market leaders outdistance the competition and how great companies can catch up and win* McGraw-Hill, New York.
- Swaminathan V. (2003) The Impact of Recommendation Agents on Consumer Evaluation and Choice: The Moderating Role of Category Risk, Product Complexity, and Consumer Knowledge. *Journal of Consumer Psychology* 13:93-101.
- Tang V., Zhou R. (2009) *FIRST-PRINCIPLES FOR SERVICES AND PRODUCT SERVICES-SYSTEMS: AN R&D AGENDA*, INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED'09, STANFORD UNIVERSITY, STANFORD, CA, USA.
- Teboul J. (2006) *Service Is Front Stage* PALGRAVE MACMILLAN.
- Unknown. (2002) *Testing, testing - is this thing on?*, *Automotive News*, Crain Communications Inc., Detroit, MI.
- Utterback J.M. (1994) *Mastering the dynamics of innovation : how companies can seize opportunities in the face of technological change* Harvard Business School Press, Boston, Mass.

- Utterback J.M. (2010) Disruptive Technology, Class Three: Innovation and Competition, Disruptive Technology, Massachusetts Institute of Technology, Cambridge, MA. pp. 28.
- Wang W., Benbasat I. (2008) Attributions of trust in decision support technologies: A study of recommendation agents for e-commerce. *Journal of Management Information Systems* 24:249-273.
- Webb J. (2010) Driving connectivity: the future of the US telematics industry and its impact to Toyota Motors.
- Webb J., Massachusetts Institute of Technology. Engineering Systems Division., System Design and Management Program. (2010) Driving connectivity : the future of the U.S. telematics industry and its impact to Toyota Motors. pp. 78 p.
- Xu X.W., He Q. (2004) Striving for a total integration of CAD, CAPP, CAM and CNC. *Robotics and Computer-Integrated Manufacturing* 20:101-109.