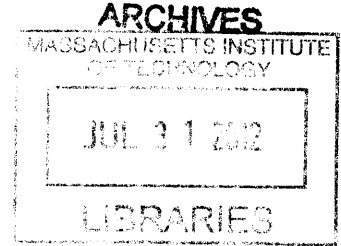# User Experience Design of Complex Systems

By

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User Experience Design of Complex Systems

Todd R. Reily

Abstract

Over recent years, the global marketplace and its consumers have developed a mutual recognition for the rising prominence of design that delivers high quality user experience. For the provider of products and services, such design has emerged as a critical differentiator that creates new opportunities for revenue and drives customer loyalty. For the consumer, design can often surpass commoditized technical specifications as a basis for making purchase decisions.

Nevertheless, despite their best intentions, many organizations still fail to successfully integrate design strategies into their existing processes and culture. This research examines the critical factors that enable successful implementation of design strategies under current market conditions in a way that produces sustained customer loyalty and revenue.

Methods utilized in this research include one-on-one interviews, online surveys, and comparative case studies to ensure proper balance and perspective. The interviews were conducted with design leaders at organizations such as Philips and Frog Design. They covered the role that design plays at organizations, including the conditions necessary for successful design strategies and the barriers that they generally face. Surveys conducted for this research examined the personal experiences of 120 managers, engineers, and designers on the development of consumer-facing products, services, and systems.

The result of these methods was a series of findings that supports the notion that a holistic "systems-based" approach offers competitive advantages to organizations looking to successfully implement a design-oriented strategy. It is this perspective that allows organizations to realize solutions that balance business objectives, technical capabilities, and design principles to meet customer intentions. It is proposed by this thesis that a systems-based approach has become necessary due to the ever-converging nature of today's networked products and services, particularly in the consumer marketplace.

This thesis concludes with a framework of methods and principles for conceiving and designing user experiences for a complex market of convergent products and services. The framework borrows methods from Systems Thinking, Design Thinking, and User Experience Design to create a singular process that provides the clarity and simplicity necessary for a user experience amidst the complexity of a system design process.

Dedication

To Dad,

For the endless sacrifices. Through the late-night math tutoring, road trips to away games, and unwavering support when I needed it most, you showed me the meaning of loyalty.

For the incredible example you set. You showed me that it is possible to be successful without sacrificing an ounce of humility, dignity, or devotion to family.

For your encouragement. You instilled in me the confidence to pursue my ambitions, no matter how crazy they sounded, and the courage to not be afraid to fail.

For your outlook. You showed me the importance of not taking things too seriously and keeping what matters in perspective.

I am honored to dedicate my entire MIT experience to you.

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To Cole and Mopus. Only a loyal dog stays up with you until 3:00am while you work, refusing to end their day until you've ended yours. I am lucky to have two of them.

To my family, especially my mother and sisters, whose unwavering support and encouragement keep me going, keep me grounded, and provide a constant reminder of what really matters in life.

To Becky. I am forever thankful for your patience over the past two years while I put everything on hold. I can't wait to get back to our life together. You're a true companion.

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Chapter 1: Motivation

I have been working professionally as a User Experience Designer and Human Factors Engineer since 2000. I entered the field after graduating with a Bachelor's of Science in Engineering Psychology from Tufts University where I served as the President of the Tufts Chapter of the Human Factors and Ergonomics Society and earned the de Florez Prize in Human Engineering. Over the past eleven years, I have worked in the private and public sector in design, consulting, and leadership roles, all related to design and Human Factors Engineering.

Design and Human Factors roles involve a wide range of responsibilities and activities. In the early stages of my career, while at Groove Networks, I was primarily focused on software interface design and usability. This role involved standard design activities such as designing graphical user interfaces, writing interaction design guidelines, and running usability tests. Following this experience, I shifted into the consulting world to gain a broader perspective on the design process. At Human Factors International, the world's largest and oldest Human Factors consulting firm, I had the opportunity to provide design consultation to many of the leading companies in the consumer product and financial services industries. It was during this period that I learned how to communicate the strategic benefits of design and usability, often presenting strategy and findings to executive boards or teaching design courses to product teams.

Following a period in consulting, I shifted to the public sector to the MITRE Corporation where I have been for over four years. MITRE is federally funded not-for-profit research and development organization that applies Systems Engineering and advanced technology guidance to the critical needs of US Government sponsors. At MITRE, I have been involved in the more strategic side of design and Human Factors. I have conducted user workflow studies in the Middle East, led business development for Human Factors personnel, conceived and designed new product concepts, and led small-scale innovation programs. Due to MITRE's unique Systems Engineering capability, I have also been heavily involved in the user experience design of large-scale complex systems of

interconnected products and services. This on-going experience has given me a unique perspective on the role that design can plan within complex system development.

Due to the diverse range of roles and domains that I have worked in over the past eleven years, I have experienced the many ways in which design is integrated within organizations. I have witnessed at first hand the dynamics of cross-disciplinary teams and the varying methods for incorporating design into processes. I have also experienced both design-centric and engineering-oriented organizations, which can have vastly different cultures and methods. I believe this extensive, diverse, first-hand perspective may provide insights to those looking to successfully integrate a design-oriented business strategy. While I am primarily a designer, I believe my experience managing complex cross-disciplinary projects gives me a unique perspective on the strategic, technical, and user-facing aspects of developing products. It is this multi-faceted perspective that attracted me to the System Design and Management program over a Business Administration, Human Factors, or Design program.

As I began the SDM program in 2010, I quickly learned of the value of a systems-based approach to understanding and managing complexity. As I progressed through the curriculum, I developed a better comprehension of the ways in which the disciplines of management, engineering, and design could be cohesively managed to meet strategic goals. The principles and methods taught in the program also provide ways to deal with the challenge of uncertain markets, the pace of ever-evolving technologies, and intricacies of managing employees. In a sense, it is a framework for holistically managing the art and science of business. This cross-disciplinary balance is primarily what drove me to this thesis topic.

I believe that the truly successful consumer product and service companies understand how to cohesively integrate management, engineering, and design goals in ways that meet their strategic intentions. While they may not use the specific methods and terms taught in a system design program, their approach is certainly common in spirit to systems thinking. I believe that this *systems-based approach* is what separates truly great companies from the average ones. The companies that are failing to keep pace with market leaders may be doing so because of a lack of balance or integration. They may be

too market-driven, too engineering-oriented, or imbalanced on other dimensions. Otherwise, while they may have the capabilities in place to great products, but a fragmented organizational structure and isolated processes may stand in the way of integrating them in beneficial ways. I have witnessed many organizations that demonstrate these imbalances and I believe they would benefit most by shifting towards a systems-based approach.

Recent years have marked the emergence of the importance of product experience design in consumer technology markets. Beyond physical aesthetics, this type of design is signified by the consumer's end-to-end interaction with the product, its supporting services, and the underlying brand. Some companies grew rapidly and generated tremendous profits during this period by providing world-class user experiences, while others have fallen off considerably by solely providing utility or functionality. Much like system design, the discipline of user experience design is primarily concerned with the convergence of design and technology to produce a differentiated interaction for the product user. Designers must be aware that the experience of interacting with their provided product is not as simple as providing the right features in an attractive package. Just as systems contain emergent properties, which are attributes that appear as results of the convergence of the system, a product's user experience is a unique result of a user interacting with a product. These concepts of convergence and emergence are paramount in the systems world and could provide great benefit to those in the experience design discipline.

Perhaps the most significant threat to providing great product experiences to customers will be the increasing interconnectedness of products through web-enabled capabilities and services. As technologies become increasingly interconnected, we will see a rising "systemization" of products, services, and markets. For this reason, it will be imperative for product organizations to understand how to execute a systems-based strategy. I have experienced the reality when a systems-based approach is not taken and the result is an inability to manage complexity and a failure to balance business strategy, engineering efforts, and the resulting product experience.

Part of my motivation for exploring the application of system design to user experience design is at the interpersonal level. Over the years, I have become increasingly intrigued by the conflicts, weaknesses, and inefficiencies of product teams that are purely due to the diverse perspectives of the people involved. The various disciplines involved in a normal product development process each have their own priorities, viewpoints, and terminology. Yet, it's astonishing how rarely this is recognized and addressed. I have also witnessed numerous instances where team members lose site of the intent of the product because they allow the minutiae of their specific roles to take over. Managers, engineers, and designers often fail communicate well due to their inability to find a common language. Designers often fail to make their case for design decisions, often being over-ruled by more quantifiable arguments of marketers or engineers. Finally, managers often fail to successfully integrate the qualitative aspect of design into their key business processes. I hope this research may shed some light on possible ways to improve cross-disciplinary collaboration on product teams.

Another interesting trend during the period of my career is the broadening exposure of the term "design" in industry. I have witnessed a great many people using the term loosely to describe many different sub-disciplines, including user-centered design, interaction design, industrial design, and countless others. I believe that this generality has led to a good deal of misconception and inconsistency across markets. While everyone in the consumer product space understands that design matters, they are not all working with the same perspective of what design truly means.

In some organizations, design is treated primarily as the aesthetic aspect of a product. These organizations, such as Bang and Olufsen, take great measures to design products of such great aesthetic beauty that they are featured in New York's Museum of Modern Art. In other organizations, design is much more of a utilitarian function. In these places, the purpose of design is to ensure that engineered products properly support the interactions of a user. A third type of organization is the one that can balance the art and science of design. Apple's recent marketplace success is a primary example of this. They have created products that are artistically stunning while also driving innovation in engineering and interaction design to create them. One of the things that I was curious about is

whether or not organizations such as these realized that they are approaching design in many different ways. A range of perspectives and methods is always beneficial, but I believe it is worth examining if this variance was intentional or not.

Throughout my career, I realized that have developed a range of hypotheses for ways in which design should be integrated successfully into organizations. For example, I noted earlier that I believe that an integrated, holistic, systems-based strategy for designing products is the best strategy towards success in a consumer market. I wondered if this is true, and if so, do leaders in design and innovation agree? What is it that separates the companies that create great product experiences verse those that do not? For instance, are there hidden indicators that are leading to companies failing in their design strategies? Is due to a lack of design leadership, stove-piped processes, a loss in user-centricity, or perhaps something else?

Since this a complex problem that spans the art and science of business, I decided to approach it from a range of perspectives. First, I examined a series of relevant product cases from the past decade, mostly in consumer technology for a foundational reference. From there, I took my own hypotheses and conducted extensive conversations with a diverse set of thought leaders in design and innovation. These subject-matter experts came from consumer product industry leaders, such as Philips and Hewlett-Packard, and notable innovation consultants, such as Frog Design. Finally, I wanted cross-disciplinary perspectives of the people that are actually executing the work itself. For that reason I conducted a survey of managers, engineers, and designers from across diverse industries to see if they validated or disagreed with my hypotheses.

In the following chapters, I will examine various ways in which design has been integrated, both successfully and unsuccessfully, within consumer product and service organizations. Drawing upon the System Design, Engineering Psychology, and User Experience Design, I will explore the possible application of a systems-based strategy for designing product experiences. This approach is advantageous not only because of the improved experiences that result, but also because the process itself provides greater internal clarity along the way. With this work, I aim to enable practitioners of design and

non-design disciplines to develop innovative product experiences by providing a series of accessible, actionable, and repeatable principles.

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Chapter 2: Thesis Overview

The remainder of this thesis examines the increasing strategic importance of high-quality user experience design and the necessary conditions for succeeding with design-oriented business strategies. This examination will begin in Chapter 3 ("The Rising Prominence of Design") with an overview of the factors that have led to design's prominence in the global consumer marketplace, which includes the commoditization of technical specifications, the growing complexities of consumer products, and the ever-increasing convergence of products and services. Recognizing a changing environment that requires an understanding of experience design *and* system complexity, Chapter 4 ("Comparison of Methods") will then provide an overview of relevant disciplines or design strategies that may provide applicable methods for designing user experiences for complex systems.

The initial marketplace examination combined with the author's extensive professional experience led to an initial set of hypotheses, which are outlined in the introduction of Chapter 5 ("Analysis"). This chapter will describe the primary research conducted for this thesis, which includes a series of interviews, online surveys, and comparative case studies. The interviews, conducted with successful design leaders, cover the role of design within organizations, including beneficial conditions and notable barriers. The surveys examine the personal experiences of 120 managers, engineers, and designers regarding the design and development of consumer-facing products and services. The initial hypotheses of this thesis are revisited and evaluated throughout Chapter 5.

In an effort to leverage the findings from this research, Chapter 6 ("Recommended Conditions") will identify the organizational conditions that will best facilitate the successful implementation of design-oriented business strategies. Chapter 7 ("Recommended Process – System Experience Design") will then propose a framework for designing user experiences for complex systems. This framework borrows methods from Systems Thinking, Design Thinking, and User Experience Design to create a singular process that provides the clarity and simplicity necessary for a user experience amidst the complexity of a system design process. This thesis concludes with a short summarization of notable challenges and recommendations for follow-on research.

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Chapter 3: The Rising Prominence of Design

Introduction

Over recent years, the global marketplace and its consumers have developed a mutual recognition for the importance of design. For those creating consumer-facing products or services, design has emerged as a critical factor for distinguishing a product from the competition or reinforcing a brand with a unique service experience. If designed well, the product experience will evoke positive emotions in a loyal customer base and drive growth and superior returns. Conversely, a poorly design product experience will diminish a brand, imply an inferior product quality, and likely lead to failure in the marketplace. From either perspective, design has clearly become a critical differentiator in the marketplace.

Just a quarter century ago, organizations competing in consumer-facing industries were able to rely upon manufacturing and operational excellence to best their competition in the marketplace. Unfortunately for those organizations, the days of the isolated, utilitarian product are now gone. As the global economy developed, organizations strived to find new ways to capture value. In many industries, such as those of cameras, computers, or appliances, one of the new differentiators has been design. This notion is not relegated the superficial style of physical products. Organizations must now design whole product experiences, from aesthetics and usability to supporting services. Yet, design cannot provide success in isolation. In today's highly competitive markets, survival requires that great design be fully integrated with exceptional engineering and manufacturing.

Several key factors are driving the emergence of design as a critical strategic measure. These causes appear commonly across consumer markets, yet they vary in significance and frequency depending upon the specific market. They each present their own unique challenges and opportunities in the marketplace. Based upon observation, the factors driving the prominence of design often align with one of the following three themes:

1. *The Commoditization of Technical Specifications*: Functionality and high levels of performance become commonplace and cross-product distinctions becoming negligible. Experience design becomes a differentiator for organizations.

2. *The Growing Complexity of Consumer Products:* Organizations compete on ever-rising features and functionality, leaving consumers with overly complicated products or services. As a result, consumers seek simplicity in design as they grow tired of technical complication.

3. *The Convergence of Products and Services*: Physical products and digital services become increasingly interconnected, thus creating a complicated system of intersections and interdependencies for consumers. No organization owns the system and consumers are left confused. Successful companies learn how to use design to manage complexity and create new revenue-producing systems.

The Commoditization of Technical Specifications

Over time, nearly all products in industries involving technological innovation demonstrate commoditization. Organizations within these markets converge upon and optimize for the same metrics until all the competitive products share some set of almost indistinguishable attributes. In an effort to extract the greatest amount of value from the market for themselves, the competitors compete on price and in doing so diminish the overall value of the market. This "race to the bottom" is only offset by the introduction of some disruptive factor that changes the nature of the competition and the direction of technological innovation.

While consumer needs do not evolve at the rapid rate of technological capabilities, our expectations of products are constantly changing. Consider the tablet computer market. At one point, the presence of a camera was a key differentiator, then it became an expectation, and soon, it will be expected that every tablet computer will have rear and front-facing cameras capable of high-definition video capture. Today's "bells and whistles" become tomorrow's expectations. With the diminishing returns afforded by technical capabilities and performance, one could see how competing upon engineering-based measures is a shortsighted pursuit. In cases such as this, design becomes a way to avoid commoditization.

This shift from commoditized technical specifications to differentiating product experience design is particularly prominent in the United States. The rise of the global marketplace has created an environment where it is advantageous for companies to outsource mechanical, electrical, and software engineering to countries that can produce comparable outputs at a lower cost. The result of this shift is an environment where individual companies must seek new ways to stand out from their competition, since they are all getting their engineering components from the same sources. As Tim Brown states in *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, "A purely technocratic view of innovation is less sustainable now than ever, and a management philosophy based only on selecting from existing strategies is likely to be overwhelmed by new developments at home or abroad." (Brown 09)

For an example from recent history, consider the personal computer market. There was a time where this industry participated in a capability "arms race". Yet in today's market, technological or performance-based metrics such as hard drive storage, memory capacity, and processor speed have exceeded consumer expectations and needs. Retail prices have leveled out to a point where they are attractive to consumers while still cost-efficient for the product providers. The differences between the offerings of competitors are, however, barely distinguishable now.

Engineering alone is no longer a viable option for an organization aiming for distinction in this particular market. Companies have sought instead to change the nature of competition in the personal computer market in a variety of innovative, design-driven ways. This includes the design and production of low-end laptops aimed at the "family room user" to high-end media centers with capacitive touch displays targeted towards the creative professional. Perhaps the best example of design disrupting the home computer market is the emergence of the tablet market, which was essentially a re-imagining of the personal computer experience. The transformation of this market is due in large part to innovations in engineering, but the direction of that engineering towards improvement in product experience would not be possible without design-oriented thinking leading the way.

The mobile computing industry will undergo a similar commoditization over the coming years. We are already witnessing a convergence in both design and capability. In the near future, all devices will feature high-resolution, hyper-thin, capacitive touch displays, exceedingly high data storage and memory capacity, and be supported by ubiquitous network coverage. Competition in the marketplace will drive product prices down to a level where the distinctions will become minimal. When it reaches that point, a product's experience design may be the only differentiator.

Some companies have learned to completely avoid the commoditization cycle and compete primarily on experience design. Consider the case of the Nintendo Wii. While Sony and Microsoft competed for years with video game consoles of increasing capability and price, Nintendo developed a strategy all their own. They understood that their legacy and brand were more associated with social, relaxed, family-based gaming than the more intense, competitive gaming world dominated by Sony's PlayStation and Microsoft's XBox platforms. Their strategy was to utilize newly available accelerometer technologies to create a "social gaming" system with a uniquely engaging and interactive experience. The result was an entirely new paradigm in gaming that addressed a much broader market demographic than the existing game market had. The Wii gaming experience was much simpler, more interactive, and presented a lower learning curve to the casual gamer. During the holiday season of 2006, soon after their debut, the Nintendo shipped 1.1 million game consoles to the US market alone, which was 60% more than Sony shipped of their PlayStation 3. (Wai-yin Kwok 07) The value that Nintendo has been able to extract from design is quite impressive when considering that the Wii console utilizes a vastly inferior graphics engine and computing power compared to its competition.

Another way that design can help companies overcome commoditization is through the addition of complementary services in a way that enhances the overall brand experience. Starbucks has created an iconic global brand with this strategy by offering an enduring "coffee house experience" around their products that brand consultant Stanley Hainsworth describes as "handcrafted, artistic, sophisticated, human, and enduring". (Millman 11) With products that are comparable yet higher priced than their competition,

and a consistently implemented brand experience design, Starbucks is earning in the range of $300 million in revenue per quarter. (Associated Press 11)

The Growing Complexity of Consumer Products

In an effort to gain an edge on their competition, companies across a range of technology industries have continually introduced nearly identical products with similar capabilities and features. The consumer technology markets of digital cameras, digital music players, mobile phones, and televisions all fit this description. Competition drives this copycat behavior, with each organization attempting to exceed the competition by providing products with incremental improvements across the same performance-based metrics. These technical metrics may include processor speed, data storage, memory capacity, or image resolution. This model of "competition by addition" often results in unnecessarily high levels of performance and an overwhelming experience for consumer.

Producers of consumer products and services certainly do not intend to make overly complicated products that overwhelm or confuse their customers. Yet, the reality sustains where companies demonstrate an engineering-driven focus in the short-term without a clear prioritization for providing a differentiating experience for their customer over a sustainable period. One significant factor in this situation is simply the matter of economic competition. Consider the "point-and-shoot" digital camera market. If Sony, Canon, and Nikon all offer digital cameras with 14 megapixel imaging and a 5x optimal zoom, any competitor must meet those marks or better in order to stay competitive in the short-term market. If that competitor does indeed meet those marks, Sony and others may respond and match them. As the competitors try to "one up" each other, the products they produce get more and more impressive from a capabilities standpoint, but the resulting product experience likely levels out. Worse yet, if the competition is centered on features, the increasing complexity will often diminish the resulting product experience over time.

Unfortunately, faced with an overwhelming array of choices, consumers will often anchor on to quantitative factors from which to compare one product to another. Essentially, they initiate the problem that they will later try to avoid. In the case with the

digital cameras, consider the choice between a Canon that shoots at 14 megapixel quality with a 10x zoom lens compared to a Nikon at 12 MP with an 8x lens. Most likely the average consumer will opt for the camera with the more impressive metrics. This is an easy point-of-comparison that is possible by simply comparing the quantitative values on the product packaging or examining the company website. However, that consumer likely won't need the extra performance level, and is therefore basing a selection on criteria of diminished importance. It is only after the consumer takes the camera home and uses it for a period of time that he or she experiences the design of it. For instance, it may be very easy to quickly learn how to use or perhaps frustrating to navigate through the option menus. Unfortunately, the qualitative attributes of product experience design are not readily apparent or easily evaluated during the point of purchase. These critical yet non-apparent attributes do not emerge until well after the purchase has been made. As a result, consumers continue to make purchases on more quantitative criteria.

While it may seem like a safe strategy to provide products with incremental engineering improvements, engineering-based advantages are nearly always fleeting and therefore not sustainable as a market strategy. Quantitative capability measures may provide a positive impact on initial sale figures. However, the capabilities race within markets transitions over time from quantitative attributes to the less-measurable factors, such as user experience design. As explained by Debora Viana Thompson in a 2005 entry in the Journal of Marketing Research, the reason for this shift may be that "consumers do not make a connection between increasing the number of product features and the difficulty of using a product". (Thompson et al. 05) Over time, consumers end up overwhelmed and stressed by the capabilities of their products, a phenomenon known as "feature fatigue". As IDEO CEO Tim Brown puts it, "by focusing their attention on near-term viability, they may be trading innovation for increment." (Brown 09)

Some companies have found a way to create value through simplicity while their competitors are releasing products of increasing complexity. In 2006, Pure Digital Technologies released the "Pure Digital Point & Shoot" video camera, which was later renamed "the Flip" the following year. The concept for this product was based on the insight that most video camera consumers use only a small set of the overall offered

features in most cameras. For these people, the priority is a simplified and convenient user experience from initial video capture through sharing of the video via the Internet. What the Flip presented to consumers was a small, relatively inexpensive, and easy-to-use camera with only a few critical features and an easy built-in adapter for uploading video to a home computer. The result was a camcorder that met the latent needs of a large segment of the population. Despite its relatively low resolution, limited zoom capabilities, and other technical inadequacies, the Flip Video went on to become the best selling on video camera on Amazon.com, capturing 13% of a camcorder market that features electronics leaders such as Panasonic, Samsung, and Sony. This market "upset" was made possible by ignoring the engineering-driven market forces and instead reacting to the behaviors of everyday consumers. "Comparisons with a real camcorder are nonsensical" wrote David Pogue of the NY Times in 2008, "because the Flip is something else altogether: it's the video equivalent of a Kodak point-and-shoot camera. It's the very definition of *less is more*." (Pogue 11)

Figure 1: Images of Flip Camera (Source: Amazon.com)

The Convergence of Products and Services

In order to properly account for their customers' situation amongst the complexities of interconnected technologies, organizations now need to broaden their design approach from isolated product design to a more holistic "experience design". This form of design considers the customer's entire interaction with a product over time, from initial discovery and purchase through product usage and utilization of supporting services. Leading innovation and design consultancies understand this shift. IDEO, like many of their competitors, has strategically evolved from "designing products, to designing services, to currently designing entire customer experiences with products and services" (Utterback 06). If the services offered by design and innovation consultants reveal market needs, this would be indicative of a shift towards a systemization of product experience design.

The good news is that a successful shift towards convergence can lead to expansive revenue opportunities. In fact, network-enabled capabilities and capacities have presented new opportunities for entirely new markets and business platforms. In digital services alone, companies such as Google, Amazon.com, Facebook, and eBay have created and captured significant new value from business models that weren't even possible a decade or two ago. For more traditional consumer technology companies, integrating digital services into their existing business model is much more of a challenge. For companies such as Motorola, Sony, or Samsung, their survival has relied upon their ability to merge the digital and the physical to create a cohesive revenue-producing brand experience.

Unfortunately for the consumer, a single organization does not always own all the pieces of the convergence of physical products and supporting services. As a result, consumers are often left with complicated relationships between products and services. Consider the first-generation Apple iPhone, for example, where many customers complained of poor coverage from AT&T, thus diminishing the user experience of the device. A more recent example is that of mobile applications that are reliant upon the capacity, resolution, and software of mobile devices to present the best user experience possible.

The convergence of physical products and digital services may provide the greatest opportunity for increased revenue for those that can figure out how to capture it. By designing a cohesive system of products and services, companies can create value for a customer that is far greater than the sum of the individual components of the system. In addition, integration of digital services can provide those opportunities at a cost that is far lower than the investment necessary to manufacture physical products.

Apple's rise to leadership in digital devices in recent years has demonstrated exactly how to integrate hardware, software, and services to create a truly innovative customer experience. With their hardware devices, software applications, supporting digital services, and extensive digital media, Apple has created a system of value comprised of independent yet complementary products and services. Across their system of offerings, Apple has been able to provide products that are simultaneously high in both engineering and design quality in a consistent way. The result is something that feels like convergence of the physical and digital world, not just a summation of pieces and parts. This strategy has clearly brought success to the organization, earning them a 66% *average increase* in net profit from 2007 to 2011. (Wall Street Journal 12)

What Apple has created is much broader than well-designed products. What they have demonstrated is the new nature of design – it's the consistently designed and system-oriented customer experience. They have established a system of convergence for the physical products, digital services, and the customers themselves. This holistic strategy has been established as a path to sustained success because of the dynamic effects offered by so many inter-connected points of revenue. In addition, the system evolves better over time compared to isolated products because of its ability to sustain technology upgrades to individual components while the system sustains.

A competitor of Apple that has also understands the benefit of a systems-based strategy is Amazon.com. The US-based electronic commerce company has seen incredible success and profits over the years with its online retail store since which launched in 1995. In an effort to broaden their system, Amazon.com recently released the Amazon Kindle Fire, a tablet-based computer that will essentially serve as an extension of their online store. It provides users with all of the digital media and services available on the main site, such

as electronic books, magazines, movies, and applications. CEO Jeff Bezos sees the Kindle Fire not as an isolated device but an "end-to-end service" that will "unleash all the digital media services Amazon offers". Mr. Bezos clearly recognizes the importance of a systems-based strategy for generating revenues and improving customer experience. For an example, consider a recent quote from the popular technology website, TechCrunch: "In the modern era of consumer electronics devices, if you are just building a device you are unlikely to succeed. Some of the companies building tablets didn't build services, they just built tablets." (Schonfeld 11)

Embracing digital services to enhance the customer experience of physical products is not just for the consumer technology industry. Nike has evolved over recent years from a strictly a footwear, equipment, and apparel company to a more experience-driven company. They have done so by executing on physical and digital design strategies to develop a world-class, authentic, and cohesive brand experience. Nike+ and NIKEiD are two shining examples of Nike's ability to fuse the products and services to create unique revenue-generating systems. The Nike+ system utilizes a small accelerometer device, an Apple iPod or iPhone with attached signal receiver, a mobile software application, and a website to create an entirely innovative running experience. With the Nike+ system, runners stay motivated through the accurate tracking of performance, the motivation of integrated challenges, and the encouragement of an online community. With NIKEiD, Nike utilizes web-based technologies to enable customers to design their own apparel and footwear through an easy-to-use web application. Creative or fussy customers benefit by getting customized products to their liking, while Nike benefits from an endless flow of ideas from their customer community. As Nike Brand Manager Charlie Denson recently noted in Nike's Fiscal 2012 First Quarter results, "digital technology affects every part of our business, product design and production, consumer experiences, commerce and in how we connect and communicate. Digital is a huge priority for us". (Parker 11)

Even the most traditional product organizations can benefit from embracing the strategic advantages of "systemizing" their products. Consider the case of the Danish LEGO Group, creators of the internationally famous LEGO toys for over seventy years. Over the past decade, LEGO has enhanced their product experience with new technologies while

still remaining true to the original vision of the simple building blocks. In this sense, they have created a product experience that is consistent with the brand while maintaining equilibrium between innovation and tradition. For an example, LEGO branched out into software development in 2004 with their release of the LEGO Digital Designer, a web-based application that enables users to build their own custom LEGO sets. What it created was an entirely new LEGO brand experience, one that pushed the creativity of its customers to new levels. Recent years also marked the arrival of LEGO as a dominant gaming brand as they partnered with entertainment companies to produce co-branded game titles such as Lego Star Wars and Lego Harry Potter. LEGO's innovative systems-based strategy has enabling them to create a revenue-generating ecosystem of products, services, and licenses line that should endure for some time. This is quite impressive for a 70-year old toy company during a period of high-technology dominance.

Many Companies Still Fail to Execute Successful Design Strategies

The rising prominence of design in the marketplace is not new knowledge in 2012. This trend does however prompt one to question why some companies are failing to execute successful design strategies in this new design-centric market. Is it a failure to grasp the importance of design or simply an inability to employ it successfully? Is the complexity presenting by today's convergent technologies simply too overwhelming for some organizations? The previously mentioned profits of Apple are not solely tied to design in the traditional aesthetic sense, but they are inarguably a company that prioritizes a consistent, well-designed user experience across a system of complementary products and services. Hewlett-Packard and Dell, two of their competitors in the consumer technology market, suffered profit losses of -8% and -42% respectively from 2007 to 2009. (CNN 11) While HP and Dell have seen some success in specific markets during this period, such as HP's continued dominance in the computer printer market, these two companies have clearly not developed these "systems-level" capabilities to deliver a robust system of complementary products and services, the reputation for innovation, and the customer loyalty that Apple has earned during this period.

It is possible that many business leaders overlook the influential role that design can play in establishing a vision for a cohesive and consistent product experience. They may maintain the traditional view of design in the aesthetic or isolated sense, missing the critical point that design can facilitate the understanding of a customer segment and provide the vision for a differentiating (i.e. profitable) brand experience. Specifically, user experience design is more expansive than the style or function of a tangible product. Instead, the discipline is broadly focused on providing a consistent experience across every touch-point that a person will have as a user of a product or service. In this sense, design becomes means for understanding customers and conceiving solutions for them. Famed management consultant Peter Drucker makes this point more succinctly, stating: "the job of the designer is converting need into demand". With this viewpoint, design is more closely related to systems engineering than art.

As noted earlier, some companies have succeeded on systems-based strategies by finding innovative ways to utilize digital services to support their product experience. Unfortunately, this is a challenging endeavor and a lack of understanding of systems principles can lead to a sub-optimal experience for consumers. For example, the Ford Motor Company recently came under public scrutiny for the quality of their automotive line primarily due to poor user experience design of the MyFord Touch telematics system in their vehicles. This system, which was supported by Microsoft, is a touch-enabled LCD screen that intends to allow drivers to easily control their entertainment, interior settings, navigation, and phone calls with touch gestures and voice commands.

Unfortunately, the user experience of the system that Ford provided was deemed to be so frustrating that it prompted widespread, negative backlash from its customer base. Ford owners complained of being distracted by an over-abundance of information, confused by complicated menus and displays, and annoyed by a lack of response to touch-based gestures or voice commands. In some cases, Ford owners were not able to defrost their windshields or heat up their cars due to a lack of responsiveness in the system. This experience not only affected the usability of the touch-screen interface, but also diminished the overall experience of driving one of these Ford vehicles.

Following the MyFord Touch design misstep, Ford dropped from the 5th spot in the J.D. Power & Associates 2010 Initial Quality Study down to 23rd in 2011. (Jensen 11) Lincoln, Ford's subsidiary, fell from 8th to 17th for its identical MyLincoln system. The reason for this sharp decline was primarily credited to the negative responses of over 70,000 drivers regarding the interface design of the MyFord and MyLincoln systems. Consumer Reports echoed the sentiments of J.D. Power, pulling its recommendation from the 2011 Ford Edge and 2011 Lincoln MKX based on the fact that the in-car telematics system had an "aggravating design" that was "overly complicated". (Jensen 11)

Figure 2: Images of the MyFord Touch User Interface (Ford.com)
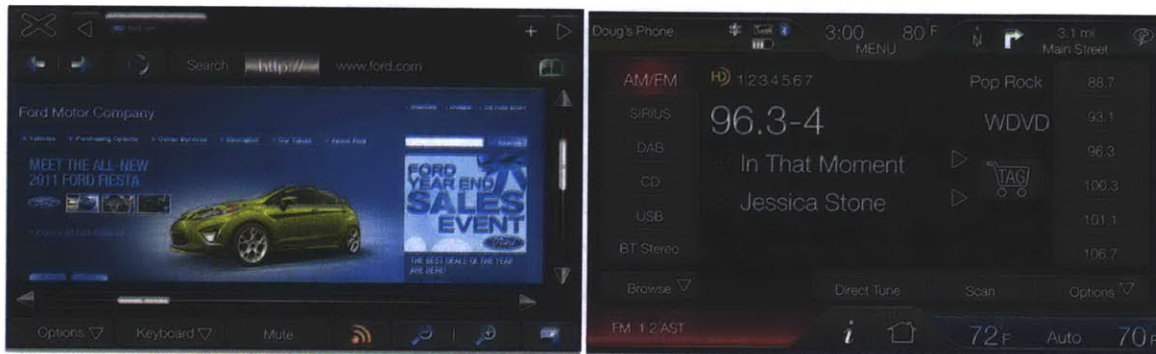
Had Ford's designers approached the touch-screen interface from a systems-based perspective, they may have paid more attention to the entire environment and situation of the driver. This awareness would have placed a prioritization on simplicity and usability over unnecessary features and extraneous information. As such, Ford may have designed a more driver-accessible and context-aware user interface that does not present a hint of distraction to the driver. Fortunately, it appears that Ford has taken such an approach with a complete redesign of the MyFord Touch system, which they plan to roll out as a software upgrade for existing and new customers in early 2012.

The rising prominence of design in the marketplace raises a great deal of questions. For instance, what is different about the companies that provide desirable and innovative user experiences for systems compared to those that do not? Is it a richer understanding of

design or simply an ability to execute on it? Clearly, a design-oriented strategy is not easily implemented even when organization understands the importance of doing so. One could imagine innovative system experience design requires the right organizational structure, process, skills, culture, and various other factors. However, it's possible that some of these factors are more critical than others. As products and services become increasingly interconnected in the coming years, and an increasing amount of technology products become commodities, the importance of system experience design should heighten to new levels. As a result, it will likely become necessary for consumer-facing companies to understand and implement the right conditions for designing great system experiences.

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Chapter 4: Comparison of Methods

Introduction

Understanding the strategic benefits of design is only half of the story for organizations looking to create well-designed systems of products and services. Organizations must carefully select a design-oriented business strategy that best suits their capabilities, context, and goals. Yet, the systemization of today's marketplaces and rising prominence of design has led to the importance of more holistic or multi-disciplinary methods. With a broadened perspective on the entire user experience, designers are able to examine, design, and manage the entire interaction that a customer will have with a product, service, or combination thereof. This interaction spans the customer's initial interface with the brand through the lifecycle of product purchase, usage, and disposal. This also includes the customer's experience across complementary products and supporting services.

The challenge of designing a high-quality system-level user experience is in the ability to balance the high-level *system* design goals with the detail-orientation necessary for user interface design. System designers are required to manage the economic, technical, and social aspects of a system. The user experience designer needs to address this at a more detailed level, essentially acting as the intermediary between technology and people. What this requires is a rich understanding of technologies as well as a comprehension of the cognitive conditions of the people interacting with them. In addition, user experience designer must understand other products and services on the market that may be driving the expectations and behaviors of their users.

Fortunately system design and user experience design share a common goal: to positively influence the primary beneficiary (e.g. user, stakeholder, etc.). For this reason, I believe these perspectives are complementary and a convergence between them maybe beneficial for practitioners on either side. For example, both disciplines attempt to merge and balance the goals of businesses, the capabilities of technologies, and the intentions of people. For system designers and user experience designers, the focus is more on the

composite that results from this convergence more than the analysis of individual components. In this sense, both understand the concept of emergent properties, which are attributes that result from integration yet are not present in the components themselves.

Applying Design Disciplines to System Experience Design

There are a wide variety of design disciplines that contain both common and unique principles and methods that could be applied to design of a system user experience. For example, User Experience Design and User-Centered Design have common orientations towards the user, but also have distinctions regarding processes and methods. Design Thinking and System Thinking each take a holistic approach that would be valuable for designing systems-level user experiences, yet the former is more creative and future-oriented while the latter is more concerned with understanding complexities of the present. As Tim Brown, CEO of IDEO, explained during a presentation at MIT in 2010, "Design thinkers usually think about the future. They are less grounded in reality than systems thinkers." Finally, a range of innovation models that address the integration of design with technology and business will be examined. Examples of these include "Design-Driven Innovation" and "Design-Inspired Innovation".

Clearly, there is not one "catch all" solution for designing high-quality system-level user experiences due to the complexities of today's business problems. Organizations interested in designing systems will find themselves in different circumstances that will require unique approaches and varied design methods. Some of the design disciplines discussed in this chapter may apply best at the earliest stages of a project to provide proper direction, while others are best suited at detailed late stages to ensure proper "fit and finish". For example, the principles communicated by Design Thinking are best suited at the early influential stages of a project, while the goal of Interaction Design is to design product interfaces that are easy to comprehend without frustration or error. This formal discipline is most applicable after the direction of the project has been determined.

This chapter will outline a series of design-centric disciplines, both formal fields of study and emergent strategies, in an effort to define the right attributes for designing complex

systems for optimal user experiences. Each approach will be scrutinized and categorized as the basis for comparison. For example, disciplines will be examined for their perspective on how design should be integrated within an organization, what methods should be used to execute on design, and what principles could be applied to the design of systems. In addition, the disciplines will be compared and contrasted for their varying viewpoints across the spectrum of a product development lifecycle. This would include the range from original product intention and research through ideation, design, and product implementation.

Attributes of an Optimal System Experience Design Method

In order to support the experience design of complex systems, an optimal method would likely need to draw from a range of the disciplines in this section. Drawing from professional experience and foundational research, this section proposes a set of attributes by which each of these disciplines should be examined for their applicability to system experience design. For the reader's awareness, there is also an overview of each discipline.

An ideal discipline for system experience design would likely contain the following attributes:

- *User-Centricity:* An ideal method for designing a system experience would begin with a proper understanding of the potential customer. A rich comprehension of the mindset, expectations, and behaviors of those interacting with the system will lead to better-informed decisions and ultimately, better alignment with the wants and needs of the customer. An optimal discipline will contain a variety of methods for understanding people, including both direct and indirect forms of insight collection. Furthermore, the discipline must have a dedicated strategy for maintaining user focus throughout the system design process.

- *System Comprehension:* More than just working across disciplines, an ideal method for system design must promote a holistic view of the composite solution. This will enable the designer to understand how the components and services

converge to create a new entity, the system. This system will have emergent properties, attributes that must be understood by the designer as they will be experienced by the customer.

- *Cross-Disciplinary Balance:* Today's business problems are highly multi-disciplinary and complex. Attempting to develop solutions with an imbalance towards business strategy, technology, or design will only lead to unexpected shortcomings or errors. Furthermore, breaking down the barriers between disciplines is critical if a design-oriented strategy is going to be successful. Today's innovative solutions must be ground in cross-disciplinary insights and delivered through perfect execution across those channels.

- *Systematic Ideation:* As noted in the overview of the current situation in the marketplace, purely functional product experiences are no longer adequate in an experience-driven competitive landscape. An ideal design method will present repeatable processes for developing highly unique and desirable solutions from the perspective of the customer. Creativity must be systematically integrated into the process.

- *Concept Exploration:* Given the vast complexities of technology systems and uncertainties in their markets, it is far more effectiveness to develop, explore, and learn from prototypes than it is to rely on forecasting. It has been widely proven that the creation of innovative solutions requires an environment of open exploration of ideas.

- *Communication:* One of the primary struggles for designers is the effective communication of customer insights and product vision. In order for a design-oriented strategy to be successful, it must support internal clarity and communication across roles. This requires design-centric artifacts that are easily understandable and provide enduring points-of-reference throughout the product development lifecycle.

- _Usability:_ As products and services become increasingly interconnected, frustrations caused by poor user interface design will heighten with cascading effects. An ideal method for system experience design would promote simplicity, usability, and consistency across the specific user interface design of components within the system.

Analysis of Design Disciplines

The following pages are an analysis of prominent design-centric disciplines and strategies. They are reviewed against the previously explained "ideal attributes" for designing systems for people. The review of each attribute will be measured by its applicability to system experience design. Attributes that are of particular relevance to system experience design are noted in green. Note that this is not an all-encompassing examination of disciplines and methods that could benefit the design of system experiences. For example, Human Factors Engineering and Interaction Design are well-established technical disciplines that have a great deal to offer in terms of strategies and techniques. However, I chose to omit them due to their overlapping nature with User Experience Design and User-Centered Design so not to confuse the reader. In addition, there is much to be gained from the tools and techniques developed in the domain of marketing, business administration, and the like. However, I chose avoid broadening to this level because the focus of this research is ultimately on the discipline of experience design.

Design Thinking

Overview

Design Thinking is a process for understanding and addressing complex problems by employing creative design methods. The philosophy behind Design Thinking is that a design-centric approach allows practitioners to freely explore the validity and feasibility of a wide range of divergent solutions at the early, low-risk stages of a process. Design Thinking has grown in notoriety in recent years due to the ever-increasing complexity of business problems and efforts of designers to be involved in addressing them. The cross-disciplinary nature of Design Thinking presents considerable overlap with Systems Thinking, yet the former is primarily focused on producing new concepts while the latter is more focused on understanding existing ones.

User-Centricity

By maintaining its focus on problem solving, Design Thinking is able to prioritize the overall intended purpose of the effort over technical or financial details that tend to arise.

System Comprehension

Tim Brown has noted that design thinkers embody "integrative thinking" as they "exhibit the ability to see all the salient – and sometimes contradictory – aspects of a confounding problems and create novel solutions". (Brown 08)

Cross-Disciplinary Balance

This inter-disciplinary method forces the practitioner to consider the "customer desirability", "technical feasibility", and "business viability" of possible solutions. In *Harvard Business Review* in 2009, Apple CEO Steve Jobs shared his example of how Apple executes on a Design Thinking strategy. He advocated designing first, focusing on "what you think people need and want, how they would interact with the product". Only after, designers should "work with engineers to figure out how to achieve it technically." (Thomke 09)

Systematic Ideation

Design Thinking teaches those in traditionally non-creative positions to approach problems in more creative ways, which should positively impact the design culture within an organization. Design Thinking promotes creativity by decoupling what's "desirable" from what's technical or financially possible. This approach enables design thinkers to consider solutions without being constrained by existing limitations.

Concept Exploration

The most distinguishing activity of Design Thinking is the rapid exploration of ideas. Prototyping allows design thinkers to leap forward, learn from mistakes, adjust, and evolve their concepts. This approach is beneficial for complex situations where relationships are best learned through exploration, not through planning and forecasting.

Communication

Design Thinking strongly supports communication across roles through its development of highly visual concepts. This facilitates a high degree of clarity and communication, both internally and externally, throughout the product development process.

Usability

Non-designers will not necessarily be able to design more usable product interfaces through this methodology. However, the exploration of interface concepts through prototyping can be a beneficial learning tool towards the goal of improved usability.

Systems Thinking

Overview

Systems Thinking is a discipline that contains a range of tools and methods for understanding complexity by holistically examining a system's components and identifying relationships and behaviors. A system, as defined by Ed Crawley, MIT Professor of Engineering Systems, "is a set of inter-related entities which perform a function, whose function is greater than the sum of the parts" (Crawley 11). As noted earlier, the holistic and cross-disciplinary nature of Systems Thinking presents

commonalities Design Thinking. Also, this discipline shares qualities with the field of User Experience Design, as both are interested in conditions that emerge from interaction between components within a system.

User-Centricity

With its holistic approach, Systems Thinking methodologies include product users as part of the system. As a result, this discipline should repeatedly produce systems that are beneficial to people within them.

System Comprehension

Understanding and managing complex relationships and structures is the purpose of Systems Thinking. As a result, any "system-related" problem could be addressed through the utilization of Systems Thinking methodologies.

Cross-Disciplinary Balance

Systems Thinking provides a fundamental framework for balancing varying perspectives as they pertain to a complex system. As such, Systems Thinking is properly equipped for supporting the economic, technical, and design-centric goals of a system.

Systematic Ideation

By adhering to systems thinking principles, a practitioner can look at relationships in abstract or holistic ways, which can lead to unexpected connections and novel ideas.

Concept Exploration

Systems methods can be utilized to explore conceptual solutions through the use of holistic system architecture diagrams, system dynamics diagrams, and others.

Communication

The inclusive multi-disciplinary aspect of a systems approach fosters an environment where practitioners of specific disciplines can relate to common reference points.

Usability

While there is not a specific method for designing interfaces, this approach ensures that an interface between users and products or services will not be overlooked. An example

of this is the Design Structure Matrix method, which examine the dependencies between individual entities within a system.

User-Centered Design

Overview

User-Centered Design (UCD) is a design discipline that formally integrates user engagement at each stage of the product design process. Exact methods and terminology may vary, but the trademark of a UCD process is an emphasis on user research, prototyping, validation, and iteration. The philosophy of User-Centered Design is that the product should be designed around the existing behaviors and feedback of the user. UCD features a wide variety of methods that are utilized by other design-oriented approaches as well, including the development of user personas, task analyses, interface mockups, user stories, and usability tests.

User-Centricity

Alignment with the user's intentions and issues is the hallmark of User-Centered Design. The process is structured around user engagement at each stage.

System Comprehension

User-Centered Design views the product and the interacting user as a singular system. However, it does not have a stated strategy for high level system understanding.

Cross-Disciplinary Balance

UCD views technology and business as a means for supporting the user needs. While some have demonstrated the strategic benefits of UCD, its methods offer little in the way of day-to-day cross-disciplinary balance.

Systematic Ideation

UCD utilizes user engagement as a source of innovation. The downside is that it is difficult to derive innovative ideas from insights derived from today's reality.

Concept Exploration

UCD provides methods for developing and validating conceptual designs. These methods should support the development of systems level prototypes.

Communication

Due to its level of user engagement, User-Centered Design generates artifacts and user-driven data points that could be used to facilitate conversations between designers and other disciplines. For example, practitioners often develop and share user "personas" (i.e. notional representations of user types) to provide tangible archetypes of intended users.

Usability

Practitioners of User-Centered Design conduct user research, produce design prototypes, and run validation sessions with a focus on improving the product experience for the user. Performed correctly, and this approach will lead to highly usable products.

User Experience Design

Overview

User Experience Design (UXD) is a broad, strategic discipline comprised of numerous sub-disciplines. These fields of study include User-Centered Design, Human Factors, Interaction Design, Industrial Design, Human-Computer Interaction, Information Architecture, and many others. This discipline is more strategic and dynamic than its sub-disciplines as it draws from many fields and is not tied to specific methods or processes. The intention of User Experience Design is to optimize the "desirability" of a product or service by understanding and affecting factors related to human cognition, technology, design, and the interactions between them.

User-Centricity

The user is the priority of the UXD practitioner. The sub-disciplines provide varied perspectives focused on the cognitive processes and physical interactions of the user.

System Comprehension

UXD takes a holistic, multi-disciplinary approach to understanding a user's situation and

designing optimal experiences for them. Also, the practice of developing visual "experience maps" can be highly beneficial in understanding the scope and complexity of a system.

Cross-Disciplinary Balance

As noted, UXD draws from a range of disciplines. However, these disciplines are primarily design-oriented or cognitive in nature. Business and technical goals are inadequately integrated.

Systematic Ideation

UXD practitioners may elicit ideas from a range of sources and design-oriented methods, including ethnographic research, cognitive task analyses, or direct user engagement.

Concept Exploration

UXD provides a range of methods for developing visual or interactive prototypes for exploring conceptual ideas.

Communication

UXD is largely design-oriented and may be insufficient in its abilities to communicate with those of strategic or technical perspectives. However, emerging sub-disciplines, such as "Agile User Experience Design" offer specific tactics for tying technical requirements to user intentions.

Usability

UXD offers methods for designing products and services that will be highly usable by customers.

Design-Inspired Innovation

Overview

Design-Inspired Innovation is a strategic approach to innovation that is communicated by a series of authors, primarily James Utterback, Professor of Management and Innovation and Professor of Engineering Systems at MIT, in *Design-Inspired Innovation*. It explores

the role that design can play towards instigating innovation within organizations, particularly in the presence of complex technology systems. The authors advocate the re-examination of existing technologies and product designs in an effort to discover new solutions. The strategy is decidedly system-oriented, which leads to principles that are excellent candidates for adoption.

User-Centricity

This strategy is focused on design within technology markets in an effort to discover innovative solutions. It is less concerned with tactics for examining potential users.

System Comprehension

This strategy utilizes systems-based methods for discovering new ideas and implementing new technologies. As Utterback notes, "greater value is being created more consistently by innovation at the system level, rather than at the components level." (Utterback 06)

Cross-Disciplinary Balance

This strategy advocates a strong tie between the processes of understanding customer needs and understanding technology capabilities. Specifically, It proposes that design should not be an "isolated function" and instead should "involve every single aspect of the company working together on the entire customer experience". (Utterback 06)

Systematic Ideation

This approach promotes technical evaluation as a means of creativity. By reconsidering "status quo" technology designs, engineers may discover entirely new opportunities. As noted by Don Norman, "design research is great when it comes to improving existing product categories but essentially useless when it comes to new, innovative breakthroughs... New conceptual breakthroughs are invariably driven by the development of new technologies." (Norman 09)

Concept Exploration

According to Utterback, customer engagement "helps companies learn how their evolving products are actually used. They can observe the gap between product

capabilities and customer requirements". (Utterback 94)

Communication

Design-Inspired Innovation discusses the concept of a "design statement", the notion that a product's design embodies a "personal conversation between the designer and customer". In this sense, this strategy sees design itself as a means of communication.

Usability

Since it is a strategy, this approach does not offer specific tactics for designing usable interface. However, by utilizing interactions with existing technology as a means of innovation, practitioners may utilize their experiences to develop improved interfaces and enhance overall product experience. Improved usability may emerge as a result.

Design-Driven Innovation

Overview

Design-Driven Innovation is a design strategy that is articulated by Roberto Verganti in his book by the same title. Verganti believes the only path to long-term competitive advantage is through radical innovation. He demonstrates this point by emphasizing the importance of "meaning" in products, such that every purchase or usage decision is made for "profound emotional, psychological, and socio-cultural reason as well as utilitarian ones". By re-examining the inherent meanings in products, designers can generate breakthrough ideas and deliver with market-changing products. According to Verganti, "Consumers don't know what they want until we show it to them". (Verganti 09)

User-Centricity

This strategy emphasizes relationship that people have with their products. While Verganti does not believe in ideas coming from user engagement, the approach is certainly user-focused.

System Comprehension

Since it is a high level strategy, this approach does not have specific methods for understanding systems. However, its emphasis on examining products for their holistic meaning is beneficial for system experience design.

Cross-Disciplinary Balance

Verganti advocates the usage of "interpreters" from a wide variety of backgrounds to ensure that proper perspectives are examined and considered. He also emphasizes the critical role that executive leadership can play in creating a design culture.

Systematic Ideation

With this approach, designers should rely upon their own experiences with meaning in products to conceive breakthrough ideas that have potential to change the lives of consumers. Also, the use of interpreters is seen as an invaluable instigator of innovative ideas.

Concept Exploration

By employing the use of interpreters, practitioners of this strategy are able to test out ideas and hypotheses before fully investing engineering costs in them.

Communication

Again, the usage of interpreters encourages a discourse across disciplines within an organization.

Usability

Due to the strategic nature of this approach and its focus on product "meaning", it does not necessarily facilitate the design of user interfaces.

Summary

What is apparent from this examination of design disciplines and strategies is that they each offer a unique combination of benefits for the design of system experiences. The two holistic disciplines, Design Thinking and Systems Thinking, are most beneficial for understanding the whole of a product system and working across disciplines to explore and realize concepts. However, these two disciplines are not as proficient at understanding users and designing optimal user experiences for them as the disciplines of User-Centered Design and User Experience Design. Finally, the two design strategies, Design-Inspired Innovation and Design-Driven Innovation, offer comprehensive approaches for integrating innovation into an organization, yet do not function at the tactical level of user interface design. The following chart is a review of the applicability of the critical attributes of the disciplines and strategies examined.

**Table 1: Applicability of Design Disciplines and Strategies
Against Critical Attributes for System Experience Design**

Discipline						
Attribute	Design Thinking	Systems Thinking	UCD	UXD	Design-Inspired	Design-Driven
User-Centricity			■	■		■
System Comprehension	■	■		■	■	■
Cross-Disciplinary Balance	■	■			■	■
Ideation	■	■		■	■	■
Concept Exploration	■	■	■	■	■	■
Communication	■	■		■		■
Usability			■	■		

One could further synthesize the results from Table 1 by examining each of the disciplines and strategies for their value in conceiving new product systems against their value in designing innovative user experiences. The result of that examination is contained in the following figure.

Figure 3: System Conception vs. Innovative User Experience Design
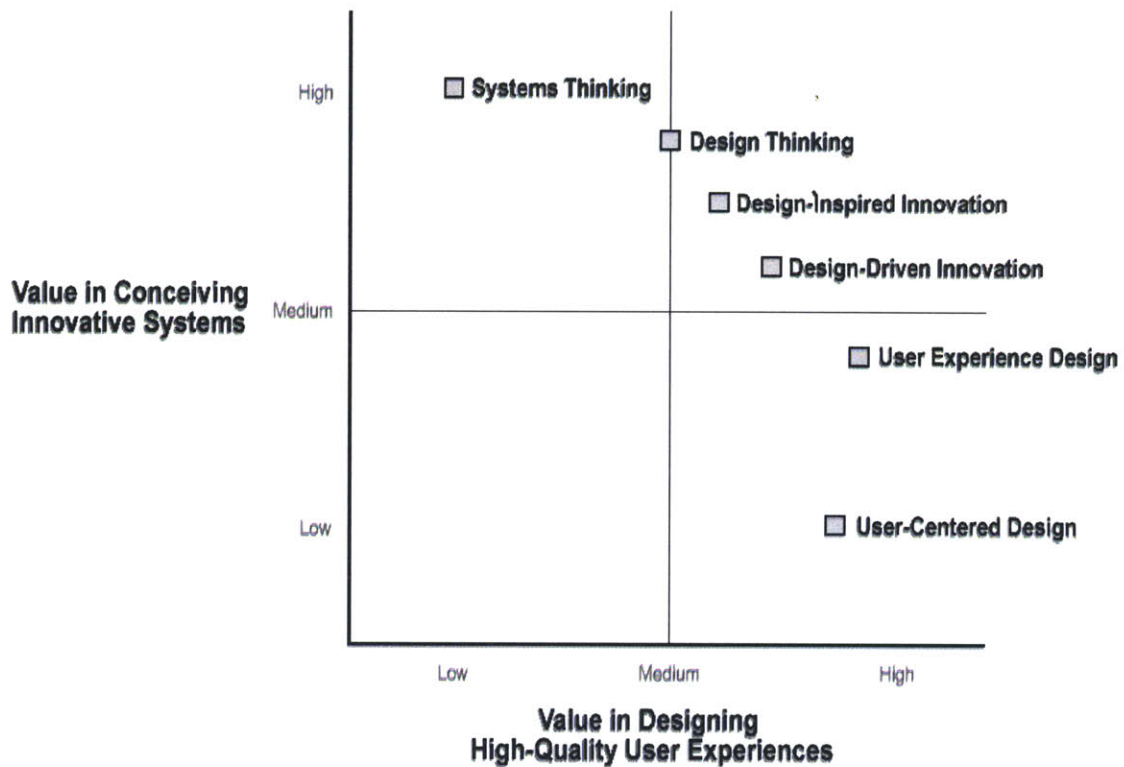
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Chapter 5: Analysis

Overview

Clearly, some organizations have learned to adapt and thrive in the modern marketplace that rewards design, creativity, and the convergence of products and services. What has gone unanswered is the question of which organizational attributes or behavioral are indicators of that success. It is equally as critical to determine what prohibits some organizations from successfully integrating a design-oriented business strategy. Success is likely only possible from a range of attributes falling place, yet what are those attributes? One must consider if it's a matter of leadership, skill, process or organizational structure. Or, perhaps it is something much less measurable, such as culture and creativity. The intent of this research is to determine the patterns of perspective, behavior, and structure in companies that employ successful design strategies versus those that do not.

Thinking about this design question started long before this research effort. Throughout my career I have continually witnessed the wide range of culture and practices that augment or detract from well-design products. It has been natural for me to formulate my own mental model of what it takes to design great products. Through the years, this mental model has evolved in the form of principles. As I became educated in systems-related disciplines, my design principles evolved to reflect my new insights. As discussed throughout the previous chapter, I have begun to recognize and appreciate the benefit of a systems-based approach to every stage of the product development process. What this prompted was a question about the practice of multi-disciplinary processes and holistic thinking within organizations. While they likely were not using systems-based terminology, it would not be surprising if the successful organizations were adhering to principles similar in spirit to a systems strategy.

Clearly, there is an art and science to the process of designing user experiences for complex systems. It was therefore necessary to address this research topic from a range of perspectives, including both qualitative and quantitative methods. The starting point for this research began with the formation of design principles, essentially hypotheses, which were based upon eleven years of professional design experience combined with

formal educations in Human Factors Engineering and System Design and Management. In an effort to look beyond my own perspective, I conducted a series of one-on-one interviews with subject-matter experts from various perspectives at consumer technology companies and innovation consultants. This allowed me to evolve my initial hypotheses to address a broader viewpoint. Following these conversations, a series of product case studies were examined across a range of industries. Insights from the case studies helped refine the hypotheses as well as establish case possible commonality or distinctions across industries. The step that followed was in-depth survey with experienced product designers, engineers, and leaders. The rationale for this survey was to ensure proper balance in perspective and also elicit insights about possible discrepancies across disciplines. Finally, the hypotheses were revisited and refined to reflect the research results.

The knowledge developed during the research phase of this work was translated into a series of mew principles and supporting lessons learned that are featured in the final chapter of this thesis. Such implications of the research phases may include the importance of understanding the benefits of design, the prioritization or discipline towards user experience, or the benefit of "systems thinking" to manage the experience development process. The expectation for this section is that the development of great product design requires a holistic and integrated "systems thinking" approach that prioritizes product user experience while addressing strategic and technical requirements. In is intended that these principles will facilitate in the design of user experiences for complex systems. Hopefully, the lessons presented will help teams conduct more effective research, develop more innovative ideas, and ultimately provide richer and more valuable experiences for users of converging products and services.

Research Method

Stage 1: Articulation of Hypotheses

- Activity: Principles for designing user experiences for complex systems

- Rationale: Formulation of personal mental model based upon experience

- Output: Hypotheses

Stage 2: Interviews with Subject-Matter Experts

- Activity: Series of interviews with experienced professionals from design and innovation leadership roles in consulting and product organizations

- Rationale: Broadening of personal hypotheses

- Output: Interview summaries contained throughout this chapter

Stage 3: Examination of Product Cases

- Activity: Development of case studies that give context to hypotheses

- Rationale: Provide context and validation

- Output: Insights and patterns distributed throughout this chapter

Stage 4: Cross-Disciplinary Survey

- Activity: Survey of professionals with experience in leading, designing, or engineering products and services

- Rationale: Provides validation and broadened perspective. May reveal discrepancies across disciplines.

- Output: Quantitative data distributed throughout this chapter. The complete survey outline is contained in Appendix A.

Stage 5: Re-examination of Hypotheses

- Activity: Revisit hypotheses against implications of research results

- Rationale: Ensure that implications of research results properly considered and synthesized into viewpoint regarding design within organizations.

- Output: Validated set of hypotheses

Hypotheses

The following is a set of hypotheses that led to the research of this thesis. These guiding principles are based on the underlying theory that an integrated "systems-based" approach provides an advantage to those faced with the complexities of developing customer-facing products and services in today's consumer marketplace.

Research & Ideation

H1. Organizations should conduct extensive, balanced research related to market, technology, and customer conditions.

H2. All disciplines should be involved in the development and exploration of new ideas for product and services.

Design & Development

H3. Organizations should explore a wide variety of design concepts at early stages to prevent late-stage iteration.

H4. Clear communication of product vision is critical to the success of the product.

H5. The original intent of a user experience is often diminished by the influences of the product development process.

H6. It should be the responsibility of an individual within an organization to own the vision for a product's user experience.

H7. Engineering and market-driven factors are emphasized over design because they are more tangible or quantifiable.

Organizational Culture

H8. Organizations must foster cross-disciplinary collaboration to ensure balance between strategic, technical, and design-related expectations.

H9. A design-oriented culture is necessary for create great product experiences.

Interview Participants

The following individuals participated in one-on-one conversations that spanned 45-60 minutes during the period of July 2011 to September 2011. The reason for the interviews was to gather insights from a range of perspectives related to the design of products, services, and systems. The discussions covered the role that design plays within organizations, including the conditions for successful design strategies, the key principles and methods for success, and the misconceptions and major barriers that design faces. For a broadened perspective, the interview participants represented both consulting organizations and consumer product companies.

Table 2: Interview Participants

#	Name	Role	Organization
1	Jerome Nadel	Chief Experience Officer	Option Wireless Technology
3	Mark Rolston	Chief Creative Officer	Frog Design
4	Theo Forbath	Vice-President of Innovation Strategy	Frog Design
5	Jean Schmitt	Venture Partner	Sofinnova Partners
6	Erika Darling	Associate Department Head	MITRE Corporation
7	*Name Withheld*	Former User Experience Designer	Motorola
8	Joshua Balgos	Multimedia Designer/Director	Gilmore Media
9	Sean Carney	Chief Design Officer	Philips
10	Rick Zampell	Director, Category Marketing & Sales, Americas	Hewlett-Packard
11	Carol Zampell	Process Lead, Inkjet High Speed Printing Solutions at Hewlett-Packard	Hewlett-Packard
12	Juhan Sonin	Creative Director	Involution Studios
13	Ron Black	Chairman & CEO	UPEK

Overview of "Cross-Disciplinary Perspectives on Design" Online Survey

The survey conducted for this research examined the perspectives of managers, engineers, and designers on the development of consumer-facing products, services, and systems. Participants were recruited using a variety of methods, including face-to-face requests of co-workers at The MITRE Corporation, face-to-face requests of graduate students at MIT, and online requests through popular social media networks such as Facebook, LinkedIn, and Twitter.

The survey was distributed in the form of a remote Internet-based survey in which participants were asked to answer a set of six background questions followed by a series of twenty-two questions regarding their personal opinions and experiences. The survey was created and distributed using the online survey service named SurveyMonkey. The questions of the survey spanned topics such as research, ideation, process, and organizational culture. Completing the survey took approximately 10-15 minutes. It is unknown how many people were requested to take the survey as it was posted in multiple online forums (e.g. LinkedIn). However, it is known that 120 participants started the survey and 95 of them (79.2%) completed it.

Participants were asked to rate their agreement with each statement on a 5-point Likert scale with the following categorizations:

1. "Strongly Disagree"
2. "Disagree"
3. "Neither Agree nor Disagree"
4. "Agree"
5. "Strongly Agree"

Section 1 of the survey was intended to gather background information on the participants by covering the following topics:

- Nature of current role (e.g. Management, Design, Engineering)
- Nature of education and professional background (e.g. Management, Design, Engineering)
- Years of professional experience

- Contribution to the development of products or services
- Percentage of products/services worked on that include a human user
- Percentage of those that could be considered a system

Section 2 was focused upon the Research and Ideation stages and asked for agreement on the following statements:

- "We explore a range of ideas before selecting one and moving forward."
- "We fully understand our customer before we begin a project."
- "I believe our product ideas are mostly just reactions to the market."
- "I am encouraged to share and explore new ideas for our products or services."
- "All disciplines are involved in developing product ideas in my organization."
- "The key to innovative products is technical discovery."
- "Truly innovative product ideas come from understanding users and their needs."

Section 3 was focused upon the general product design and development process and asked for agreement on the following statements:

- "There is clear vision for the product experience throughout our process."
- "Our original idea is often diluted as it passes through the engineering process."
- "There is a clear vision of what we're building before we begin a project."
- "A validated design vision reduces ambiguity and minimizes engineering iteration."
- "We generally know the research and rationale behind the product we're creating."
- "Designers are free to explore range of design concepts on our projects."
- "Product ideas aren't as important as your ability to implement them."
- "One person should own the product vision throughout the development process."

Section 4 was focused upon organizational structure and culture and asked for agreement with the following statements:

- "Great product companies keep their customer and product experience as a priority."
- "Designers do not give adequate concern for constraints of the technology or budget."
- "Engineers make too many product decisions without consulting designers."
- "Technical or financial constraints force us to create less innovative products."
- "We would create better products if our designers were more influential."
- "The creation of great product experiences is a priority for our managers."
- "Great products come from cross-disciplinary communication and integrated teams."

Executing a Systems-Based Design Strategy

<u>Overview</u>

This research has proposed that a systems-based strategy provides a competitive advantage to an organizations looking to successfully implement a design-oriented strategy in the marketplace. Given the commoditization of technical specifications, ever-growing complexity of technologies, and increasing convergence of products and services, "systems thinking" will become a critical path to market differentiation. As noted by Utterback in *Design-Inspired Innovation*, "greater value is being created more consistently by innovation at the system level, rather than at the components level. The most powerful designs appear to be those that are architectural and modular – they are defined by creating new ensembles of components and connections among them, rather than simply adding new component." (Utterback 06)

The commonality of consumer-facing systems was evident in the case studies, surveys, interviews conducted in this research. Of the 120 survey participants, for example, 85% of them reported creating products or services that have a consumer interface and 59% of those products or services constitute or are part of a complex system. Curiously, the surveyed engineers reported more experience working within systems (66%) than non-engineers (54.7%). This may be due to actual experience with system-based work or perhaps their activities as engineers increased their awareness of the interconnected nature of their work.

So what does it mean to have a systems based approach to designing and developing products? The design experts interviewed spoke extensively of the importance of understanding convergence (e.g. discussing importance of "how things come together"). The correlation is that experience design is about more than the sum of a product's features, parts, and performance. It's about the attributes that emerge as the product or service comes together as a whole with a singular user experience. In this sense, experience design and systems thinking share a common intent – one could say that it's the design and management of emergence. In a business context, this systems based approach to experience design comes down to benefiting from the second-order effects of

convergence. This is a powerful concept that is discussed throughout this research with the case of Nike and Apple's "lifestyle" systems.

<u>Finding: Research supported the notion that a systems-based approach offers a competitive advantage as a design strategy.</u>

Much has been written about the economic benefit of a successful design-oriented strategy. However, most attempts to actually integrate market-focused design metrics within an organization have failed to catch on. This is most likely due to the subjective nature of design that makes it highly difficult to objectively measure.

Whirlpool provides, however, an example of a company that has put the economic measurement of design into practice. Chuck Jones, the Vice President of Global Consumer Design at Whirlpool, developed his own plan for measuring the financial return on design investments. He and his team developed an approach that borrows methods from User-Centered Design, yet implements them in a particularly market-oriented approach. Whirlpool's design team develops a series of prototypes that they then put in front of prospective customers. Instead of an open-ended discussion as one would get from traditional focus groups, the prospective customers are asked to rate the Whirlpool prototypes across a series of specific attributes against those of their competitors. Those attributes include aesthetics, craftsmanship, performance, ergonomics, and usability. Whirlpool's Architect Series II, which was the first product resulting from this new design strategy, returned "30% more in profits to the company over its predecessor." Whirlpool's success stands as an excellent illustration of the benefits of bridging the gap between design and marketing. As Jones states, "We can no longer get by on being the wacky creatives who can't be held to any kind of standard. The sooner we get over this notion of having to 'speak the language of business' and just get on with it, the better off we'll all be." (Breen 07)

While the Whirlpool case provides an example of bridging the gap between disciplines for economic gain, it is not exactly system design in the way that the previously mentioned Nike, Lego, and Apple cases are. So how does an organization evolve from isolated product design to holistic system design? Sean Carney, Chief Design Officer of Philips, illustrates a systems-based approach that he led within their organization. In the

design of X-ray computed tomography (CT) scanners, Philips looked at "ambient experience design" in a way that considers the patient's entire environment and not just their interaction with a singular product. Understandably, interaction with these devices can be a daunting challenge for patients, especially young children and the families supporting them. The Philips approach was to improve and ease the entire experience through a variety of design methods. In the redesigned Philips environment, young patients are walked through a simulated test, allowed to hold a soft toy in the scanner, presented with soothing lighting, and given other methods to ease anxiety. As a result of this system-oriented design approach, 30-40% fewer children now need to be sedated for CT scans, thus increasing hospital throughput time. Carney says this is all thanks to design and understanding the problem, which is "much more than just making it look nice". Carney says that this example perfectly exemplifies the type of design he is striving for in his leadership at Philips.

Leaders of world-class innovation firms also advocated the importance of a systems-based approach. "Technologies have become vastly more complex", explains Mark Rolston, Chief Creative Officer at Frog Design. "So much engineering has to happen before an experience comes to market. We have an illusion that we come out of research with a pure idea and engineering is merely the means to getting it out." He describes the vast array of decisions that need to be made during today's design and development process, such as hiring engineers, and buying hardware, code, and packaging. As he neatly and accurately sums it up, "we're not making toasters anymore!" If this trend is to continue, it is clear that designers will need to sharpen their skills for understanding complexity and the dynamics of a technology system. Systems Thinking offers designers a roadmap for understanding that complexity.

Rolston asserts that complexity often exceeds an organization's willingness and ability to manage it, leading to situations where they compartmentalize duties but "lack clear perspective on the whole". He recommends instituting organizational restructuring and process improvements over time. However, there are also near-term measures to address this complexity problem. "The immediate fix is to better embrace the tangible artifacts inherent in the process". Removing abstractions, he explains, is part of removing

complexity. For example, tangible product prototypes and visual system diagrams can provide much-needed clarity throughout a system development process.

Jerome Nadel, Chief Experience Officer at Option Wireless Technology, agreed that Systems Thinking is the key to a competitive edge. According to Nadel, it is critical to "look beyond isolated products to look holistically at all the connections with complementary products and supporting services". By doing so, an organization can create real value for their customers. Organizations benefit tremendously from this systemic approach for a variety of reasons. The primary one is due to the profit margins that an organization can make when offering products with complementary services. According to Nadel, "smart companies get recurring revenue and as a result, better margins". In the mobile entertainment, for example, organizations may profit on hardware devices, but margins are thin when compared to sales of mobile applications and digital media. In Nadel's words, "value equals margin", which in turn, "creates a fiscal aspect for innovation".

For Nadel, the key point of this systemic approach from a standpoint of business strategy is that "you can't make money just selling little pieces". An organization must think systemically and not in isolation. As one can see from the Apple case, they have been able to capture value through their patterns of systems thinking, creating systems of services around integrated devices. In Nadel's view, Apple has been "remarkably holistic". Success in systemic thinking should really come from the top according to Nadel. The key is "strong leadership with an eco-systemic view that is thinking in a connected way".

As noted earlier, Nike created new opportunities for revenue by broadening their brand experience with the Nike+ system. The digital services may not provide direct revenue, but they enable an interconnected product system that presents opportunities for purchases, upgrades, and sustained usage. For example, the Nike+ system enables people to benefit from the powerful motivation of feedback loops when tracking personal health and exercise through the use of converging products and services. The story behind Nike+ demonstrates exactly how a systems-based approach can be executed to achieve great success. The concept originated from customer insights that were casually observed

by Nike engineers in 2004. What they realized was that an increasing amount of their customers were running with music, which was likely due to the emergence of the Apple iPod digital music player. As Nike President and CEO Mark Parker stated in a *Wired* magazine article in 2009, "Most runners were running with music already. We thought the real opportunity would come if we could combine music and data."

What followed this seemingly mundane insight was an inspired period of integrated systems development, featuring designers and engineers collaborating on the development of prototypes, storyboards, and design concepts. Real progress came when Parker engaged with Apple CEO Steve Jobs to collaboratively design a system that integrated the Apple iPod, Nike sensor, Nike shoes, web interface, and supporting web services. This complex convergence of products and services required great coordination between engineers and designers of the two world-class companies. The result for the customer is a singular Nike+ user experience that is elegantly simple and effective. As noted in the same *Wired* article, Nike took a page from Apple's iPod strategy, an incredibly successful product that did not offer the greatest technical advantages, but did provide the "easiest, most streamlined user experience". (McClusky 09)

The development of a new system concept, such as Nike+, requires an organization to approach design and development holistically. For example, it is beneficial that engineers explore new technical bounds in coordination with designers exploring the most desirable solutions. If executed properly, design insights drive engineers to seek new technical discoveries while technical insights trigger new possibilities for designers. Juhan Sonin, Creative Director at Involution Studios, agrees with the importance of cross-disciplinary integration and balance for optimal system design. "The best managers, designers, and engineers understand the 3-legged stool", said Sonin. In his view, the failure to address the business, design, or technology-related aspects of product or service opportunity will only lead to inferior outcomes.

One risk of undertaking a more holistic and multi-disciplinary approach is a watering down of the design process through heightened influence of engineering and business goals. Sean Carney explains that organizations "need to be inclusive, but they can't be democratic". What this means is that all disciplines should be involved in the design

process, but designers should ultimately own the vision for the product experience. According to Carney, the resulting design should "look like it was designed by a single person" and that it should have "integrity to the brand".

Systems-Based Research & Ideation

<u>Overview</u>

The Research and Ideation stages are perhaps the most contentious and misunderstood stage of the traditional design process. If performed correctly, insights from in-depth, multi-disciplinary research will spark innovative ideas, define the project's intent, and impact detailed decisions throughout the process. If not performed correctly, a poorly researched product will lead to uninspired ideas that likely suffer in uniqueness or market fit. The difficult question related to these stages is whether or not patterns occur around Research and Ideation in companies that integrate successful design strategies versus those that do not.

Referring back to the Comparison of Methods chapter, a great deal of disagreement exists on where innovative ideas and design insights from come from. As noted, User-Centered Design ensures alignment with customer needs by directly engaging and providing exactly what they need. MIT Professor Eric Von Hippel, author of *Democratizing Innovation*, pushes this method out to the extreme by advocating the observation and involvement of "lead users", those motivated customers that produce innovations that others generally follow.

Even less direct are those researchers from the socially oriented disciplines, such as Human Factors, which advocate the method of ethnographic research to unobtrusively observe customers in natural settings. Despite the common practice of these methods of user engagement, there is yet another school of thought (an increasingly popular one at that) that believes that true innovation is only made possible by seeking inspiration from other sources, such as technology or the creativity of designers. Utterback, for example, advocates the examination of stagnant technology designs while Roberto Verganti asks designers to seek disruptions in product "meanings" by looking inward.

The basis for the stated hypotheses regarding cross-disciplinary research and ideation is due to considerable experience in the domains of user research and innovation. The truth is that the authors and experts in the previous paragraph are all correct to some degree. There are also a wide range of methods from the business and marketing worlds that can drive creative ideas as well. While any one of these methods can provide valuable research in their own right, it appears that it is best to draw from a range of methods and sources in a holistic manner. The reason for this is due to the network effects that occur when the insights of disciplines converge. As noted by Clay Christensen in *The Innovator's DNA*, deriving ideas from unexpected associations, or "associational thinking", is the most common pattern that occurs in innovative ideas. (Dyer et al. 11) Author of *Where Good Ideas Come From*, Steven Johnson, believes in a similar concept that he calls "the adjacent possible", which is the notion that ideas are most often derived from unexpected nearby connections. (Johnson 10)

Finding: Organizations should conduct extensive, balanced research related to market, technology, and customer conditions.

It was evident from the interviews that research should be conducted across disciplines within an organization. In many ways, the key to successful research and ideation is in a systems-based approach. By drawing from qualitative observations and quantitative analysis holistically, a project team is able to get a much richer picture of the environment and expectations surrounding a potential product or service. As a result, the ideas that are generated can span a broader solution space and lead to unexpected, second-order results. This need for a cross-disciplinary approach is heightened when one considers the complex nature of consumer systems that often span a range of user types, technologies, environments, markets.

Sean Carney spoke extensively about the role of research in a consumer technology organization. Before joining Philips, Carney was at Hewlett-Packard. As a result, he was able to speak specifically about the differences between the two organizations. At HP, Carney explained, design was "traditionally driven by the work of the marketing

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department, but the sides more recently learned to work together to develop product concepts that are informed by quantitative and qualitative research." In Carney's view, an inclusive approach to research is critical towards creating compelling and profitable consumer products. His approach to implementing an inclusive research program at Philips is to train personnel from engineering and marketing to practice ethnographic research. By observing users, conducting contextual interviews, and taking photographs, ethnographers are able to develop a high level of empathy and tacit knowledge that is not possible by more traditional means. This richer level of understanding is invaluable to anyone who is making critical product decisions in the Philips organization. It is important to note that this does not mean that personnel should interview customers and simply repeat everything they have heard. Carney explained that Phillips does not want "reporters who report what they saw and heard" but instead need "journalists who interpret the data". Before Carney took over at Philips (he was 6 months in when we spoke), they designated Design as a business group, and business groups were only expected to work on projects that provide profit back to the organization. Carney explained that this leads to an emphasis on product design and packaging, which caused them to "lose sight of creating great products and great user experiences". As a result, according to Carney, "user research and interaction design fell off the map".

For an example of the value of cross-disciplinary research, consider the case of the first generation Apple iPhone, which was driven by market opportunities, research in capacitive touch technologies, and Apple's unique brand of "user" research. It has been widely noted that Apple does not engage prospective users for ideas and feedback. While this appears to be true, this does not mean that Apple is not user-oriented. They simply look to the people within their organization as prospective users themselves. The rationale is that Apple employees are smart, think about technology and design on a daily basis, and probably know how to articulate it better than the average user survey participant. As former Apple CEO Steve Jobs noted in a 2008 interview with CNN, "new-product development starts in the gut and gets hatched in rolling conversations that go something like this: What do we hate? What do we have the technology to make? What would we like to own? One of the keys to Apple is that we build products that really turn us on." (Morris 11)

When discussing this case, Ron Black, Chairman and CEO of UPEK, noted that Apple "picked a discontinuity while the smartphone market was nascent by creating an elegant phone with capacitive touch." Black's viewpoint is that traditional MBA training teaches business strategists to "attack the big problems head on", which is an approach that would have failed for Apple. Instead, Apple "attacked the problem from an oblique angle. Sony should have owned that space but didn't".

Roger Jellicoe, Vice President of Motorola Mobile Devices, agrees with the notion of looking inward to rate the value of a product. In a *Harvard Business Review* case on the Motorola RAZR, Jellicoe, who was Motorola's Director of Operations in 2005, explained "everybody here is a consumer. All of our families are consumers. Sometimes you hit on a design where people say, 'Wow, I have to have it!' When it happens, you know it's going to be a successful program" (Anthony 11)

Theo Forbath, the Frog Design Vice President of Innovation Strategy, advocates the importance of holistic research by explaining that the companies that don't succeed on design are the ones that "fail to bring it all together". Frog achieves their balance between art and science by conducting deep qualitative and quantitative research in the early phases of a client engagement. Their qualitative research is often done in the form of ethnography, led by famed ethnographer, current Frog Design Executive Creative Director of Global Insights, and former Chief Usability Researcher at Nokia, Jan Chipchase. Forbath explains that Frog follows up the qualitative work with thorough quantitative analysis to provide their clients with "left and right brain insights".

Finding: Discovery of unique and authentic opportunities requires a holistic approach.
It's well established that extensive user research or design exploration is critical for generating innovative ideas. However, unlimited creativity is valueless without a keen understanding of context within the market. A common trend discovered in the interviews regarding the success of design strategies was the importance of offering products and services that are perceived as both unique and authentic to the brand. What

this requires is both market and design research, technical exploration, and even an internal "self-examination" of the organization.

For Jerome Nadel, Chief Experience Officer, Option Wireless Technology, the best path to unique and innovative ideas is the pursuit of "discontinuities". By discovering and capitalizing on disconnects between market expectations and offerings, organizations can create completely unexpected yet welcomed systems of value. By seeking out existing user problems, as User Centered Design methods may do, researchers will likely come to expected conclusions and incremental improvements that competitors will arrive at as well. Discontinuities, as Nadel explains, come from opportunities that were created by technology markets that did not quite align with the intentions of its customers.

One could see how discontinuity discovery is essential in its support of system design as well. Taking a systems-based approach may increase the chance of recognizing elusive discontinuities as it forces one to look at an environment from a much broader perspective. Once recognized, a holistic-minded organization can create a system-based solution around that discontinuity. According to Nadel, the most effective form of innovation is "aggregative innovation". This is when one seeks opportunities to connect products and services that already exist within their organization or market.

Design methods will certainly help discover and develop ideas, but understanding context compared to competition may take more traditional marketing techniques. Of the interviews conducted, those individuals that had a more market-oriented mindset advocated the importance of discovering and establishing a unique position amongst competition. As noted by Ron Black, finding an open position in the market "is what builds sustainable products and guarantees success". He explained why and how it's foolish to go head-to-head with established companies simply by being incrementally better. Instead, companies should "carve out a niche and build a brand around that." Black went on to explain that he would "rather be different than a little bit better if you have a successful competitor. You only need a stronger force within a specific position, not overall, and that's how smaller companies can compete and supplant the dominant company".

Understanding one's place in the market also requires an understanding of one's brand. The certain common ground between the design and market-minded experts was the importance of authenticity. Mark Rolston of Frog spoke of importance of creating an "authentic composite". In discussing what it takes to create truly great experience design, Rolston describes the concept of "The Mick Jagger Phenomenon". The lead singer of the Rolling Stones was not the most talented in the world, nor the best song writer or best-looking, explained Rolston, "yet the way they put the package together is highly authentic, completely aligned, and pure in its plan. It's an authentic expression of what they want to be". The leading creative mind at a world-leading design firm is not going to use the same terminology of the systems domain, but his viewpoint is completely aligned. Essentially, what he's discussing is emergence – the idea that the manifestation of a system is greater than the sum of its components. This authenticity drives customer loyalty to the point where customers will forgive the occasional flaw or missing feature. Customer forgiveness is an extremely powerful attribute in a hyper-competitive technology market.

Finding: The urgency of market competition is the most critical threat to innovation as it limits time spent in research.

It was widely stated in the interviews that organizations often forge ahead too quickly into the solution space of a project. Those from innovation consulting firms believed that this is one of their greatest challenges. Often, it was explained, clients will come with a solution in mind but they haven't done the proper research. This uninformed approach can lead to failure, at worst, and at best, mediocrity. Frog Design addresses this challenge of solution-oriented clients by working with them to "delay the fixing of plans as long as possible". It is this mindset that Frog refers to as "pushing determinism forward". In their words, "the fidelity of the problem must be concrete for the sake of the financial and organizational investment, but the form of the imagined outcome should not." This approach allows organizations to understand a problem and determine their direction, and then allow plenty of time to "push and pull" to meet their objective. Put succinctly, they described that organizations need "softer clay". Sean Carney of Philips reiterated the

importance of understanding the end user and their needs before beginning a project. He also cautioned that this is not a task to be performed solely by designers. "It has to be done in partnership with other groups in the organization" said Carney.

Clearly, conducting extensive user research takes patience and discipline. When interview subjects were asked for example of companies that fail to exercise patience and give in to market pressure, Hewlett-Packard came up on multiple occasions. Carol Zampell, Process Lead of Inkjet High Speed Printing Solutions at Hewlett-Packard agreed, stating that design research is "not important enough at HP". She believes that business objectives often cause them to "lose sight of real customer value – it is all about incremental profit, which often is the focus instead of simply making customers happy and trusting that profit will follow."

According to Rolston, "HP is a great computer company. Computing is a fundamental driver in the last 20 years and next 100 years. It drives who people are and how they'll behave. HP is one of the biggest and most successful companies in this field, and yet, they can't think ahead or think aggressively." He explained that HP "passively looks at what the market wants tomorrow", focusing only on short-term innovation and not further out. He advises that it's not the market that HP should be looking at, but instead shift focus to the people. After all, "markets are made serving the wants and needs of the people".

So how does an organization like HP look past next quarter? Theo Forbath suggests that extensive qualitative research is the remedy to this myopic, market-driven thinking. One of the primary distinctions between Apple and HP is their willingness to look at core human behavior, according to Forbath. HP simply "looks to their analysts", but they need to look past the next quarter for greater success. Forbath and Rolston agreed that specific roles really are not important, just that there are individuals looking far ahead into the future. Once again, a cross-disciplinary approach is preferred. Rolston believes that focusing on competition leads to organizations only looking a quarter ahead at a time and creating products "out of the chute". Frog is trying to "unhinge this chute-like process" and get people to "be comfortable engaging a project with an undefined outcome".

Fortunately, there may be some hope for Hewlett-Packard. Rick Zampell, HP's Director of Category Marketing and Sales for the Americas explained that their design and marketing departments are now working together to build customer profiles, user workflows, and storyboards. They are basing this work on a deep set of customer insights with a focus towards a richer product experience. In an explanation of their cross-disciplinary process, Zampell explained that this approach "combined the best of customer insights, market trends, and passion for the customer experience with the technologies of today and future to deliver product experiences." This cross-disciplinary team stayed engaged through the implementation of the concepts, even working with public relations and press at the final stages. Yet, even with this holistic, design-centric process, Zampell's team is still not immune to HP's market pressure. "There is very real pressure on executives to deliver the promise on-time" explains Zampell. "When the value chain falls behind and can't deliver the projected experience you have a couple of choices: Push out the delivery (usually the exec loses face or faces difficult career choices) or ship what you have (usually a less than perfect experience that goes through a series of revisions and market set-backs)."

Finding: Design recommendations are generally less influential than those of marketing and engineering.

Even with extensive research, design intentions can still fall flat. A former Motorola designer described this frustration in great detail. She explained that their design team would conduct user research, build wireframes, and develop user interface mockups. They would first present their mockups to the marketing department. "Marketing would give their opinions and we would have to make design changes". After that came a review with Product Managers. She explained that they would review and her team would again have to make changes. The engineers followed, forcing changes due to cost and feasibility of feature implementation. "With each review, the user experience is degraded. The idea gets diluted. Our designs get worse and worse. It's ingrained in the corporate culture that design is important but not critical. Each team is just concerned with their goals, not the user experience."

According to Carol Zampell, HP often falls victim to this same type of dilution through consensus-based design. "Even if the design team comes up with a pretty compelling idea, by the time it winds its way through the development process, it gets bells and whistles added, and various changes are made until the original concept is pretty much lost. Too much is done by consensus instead of being driven by a single visionary." A result of this "design by consensus" approach is that compromises are generally made, likely causing the removal of product features that are known to be desirable by the customer.

So how does an organization address this problem of influence? Juhan Sonin offers his advice. "Just like any other discipline" explains Sonin, "there is a range of talent, skill, and knowledge in the field." Sonin believes the biggest factor is the ability to communicate design. "Most designers aren't good enough at pitching their own work". He states that designers are "delusional" if they believe they can be successful in organizations "without being able to design our own stories". Sonin stated his definition of design communication as being able to explain design and translate it into business and technical terms as well. In other words, designers must be able to bridge the gap between disciplines in order to be effective. In response to the notion that design decisions are difficult to defend because of their qualitative or subjective nature, Sonin took the counterpoint. "Most designers don't how the science of design" he explains. "There is both qualitative and quantitative data." In his viewpoint, it is no more or less opinionated than the discipline of engineering.

Survey Results

The following table displays the opinions of 120 survey respondents regarding a series of statements tied to the hypotheses on Research and Ideation.

Figure 4: Survey Results on Research & Ideation
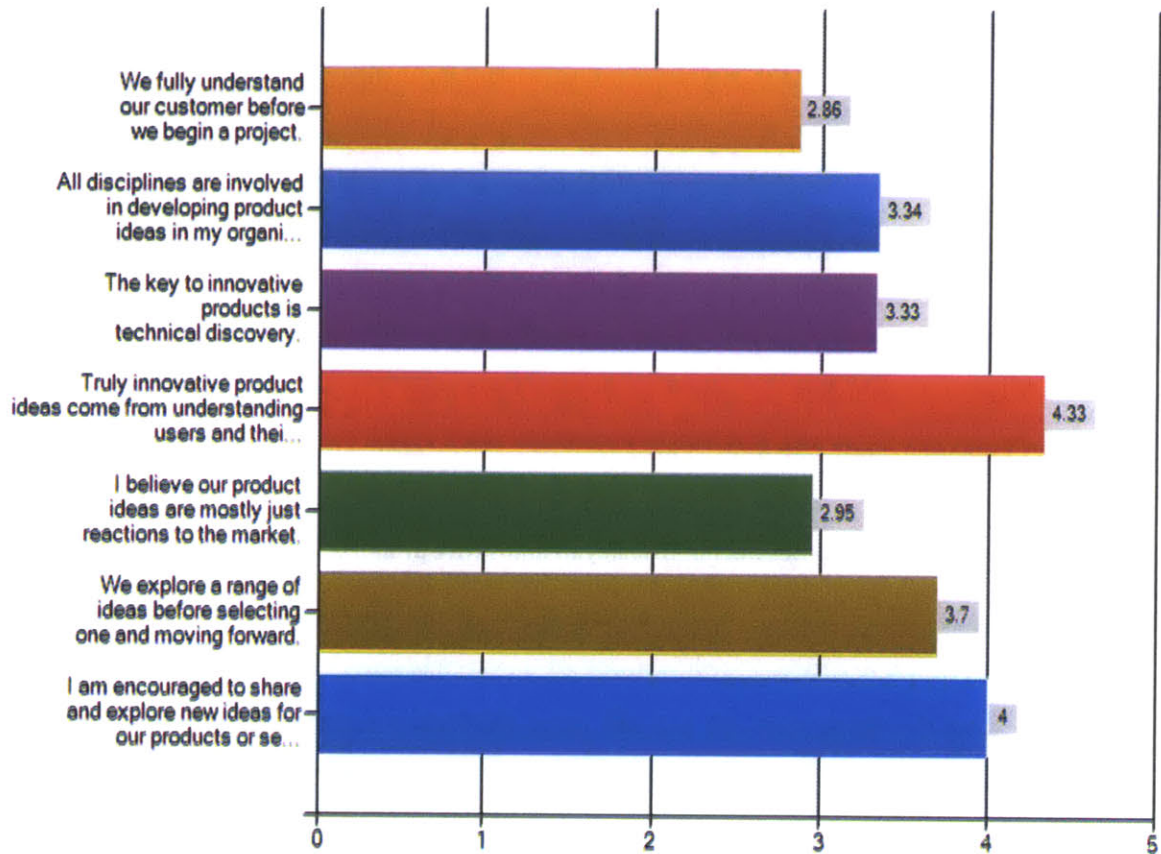
The most commonly agreed-upon statement regarding Research and Ideation was that "truly innovative product ideas come from understanding users and their needs". Over 86% of participants either agreed or strongly agreed with this statement. A closer look at the numbers reveals that the management and design participants felt more strongly about this notion, with 62% and 59% in strong agreement respectively. Only 39% of engineers were in strong agreement with this statement. Not surprisingly, engineers had the strongest preference for technical discovery being the key to innovation. Overall, the full set of participants favored innovation through user research over technical research. The role-by-role breakdown of those specific statements is contained in the following tables:

Table 3: Survey Results for "Truly innovative product ideas come from understanding users and their needs"

	Manager	Engineer	Designer
1 Strongly Disagree	0.0%	0.0%	0.0%
2 Disagree	0.0%	4.3%	0.0%
3 Neither agree nor disagree	12.5%	15.2%	6.9%
4 Agree	37.5%	41.3%	31.0%
5 Strongly Agree	50.0%	39.1%	62.1%
N/A	0.0%	0.0%	0.0%
Average Rating	3.56	3.52	2.93

Table 4: Survey Results for "The key to innovative products is technical discovery"

	Manager	Engineer	Designer
1 Strongly Disagree	0.0%	0.0%	3.4%
2 Disagree	12.5%	15.2%	34.5%
3 Neither agree nor disagree	43.8%	32.6%	37.9%
4 Agree	18.8%	37.0%	13.8%
5 Strongly Agree	25.0%	15.2%	10.3%
N/A	0.0%	0.0%	0.0%
Average Rating	3.56	3.52	2.93

Executing a Systems-Based Design Process

<u>Overview</u>

Despite their best intentions, many organizations inherently fail to development produce innovative or well-designed products and services. One of the primary reasons is that the traditional "engineering-driven" process is actually at odds with the principles of design and innovation. As noted in the previous section on Research and Ideation, organizations often leap forward into planning and production without having proper understanding of the user's situation or exploring the range of possibilities to address. By the time design processes are conducted at late stages (e.g. usability tests), it is far too late or expensive to make meaningful changes. In a traditional industrial economy, it was possible to plan and execute on a predictable product development process. However, in order to succeed in a design-centric economy, organizational leaders need to be comfortable with exploration, uncertainty, and "productive failures" during the early stages of the process. This portion of the research targeted the design and development process in an effort to seek potential patterns across success and unsuccessful design strategies. Since the Research and Ideation stages of the process were already covered, this section is primarily focused on the design and realization of existing ideas.

<u>Engineering-Driven Process vs. Design-Driven Process</u>

For the engineering-centric organization, one of the biggest barriers on the path to better design is in the product development process itself. In these environments, market research and corporate strategy are the key drivers behind product initiatives. Project plans are devised, technical requirements are set, and production efficiently powers forward. Designers work in a supporting role in this process, aiming to make products stylish and easy-to-use. This model can lead to competitive products that may even be enjoyed by customers. However, the flaw in this process occurs in its late stages as designers become increasingly involved. If designers discover significant issues with the product, such as a complete misalignment with user needs, the organization is faced with an all-to-common dilemma. They can either order drastic changes to the product, which

would waste considerable engineering effort, or they can make minor interface level changes and ship the product as is. The latter is generally the resulting choice because the short-term financial pressures are more salient and outweigh the longer-term consequences.

What a design-centric process aims to do is to iterate on ideas at the earliest and most flexible stages of the process. At an early stage, changes are both rapid and inexpensive. Given the urgency, complexity, and uncertainty of competitive technology markets, it only makes sense that a process be designed for rapid exploration and validation of plausible ideas. While some from the business management world may see this exploratory process as inefficient, it is actually far from the truth. The mindset behind a design-driven process is that alignment with customer needs is uncertain, as neither the organization or the customers themselves know exactly what they will want next. With this viewpoint, uncertainty and exploration are a given, it's just a matter of when and how to navigate it. The optimal path, from a designer's perspective, is to explore an extensive range of solutions at the earliest point in the process. Unlike the engineering-driven process, iteration in a design-driven process occurs early and often so as to prevent costly decisions at late stages. This exploratory approach is best summed up by David Kelly, founder of renowned innovation firm IDEO, with the statement that "enlightened trial and error always outperforms the planning of flawless execution".

An important question is whether or not an organization can successfully shift its process to become more design-centric. The case of the Motorola RAZR demonstrates just how an organization can do this and realize great success. Analysis of the Motorola product development process prior to development of the RAZR in 2005 revealed a strategy that was nearly devoid of early-stage design influence. Prior to this point, Motorola had conducted a market-driven process in the development of new phones. With their traditional process, regional leaders from the organization each provided the features and functionality that they would like to see in the upcoming phone. They would then create market forecasts that were directly tied on the provided feature criteria. Feature requests were then aggregated and prioritized to plan the next phone to be released. The result was a system that was sure to address the expectations of the local markets and provide

Motorola with a competitive product strategy. However, as noted in the *Harvard Business Review*, this strategy would "systematically stamp out highly differentiated, counterintuitive innovations" by creating products that are "acceptable to everyone but delightful to no one". (Anthony 11)

After years of stagnant sales, Motorola attempted to breath new life into their "stodgy" product line by producing a phone that competed primarily on elegant design and simplicity, the RAZR. To produce an innovative phone, Motorola made the conscious decision that they needed to ignore their traditional design and research processes in favor of completely product-centric viewpoint. This time, market research, financial gain, and technology development were not the dominant drivers of the product. Geoffrey Frost, the Motorola Chief Marketing Officer at the time, summed up the transition to design-centric approach best when he said "back then we were saying 'Here's the features and the technology,' then put a wrapper around it. Now the starting point is 'What does the consumer want?' and then apply the technology to that." There is no doubt that this approach still requires sharp business strategy and skilled engineering work, but the envisioned product experience was ultimately the driving force. Frost sums up the blueprint the RAZR's success with the following four points:

1. "First, it was a bet being made, not a base being covered. We didn't even include it in the sector's business plan."
2. "Second, no compromise was the standard operating procedure. We didn't juggle tradeoffs, we just insisted on excellence."
3. "Third, we didn't try to predict the market for the product based on history, we bet that if it was good enough, it would make its own market."
4. "Finally, we put the best, brightest, craziest, and most passionate people we had on it." (Anthony 11)

Upon further examination, Frost's principles reveal that the priority of the product-centric process was on innovation, excellence, and emotion. They were no longer just reacting to the market and staying within the lines, but stepping forward and taking a chance. There was clearly an emotionally stirring aspect to the creation of the RAZR, one that carried

through the entire process. The result was a wildly successful phone that "exceeded the company's lifetime total projections for the product in its first three months". Despite its great success with the RAZR, Motorola was not able to carry momentum forward to install a repeatable, design-centric process, thus reverting back to their engineering legacy. A former Motorola designer shared her frustrations with the role of the Designer in an engineering-centric organization. She explained that Motorola that during the post-RAZR era, Motorola "treated design as something you sprinkle on afterwards." As an example, she often had project managers pass market and engineering-driven product specifications to her with the mandate to "make this usable". (Anthony 11)

The value of a design-driven process was widely understood and appreciated by the survey participants. 74.5 % of participants either agreed or strongly agreed with the statement that a validated design vision reduces ambiguity and minimizes engineering iteration. There was not a significant difference of opinion across roles for this question.

Finding: The key to a design process is how it comes together, not the specific stages.
A primary topic of the interviews conducted as part of this research centered on the design and development process. A simple topic such as this facilitated the conversation because it is easy to compare the actions and activities of one organization verse another. Early on in the discussion with the Frog Design executives, the topic of process was approached in an attempt to identify the elusive patterns of behavior that lead successful or failing products. Mark Rolston of Frog pointed out that the individual steps within a process are not where problems occur. Instead, what matters is how the entire process comes together as a whole. In other words, organizations must take a systems-based view of the design process itself. Rolston continued by instructing, "in design, form is held together by negative space". In the practice of product development, "process is the positive space, and the connections are the negative space". The key for Rolston is balancing the science and art of design.

The implication of Rolston's viewpoint is that the scientific breakdown of a product design and development process into mechanical steps inherently causes one to lose site

of the product as a whole. This insight brings to mind the frustrations that some of the business community have experienced with the Design Thinking discipline described in the Comparison of Methods section. The criticism has often been that Design Thinking is too amorphous and does not provide enough actionable steps. It makes sense that the process-centric business community would fail to find value in the loose and experimental Design Thinking strategy. However, once you add overly rigid structure, you degrade the holistic and imaginative nature that can make it so valuable. By over-emphasizing the science, you sacrifice the art, and it's the art that provides the real value.

Finding: Discipline to a product vision is the most critical challenge of the development process.

There is a common notion within the creative domain that ideas are easy to come by, but the real challenge is in the actual implementation of them. Interview participants, particularly those in design roles, were in agreement on this concept as well. A portion of each interview focused around product intent or vision and the ability to see it through.

Clearly, leadership can play a key role in establishing and maintaining a product vision. Jean Schmitt, Venture Partner at Sofinnova Partners, emphasized the importance of vision when he explained, "the key to success is a great articulated vision that is prototyped and quickly executed on. Articulating a vision requires talking about it day and night with your closest friends. The power of the vision is everything." He explained the challenge that "very few people are good at vision, and even fewer know how to turn it into a reality." According to Schmitt, "people are afraid to follow a disruptive vision. The vision must be strong, well-articulated and followed blindly by a team."

Mark Rolston offered a slightly different path, explaining that great design is facilitated by but does not require great leadership. "It's true that Steve Jobs creates the impression that a single dictator-creator can shepherd a project through. However, finding such genius is elusive. We need a better answer." To offer some hope, Rolston explained, "carrying the idea does not require a person owning it". He feels it is a significant improvement, "but many organizations cannot do it. They can't afford it or they
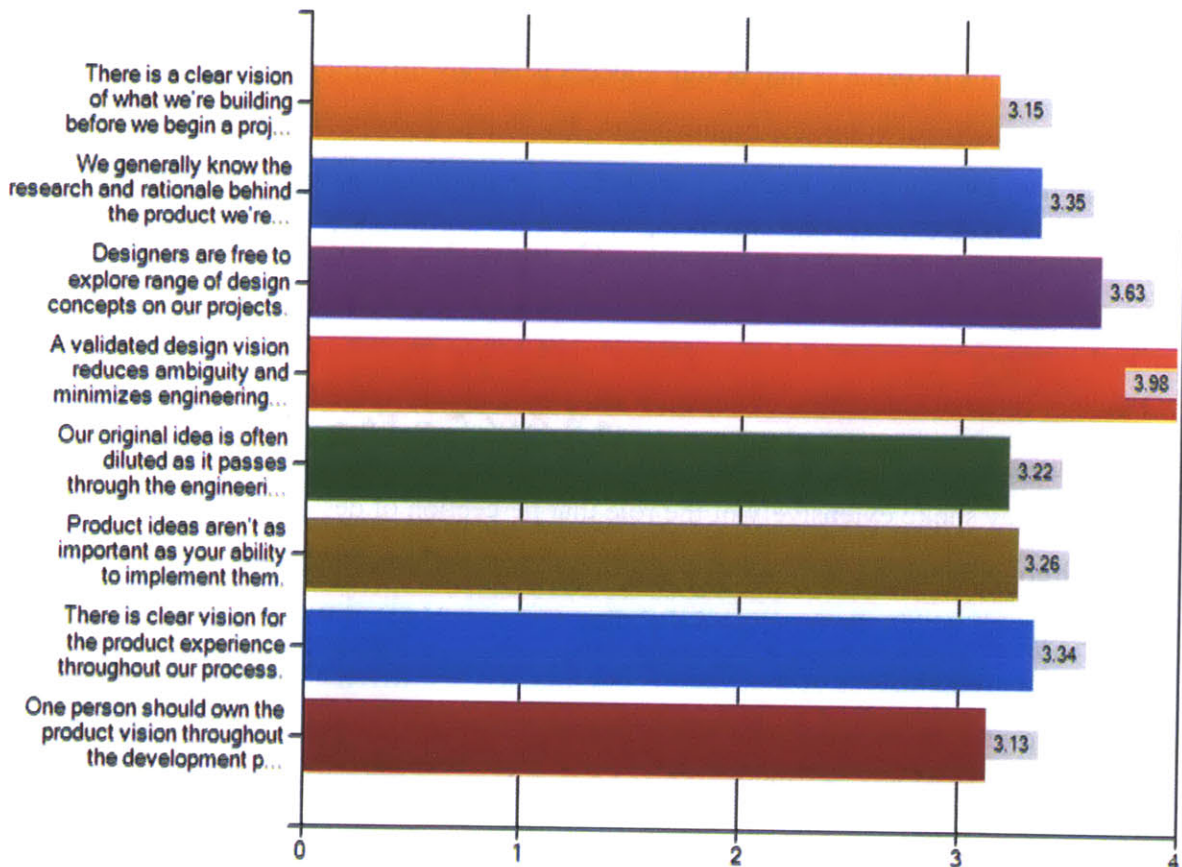
politically aren't willing to." Rolston advised that in the absence of powerful leaders, "high-fidelity artifacts are the next best thing because they don't lie and they help an organization rally behind the goal." As an example, it was noted by Rolston that concept animations are "priceless" towards carrying intent as they "create connective tissue" across the process stages. Rolston and Forbath agreed that the key to such high-fidelity artifacts is achieving a balance between inspiration and feasibility. If it's too safe, it will get a "so what, we can do this today" reaction, but too far out towards science fiction and it becomes too hard to connect.

High-fidelity design artifacts are a critical component of Apple's design process as well. Designers at Apple create "pixel perfect" mockups of products, meaning that every last detail is considered and designed. This approach is counter to what occurs in many organizations where designers hand off sketches or "wireframes" of products in order to move forward quickly with production. The hidden risk of this approach is the common practice of "interpretative changes" made by non-designers, which can be a critical cause of usability issues. While approach requires a greater degree of work from designers, the impact is significant. Detailed mockups reduce ambiguity, provide vision throughout the process, and ensure design quality at the end state. This ability to reduce ambiguity is particularly critical in the user experience design of complex systems.

Survey Results

The following diagram contains the feedback of survey participants regarding the product development process. The results show an audience that clearly understands the value of design within the product development process. For example, the strongest agreement appeared for statements related to the importance of design for providing vision and the free exploration of design concepts.

Figure 5: Survey Results on Process

Statement	Value
There is a clear vision of what we're building before we begin a proj...	3.15
We generally know the research and rationale behind the product we're...	3.35
Designers are free to explore range of design concepts on our projects.	3.63
A validated design vision reduces ambiguity and minimizes engineering...	3.98
Our original idea is often diluted as it passes through the engineeri...	3.22
Product ideas aren't as important as your ability to implement them.	3.26
There is clear vision for the product experience throughout our process.	3.34
One person should own the product vision throughout the development p...	3.13

Establishing a Design-Oriented Organization

<u>Overview</u>

One goal of this research is to determine the attributes that differentiate successful product and service design strategies. To seek answers to that goal, it is necessary to examine the role that organizational culture and structure play in a company's design capability. For instance, does a design-centric culture create an environment in which design thrives or does great design skill drive the culture? A common theme seen throughout this research is that design success is largely driven by the way in which design is perceived within the organization. Those that understand design as a multi-disciplinary endeavor and leading force behind products appear to have an advantage over those organizations that simply see it for style and usability.

<u>Finding: Internal perception of design plays a critical role in the ability of an organization to produce well-designed products.</u>

Sean Carney spoke extensively of the role that perception of design plays within defining the culture of an organization. Prior to joining Philips, Carney led the Global Experience Design group within the Imaging & Printing Group at Hewlett Packard. He explained that HP has "a proud history of innovation" but they were "missing a true design capability". Yet, the organization as a whole was beginning to understand the benefits of viewing design "simply as a catalyst for communicating the experience design, but it takes all roles and capabilities to bring it to reality". As an example, design was traditionally driven by the work of the marketing department, but the sides more recently learned to work together to develop product concepts that are informed by quantitative and qualitative research.

In his new role as Chief Design Officer at Philips, Carney is leading a design capability that is both broad and experience-driven. However, it was not always that way at Philips either. Previously, they had put design and technology on "two different pedestals", considering design to be solely about aesthetics. In Carney's viewpoint, this is a ten to fifteen year old viewpoint on design, established during the period where aesthetics-

oriented industrial design was breaking out in consumer product market. Design has taken on a much more strategic and cross-disciplinary role since that period. Through his leadership, Carney believes that he is now building a bridge between design, engineering, and business in an effort to create better products. He explains the necessity of such a strategy, explaining that without a systems mindset, companies are apt to create too many one-off products. The result is a constant set of reactions to the market, likely leading to inconsistent and inauthentic offerings. This approach also causes companies to lose out on opportunities for revenue that are gained from the second-order or network effects of "systemized" products and services.

Finding: Organizational prioritization of design may be a more important attribute than isolated design skills.

A clear distinction exists between having great designers and having design as a priority across an organization. While Apple clearly has a world-class design capability in Jonathan Ive and his team, it is most likely his influence as an executive that has allowed their design capability to dominate. His responsibility as the Senior Vice President of Industrial Design conveys an internal message that design matters within Apple, a message that carries down to every discipline in the organization. Of course, this message was bolstered by presence, words, and actions of former CEO Steve Jobs, someone of whom user experience was a cornerstone of his company.

When senior level executives are as obsessed with design as they are at Apple, the mindset cascades down and effects day-to-day decisions. A 2008 article on *CNN* described Apple's organizational passion for design. As noted by CNN senior editor Betsy Morris, "a designer has to be a borderline fanatic to care about the curve of a screw on the underside of a MacBook Air or the apparent weightlessness of the tiny door that hides its connectors." Insights such as this demonstrate is that well-designed products do not come purely from a designer's creative ideas and great artistic ability. Instead, they come from the look, feel, and overall user experience of the product truly mattering to all those who play a part in creating it. Said Morris, "The place is loaded with engineers, but it's not just the skills that are important, it's the ability to emote. The passion is what

provides the push to overcome design and engineering obstacles, to bring projects in on time -- and a peer pressure so great it sometimes causes a team to eject a weak link or revolt against an underperforming boss." (Morris 11)

Survey participants were actually at odds regarding their preferred level of influence of designers and where the responsibility of design decisions should lay. In regards to the former, 73.4% of designers either agreed or strongly agreed that their organizations would create better products if they had more influence within the process. However, only 31.3% of those in management positions and 32.6% of those in engineering positions shared this viewpoint. This is interesting because it reveals a population of designers that is clearly not perceived to be as critical as it believes it should be. It is unclear from this data whether managers and engineers believe that design should be prioritized, but designers themselves should not. The survey data is as follows:

Table 5: Survey Results: "We would create better products if our designers were more influential."

	Manager	Engineer	Designer
1 Strongly Disagree	0.0%	0.0%	3.3%
2 Disagree	37.5%	21.7%	3.3%
3 Neither agree nor disagree	12.5%	41.3%	20.0%
4 Agree	18.8%	28.3%	46.7%
5 Strongly Agree	12.5%	4.3%	26.7%
N/A	18.8%	4.3%	0.0%
Average Rating	3.08%	3.16%	3.90%

Another point of distinction within the survey data was regarding design decisions. Designers widely agreed that engineers make too many design decisions, with 56.7% either agreeing or strongly agreeing, compared to 31.3% for managers and 28.2% for

engineers, respectively. During a series of informal discussions with engineers, it was determined that the pattern of design-decisions made by engineers is actually the fault of a poorly executed design process. When designers produce and share ambiguous artifacts, such at user interface "wireframes" without proper detail, engineers are often left with the need to interpret what was intended. This often leads to poor interpretations based up on personal preference or convenience of implementation. As a point of contrast, examination of the Apple design process revealed the development of "pixel perfect" design artifacts that left no room for interpretation. As a result, engineers are not put in the position to make design decisions because of the rigor that has already been put in place. In the case where design interpretation or decision-making is needed, Apple engineers know that everything must go though Ive's team. At Apple, designers own design.

One of the great benefits that the prioritization of design offers is simplicity. Designed artifacts are visual and often tangible in nature. When shared, these artifacts provide cross-disciplinary teams with a common understandable point-of-reference. This is particularly valuable in a complex system environment where ambiguity and a lack of understanding of relationships often cause confusion. The designed artifacts cause the team to have a stronger vision of the final product and a tighter focus on the customer who benefits from it. In this sense, design is not being used for design sake, but instead served as a catalyst for shared vision. As noted in the various success stories throughout this chapter, organizations that produced successful innovations did so because they had a shared vision for creating truly great products or services for their customers.

Survey participants widely agreed with the notion that great product companies keep their customer and product experience as the highest priority, with 53.2% strongly agreeing and 41.5% agreeing for a total of 94.7%. However, designers clearly had the strongest conviction that success is tied to user orientation. 70% of designers were in strong agreement with the statement while managers and engineers strongly agreed 50% and 43.5% respectively. While this result is not surprising, it is rather odd to consider. After all, why would one discipline be more customer-oriented than the others? While designers may have the highest level of customer engagement or be most concerned with

usability, all disciplines are ultimately working for a common goal of creating and selling great products for people.

Another interesting finding came from the viewpoint that the participants had about their own companies. When presented with the statement "The creation of great product experience is a priority for our managers" the average score was just 3.24, just slightly above a neutral response. Only 43% agreed. Worse yet, managers had a much more negative response than non-managers on this question, with only 31.3% in agreement. The interpretation of this result is that managers are acknowledging that product experience is not a high priority within their organization.

Finding: Leadership may be critical for the creation of a design-oriented culture.
So how does an organization become design-oriented? It appears that it may start from the top. Interview participants widely noted the importance of those in leadership positions advocating the importance of design, innovation, and customer experience.

Jean Schmitt believes that the creation of innovative products and services is solely a matter of leadership. Coming up with new ideas isn't the challenge, he says, but having the ability and bravery to go after that different or new idea is. For this reason, Schmitt believes that the personality of the CEO is one of the most critical factors. "Finding the right CEO is the reason for a company being alive." Carol Zampell agreed, stating that "having a visionary leader is the most important factor" in delivering successful products.

Alain Breillatt best explains the importance of visionary leadership for new product innovation in a 2008 article in the Marketing journal *The Pragmatic Marketer*. "The CEO needs to be someone who looks out to the horizon and consistently sets a vision of innovation for the organization that he or she is willing to support completely with people, funds, and time. Further, that leader needs to be fluent in the language of your customer and the markets in which you compete. If the CEO cannot be this person, then he or she needs to be willing to trust that role to a senior executive and give that person the authority and latitude to effectively oversee the new product development process."
(Breillant 08)

Of course, visionary leadership alone does not lead to great product innovations. Rick Zampell offered up a case at HP where a clearly defined vision was in place for an innovative product system, yet it simply failed in the end due to a lack of understanding of the business and technical aspects of the vision. He discussed a digital music device that HP attempted to develop ("long before the Apple iPod") that featured playlists, Internet radio, web connectivity, and CD creation capability all the form of an integrated stereo component package. "The leader of that business had all the right elements and instincts sans a couple – the corporation's senior exec did not see us in that business and we had zero experience in the 'go to market' skills required to price, promote, and sell". Zampell explained how this example demonstrated where HP "had great customer experience in mind – but weaknesses in other parts of the value chain."

When Design-Oriented Cultures Fail to Catch On

The Motorola RAZR case described throughout this chapter has demonstrated the impact that a single project can have on design culture within an organization. Jim Wicks, Motorola's Chief Phone Designer at the time, credited the success of the product to a shift in culture. As he explained in 2005, "it's all about making consumer tastes the priority instead of technology". (Associated Press 11) Unfortunately, it appears that the success of the RAZR did not have an enduring impact on Motorola's culture. The interview with the former Motorola Designer revealed that the problem could be found in the legacy of her organization. According to this interview, the critical barrier for Motorola's design capability may be that they have "been run by engineers for too long". The end result is an organizational culture that prioritizes engineering over design. On a day-to-day basis, this means that the Motorola "enables engineers to override design decisions". According to the former designer, "even when engineers agree with us, they often don't have the time to implement the designs. They can't keep up with it. Motorola is just not used to functioning in this way."

Joshua Balgos, a Multimedia Designer and Director at Gilmore Media, discussed the challenges of being a designer in an organization that does not value to the discipline. He suggested that the most significant challenge for increasing the value of design is that it's

subjective nature. "Unless they're working in a creative company," stated Balgos, "I believe it's hard for others to value the time and effort designers put into their work, since it appears to be more subjective and not hard conclusive data." He explained that perception of design has actually improved with the notable success of Apple, but he think its is still "far from the norm".

Another case where design fails to overtake the existing culture is in the government domain. The MITRE Corporation provides systems engineering support to a wide range of US government sponsors, including the Department of Defense, Department of Homeland Security, and Federal Aviation Administration. As part of that support, MITRE offers guidance in user research, Human Factors, and Human-System Integration. This user-oriented guidance can be essential in ensuring that government-based organizations acquire innovative solutions that meet the needs of their end users (e.g. military personnel, government workers, etc.). Unfortunately, design-related support is often perceived as being non-essential and is not prioritized in project plans. As a result, innovation and design-orientation is lacking in the government domain.

Erika Darling, an Associate Department Head at MITRE with an educational training in Engineering Management and Human Factors Engineering, spoke extensively about this challenging reality. "There are so many barriers to innovation," noted Darling, "Government customers don't see the importance of design. They ask 'will it save lives?' and that's a tough question to answer." Darling explains that the Government's technology acquisition process outlines specific requirements to be addressed, and design measures are a sub-set of that, but they are particularly difficult to articulate and compartmentalize for implementation. Government contractors, meanwhile, are solely focused on profit and design "is perceived as not making more money".

Perhaps the biggest barrier to innovation, explained Darling, is a lack of understanding of the benefits of design related work. She discussed the common misperception that designers and Human Factors engineers are solely concerned with usability. While this is a valuable service of those in user-oriented positions, the real value of this role is in understanding users and translating those insights at the point of product and service definition. She explained that there should be increased awareness that designers and

Human Factors engineers have a unique understanding of both the user and technology perspective. This cross-disciplinary perspective is critical to building what people want or need.

Looking forward, Darling expects greater challenges as Government sponsors become more budget-conscious. While some in the Government are starting to understand the value of user-oriented work, she expects that change towards a design-oriented culture will be slow. She believes this is ironic because budget sensitivity is exactly the reason why those with design expertise should have greater involvement. This condition forces designers to simplify and "think creatively about how to do more with less".

Survey Results

The following table is a summary of the survey results regarding organizational structure
and culture. Participants widely recognized the value of cross-disciplinary
communication during the product design and development process. They also expressed
widespread agreement regarding the importance of maintaining the customer and their
experience as a priority throughout the process.

Figure 6: Survey Results on Culture
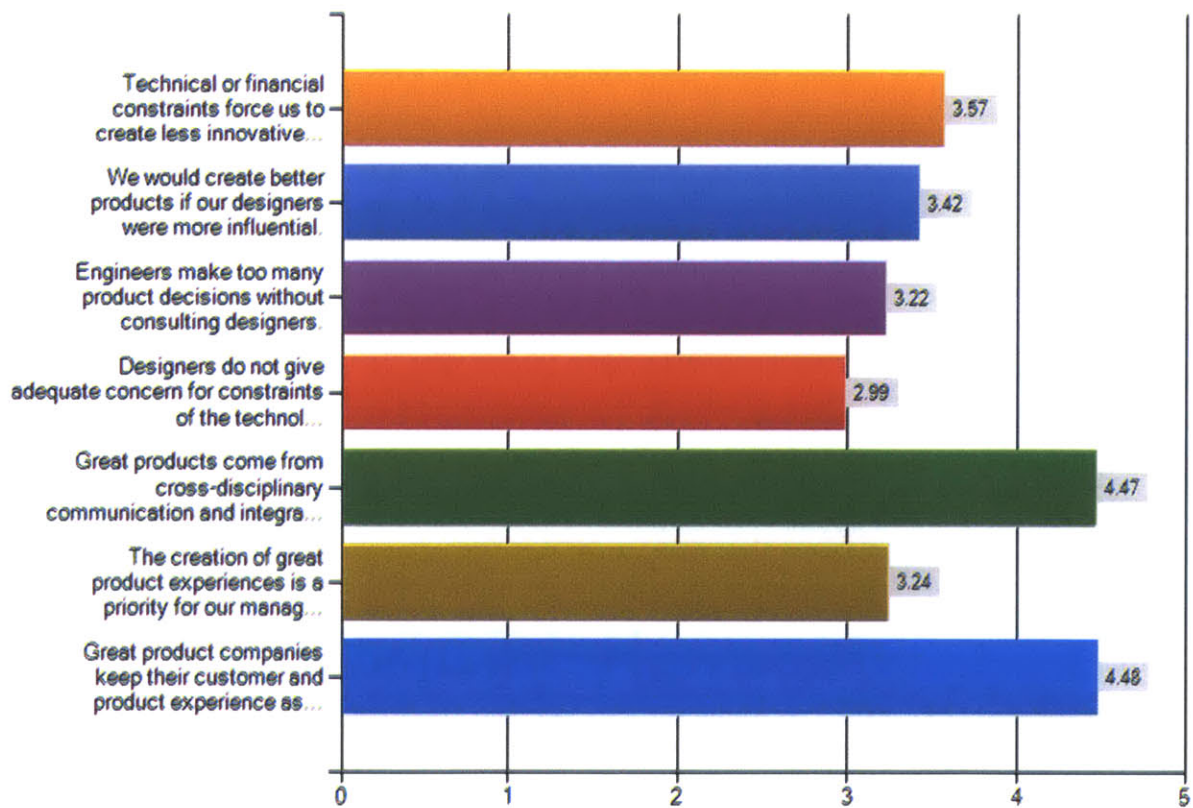
Summary of Findings

The following is a summarization of the initial hypotheses of this research and resulting findings. Viewed as a composite, they support the notion that the best approach to delivering high quality user experiences is through systems-based, design-oriented strategy.

<u>Hypotheses & Findings</u>

H1. Organizations should conduct extensive, balanced research related to market, technology, and customer conditions.

- *Finding:* It was widely agreed upon by interview and survey participants that extensive, multi-disciplinary research is highly beneficial towards high quality user experience design. H1 was supported.

H2. All disciplines should be involved in the development and exploration of new ideas for product and services.

- *Finding:* Interview and survey participants indicated a need for greater involvement of user research and related design methods at early stages to influence product direction. H2 was supported.

H3. Organizations should explore a wide variety of design concepts at early stages to prevent late-stage iteration.

- *Finding:* While early design iteration is a key tenet of Design Thinking and User Experience design, this theme did not stand out as a significant factor in this research. H3 was inconclusive.

H4. Clear communication of product vision is critical to the success of the product.

- *Finding:* Interview participants spoke extensively about the importance of a strong product vision. Providing this vision appears to be a challenge within most organizations. H4 was supported.

H5. The original intent of a user experience is often diminished by the influences of the product development process.

- *Finding:* Participants in design-related positions supported the notion that the product development process adversely affects user experience design. H5 was supported.

H6. It should be the responsibility of an individual within an organization to own the vision for a product's user experience.

- *Finding:* Strong leadership and a clear product vision appeared to be two of the most critical factors in this research. However, the notion that an individual must own the vision was not definitive. H6 was inconclusive.

H7. Engineering and market-driven factors are emphasized over design because they are more tangible or quantifiable.

- *Finding:* It was generally agreed upon by design-oriented participants that their recommendations are less influential than those of marketing and engineering. Also, there was a common theme that the urgency of market competition is prioritized over user experience design. H7 was supported.

H8. Organizations must foster cross-disciplinary collaboration to ensure balance between strategic, technical, and design-related expectations.

- *Finding:* Participants strongly agreed that cross-disciplinary communication is a critical step towards the creation of high quality user experience design. H8 was supported.

H9. A design-oriented culture is necessary for create great product experiences.

- Finding: Participants indicated that an organizational prioritization of design may be a more important attribute than isolated design skills. H9 was supported.

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Chapter 6: Recommended Conditions

Overview

The interviews, case studies, and survey results examined throughout this research support the notion that a holistic, multi-disciplinary, and systems-based approach offers competitive advantages to organizations in the design of user experiences. The following chapter outlines a set of recommended conditions for designing system experiences.

Supporting Organizational Conditions

As noted in the previous chapter, an organization's leadership, structure, and culture can have a significant impact on the design of the products it creates. As such, the System Experience Design methodology has a much greater chance for success if the proper conditions are in place. The recommended organizational conditions are as follows:

1. Design-Oriented Leadership

   It is recommended that those in relevant leadership roles have a level of understanding and appreciation for the strategic importance of experience design. Roles that would apply would include those who make critical system decisions that would ultimately affect the customer experience. Note that this does not require someone with particular design skill or pedigree. Instead, the recommendation is that leadership individuals place the customer and their experience interacting with the product or service as a high priority throughout the design and development process.

2. Sole Ownership of the System Experience

   The second recommendation for conditions is that an individual "owns" the system experience. While this person may be the same as the "design-oriented" leader described in the first recommendation, this suggestion is not the same. The idea is that someone be tasked with owning the vision for the experience of a user interacting with the system. The person in this capacity does not necessarily need to hold a formal design position, but they should understand the value of a well-

designed user experience. The existence of this ownership role is particularly beneficial in the design of systems because of the tendency to have inconsistencies or contradictions across the various user-facing components of a system. It is advised that all design-related decisions be ultimately passed through the owner of the system experience to ensure cohesion and consistency.

3. Organizational Discipline to the Enduring Benefits of Experience Design

   Competitive markets will undoubtedly test an organization's ability to maintain long-term strategy and focus. In order to succeed in experience design, an organization must remain focused on long-term benefits that product experiences provide. The implication of this is that an organization will face constant pressure to add complexity, but must resist doing so whenever possible. The design-driven organization will create systems that promote long-term usage and sustained customer satisfaction, sometimes to the detriment of short-term sales.

4. Inclusive and Collaborative Cross-Disciplinary Teams

   In an ideal system design environment, personnel from strategic, technical, and design-centered disciplines work together to holistically discover and address the problems or expectations of their customers. This approach is particularly important given the complex and cross-disciplinary nature of system design projects. A project team will have an easier time to coordinating around the common point-of-reference provided by the prospective user and their interaction with the system.

5. Culture of Exploration and Innovation

   Innovation is not possible in an environment where ideas cannot be freely conceived, shared, and evolved. Personnel across all roles should be encouraged to utilize their distinct expertise to ask new questions, try new approaches, and explore new solutions. They should understand that innovation is a "messy" process that cannot be overly planned or structured, but instead be allowed to fail, pivot, and naturally evolve.

Chapter 7: Recommended Process - System Experience Design

Overview

The previous chapter of this research presented a range of findings regarding the deployment of design strategies within organizations with particular focus on the design of complex systems. This chapter will attempt to translate those findings into a set of actionable principles for designing and developing complex systems that optimize user experience. This "system experience design" methodology will span the product lifecycle from initial research through final implementation. The intent of this methodology is to help practitioners conduct effective research, conceive creative "system" ideas, and effectively translate those ideas into a cohesive vision. Ultimately, systems created through this method should provide high quality and innovative user experiences and be highly desirable by customers.

However, this effort may also require specific methods for managing the complexities that are associated with systems design. This approach borrows specific methods from the disciplines of Systems Thinking, Design Thinking, User Experience Design, and User-Centered Design. The intent of the approach is to provide a practitioner with tools and techniques to balance the broad nature system design with detailed aspects of product interface design. Adherence to these principles will also help practitioners balance the strategic, technical, and design-oriented aspect of a systems project from foundational research through final implementation. As learned in this research, the individual steps of a design process are not as critical as the nature in which that process comes together as whole, so it is essential to keep a broad view.

Finally, an ideal system experience design process will meet the following objectives:
1. Be focused on the intent of the customer
2. Translate customer insights into technical requirements
3. Promote holistic "systems thinking"
4. Promote exploratory thinking and resulting innovations
5. Balance customer desirability, technical feasibility, and financial viability
6. Produce understandable design artifacts to serve as common points-of-reference

7. Enable the explicit communication of intent, assumptions and expectations
8. Identify and resolve gaps, redundancies, and inconsistencies across the system experience
9. Identify paths to opportunities for innovative solutions

Process Walkthrough

The following is a useful set of principles to guide you through the experience design of complex systems.

Stage 1: Situate

A compelling design for a future system experience must be built upon a rich understanding of existing situation. This includes the current conditions of the market, capabilities of relevant technologies, and expectations of prospective users. As noted throughout this research, a balanced foundation of insights from these perspectives is critical to market success.

Unlike technology and market research, the process of understanding prospective users is much less a science than an art. From personal experience, I believe this aspect of research is most effective when researchers demonstrate the following behaviors:

1. *Empathetic Observation:* The capturing of user insights can be a challenging and misleading process. One way to avoid this common trap is through ethnographic research, which is the practice of immersing oneself in the environment of a target user for an extended period of time. This allows the researcher to gather interesting insights that may not have been articulated by anyone in a user survey or interview. Just as important is the ability for a researcher to establish a level of empathy for the observed. By experiencing a prospective user's frustrations and intentions, the researcher establishes an emotion tie to solving the problem. This can be an incredibly motivational force during the process of designing and realizing solutions.

2. *Principle Development:* Research of design-oriented organizations such as Apple and Frog Design revealed the reliance on enduring design principles. This type of principle development is made possible through the sustained observation of the preferences and behavioral patterns of prospective users. When a new project arises, the organization is able to draw from existing principles that have endured over time and overlay them with new insights that are particular to the specific opportunity.

3. *Pattern Recognition:* One of the challenges of the Situate process is the attempt to understand which observations are meaningful and which are random. Researchers must look beyond current actions and comments to extract behavioral patterns and expectations that may carry through to future conditions. For this reason, the ability to quickly and accurately recognize meaningful patterns of behavior and thinking in a user environment is critical for success.

The desired output of the Situate stage is a foundation of principles and insights on which the creative process will be begin. Examples of user-related insights may include the expected priorities of users, the likely "mental model" of which they will be basing decisions, and the behavioral patterns that they will likely exhibit in future conditions. This process of extracting enduring patterns is a challenging one as it will be easy to fall into the trap of simply taking direction from prospective users. Instead, the system designer must "read between the lines" of user feedback and behaviors to extract latent needs and unarticulated expectations. One method for gathering such insights is to conduct extensive ethnographic research, which is the process of unobtrusively immersing oneself in the environment of the user to "live in their shoes" for a period of time. This type of empathetic observation allows the researcher to fully understand the conditions of the prospective user. This process reveals significantly more insights than those that are lost in strictly verbal interactions. Ethnographic methods should not be relegated simply to the responsibility of designers. As noted in the interviews with Sean Carney, those of other disciplines should be involved in the process as well. Engineers,

for example, significantly benefit from first-hand observations of the people that will be interacting with the technologies they develop.

An effective method for communicating user-related insights and design principles is the development of user personas. This is the process of developing notional profiles for the distinct user types that may interact with a system. In the marketing domain, this method is particularly focused on market segmentation and demographics. However, this level of specificity is not necessary for user experience design. Instead, user experience personas focus on behavioral patterns, preferences, and principles. The benefit of these personas is that they allow the designer to organize and communicate design principles in the most tangible way: by linking them to an actual individual human's experience. In the face of system complexity, user personas provide a simple and understandable point-of-reference of which all disciplines can center around. In this sense, user personas are a powerful means of cross-disciplinary communication and coordination.

Stage 2: Conceive

The second recommended stage of System Experience Design is to conceive the system. It is during this stage that system designers will utilize the principles and insights from the previous stage to envision a solution that will provide a more desirable experience that is both technically feasible and economically advantageous. This stage should be divided into the following three steps:

- *Step 1: Determine Intent*

    The first step of the Conceive stage is to determine the intent of the system. What this requires is a determination of the ideal system from the perspective of expected users. Specifically, the system designer must determine what the system will do for the user, how it will address their environment, and what their conditions will be like as a result. By taking a user-driven approach, the system designer is forced to think holistically about the user's entire interaction with the system. This is in contrast to a technology-driven system design approach, which may lead individual components being designed in isolation.

The resulting output of this step is a set of "intent statements" that convey the most desirable system from the perspective of the user. These statements are best communicated with the grammatical structure of "To [verb]", such as "*To improve the sharing of contextually-relevant photographs with friends*" (which is your intention) or "*To share contextually-relevant photographs with friends*" (which is the user's intention). Either one of this approaches is acceptable. It is only recommended that the system designer be consistent in which approach is utilized. These short statements will be extended in the steps that follow with technical solutions. However, this initial statement is critical because it establishes the intention of the system and ensures that all technical decisions are ground in user-centered rationale. In addition to the specific "To" statements, it is recommended that system experience designers develop a single "To" statement that summarizes the whole intent of the system as well. This structure for articulating intent was adapted from the System Architecture framework of Professor Edward Crawley, Ford Professor of Engineering at MIT.

One may find it peculiar that an innovation-centered process such as this does not contain a stage dedicated to ideation. The reason for this is that it is expected that a wide range of creative ideas be evoked and explored throughout the entire process. For example, in this particular step, the system designer should develop and consider an extensive range of user intentions to address. The designer should then carefully select the sub-set of intentions that are yet to be effectively addressed by market. The rationale behind integrating ideation into every step of the process is that a high quality product experience requires an entire range of great ideas disseminated throughout. These "smaller" ideas may be the targeting of hidden customer needs, novel methods of product interaction, or the development of original supporting services.

- *Step 2: Identify Satisfying Conditions*
  It is during this second step of the Conceive stage that the system designer must

begin to explore possible system conditions that would address the intentions identified in the first step. Ideation during this process requires a great deal of cross-disciplinary exploration, as new "system ideas" will likely rely upon a combination of insights from a range of domains. One could think of this step as a form of "targeted brainstorming" where those of all disciplines explore the various ways in which desired intentions could be met. For example, meeting the intention to "share contextually-relevant photographs" might be addressed with strategies that involve sending, projecting, or printing images. It is important that specific technical or financial constraints do not interfere during this stage. Development of innovative systems requires that seemingly ideal and potentially disruptive ideas be explored during, despite the fact that they may seam technically infeasible or financially improbable at first. This process must embrace the reality that great ideas result from the exploration and advancement of existing, lesser, or failing, ideas.

The output of this state is an articulated set of conditions that serve as the strategy for the technical solution that will be determined the steps that follow. The format for this articulation is a "By" statement, which will be associated with each "To" statement from the preceding step. In effect, this "By" statement will bridge the gap between user insights and technical solutions. To continue with the photography innovation example, a "To-By" statement may read, "*To* share contextually-relevant photographs with friends *by* direct and immediate transfer based upon proximity and authorization". The challenge presented by this intent may open up opportunities for innovations in wireless communication, hardware design, or business strategy.

- *Step 3: Envision Solution*
  It is during this step that the form of the system begins to develop. Using the intentions and strategies formulated during the previous steps, the designer must conceive the components, services, and additional elements that will converge to create a desirable system. In order achieve this goal the designer should utilize the

previously developed "To-By" statements as structure. This structure should provide the necessary creative tension to instigate ideas that draw from the insights developed during the Situate phase. This is actually the critical aspect of this process that enables innovative ideas. By determining intent, but not specific solutions, the earlier steps have simultaneously provided direction and flexibility. This is a powerful combination when utilized properly.

Note that during this step, the designer should be utilizing the "To-By" statements as a composite and not as isolated requirements. This will allow for better system design and improved opportunities for achieving the competitive advantages that well-designed systems provide. A holistic approach will also increase the likelihood that the user's experience with the system is cohesive and consistent. Another advantage of a systems-based approach at this stage is the likelihood for maximizing and controlling the positive emergent properties of the system.

The format of this step is the "Using" statement to be appended to the previously developed "To-By" statements. This allows the designer to determine the solution that will provide the conditions that will address the intent of the user. Completing this statement will create a direct relationship between proposed user intentions and specific technical solutions. To continue with the photography example, the "To-By-Using" statement may read: "*To* share contextually-relevant photographs with friends *by* direct and immediate transfer based upon proximity and authorization *using* a multi-touch camera interface, wireless technologies, and authentication based upon social networking services". This singular statement demonstrates an example of a technology solution can be tightly bonded to a user-centered purpose.

Stage 4: Graphical Depiction

As noted throughout this research, a good process should produce understandable design artifacts to serve as a common ground between disciplines. The value of design artifacts is their ability to reduce ambiguity and confusion by providing a common visual

language. This value is particularly important in the design of a system user experience where system ambiguity and domain-specific jargon can lead to frustrating or non-existent interactions. In a systems context, the goal of these visualizations is to help facilitate coordination across those involved in developing the system and to help maintain a singular holistic viewpoint.

These visualizations are also critical in establishing and maintaining a vision for the final end-state for the system. In this sense, they serve as prototypes to be constantly evolved during the system design process. This is particularly critical in long-term, complex systems projects where simple visualizations can provide much-needed clarity and focus. Beyond internal consensus, they can also be used to communicate ideas with intended users or demonstrate a vision to a client or customer.

For this method, it is recommended that the system designer draw from the "To-By-Using" statements developed into the previous stage to create the following two design artifacts:

1. *System Experience Visualization:* This visualization is an attempt to capture the entire system experience in a single diagram. It should cover the full scope of the system experience, including all people, places, objects, and interfaces. Unlike a purely technical system diagram, such as software architecture diagram, this visualization should primarily focus on the user's activities and interactions within the system. For that reason, it is not necessary to delve into the specifics of technologies at the high-level visualization. An example where System Experience Visualizations would be highly valuable would be the development of a system of convergent hardware and software products within an organization. In this case, a system-level visualization will help the various product owners to understand the context of their solution within the "big picture" of the user's environment. This approach reveals gaps, inconsistencies, or redundancies in the user's experience across the various products. More importantly, it facilitates critical holistic thinking by keeping the focus on the singular viewpoint of the user. The purpose of System Experience Visualizations is vastly different than a

technical system visualization that is primarily concerned with the functional or formal interfaces between components.

2. *System Experience Storyboards*: While the high-level visualization maintains the holistic viewpoint, System Experience Storyboards are focused on the specific interactions of the user. The idea is that the viewer gains a rich understanding of the system experience by observing a broad system view in conjunction with visualizations of the specific activities that weave through it. The expected output is a series of annotated graphical depictions of the specific activities of a prospective within the system environment, including interactions within component interfaces. Storyboards should be developed for all essential user types and activities and address all of the intentions outlined in the "To-By-Using" statements. The purpose of the storyboard is to ensure that a user's singular experience across the components of a system is seamless and consistent. In other words, it should not *feel* like a collection of components instead like single cohesive system. It is during the development of storyboards that the system experience designer will begin explore the specific interactions that each user will have with each interface. It is necessarily to continuing refer to and evolve the System Experience Visualization as the storyboards are developed. This ensures a consistency between the broad and detailed views.

The recommendation of the previously described visualizations is not intended to restrict the system experience designer from developing additional visualizations. Instead, the designer should explore any opportunities to graphically depict the experience that an individual will have while interacting with the system. For example, I have developed interactive animations in the past for a system that featured highly dynamic, non-linear interactions. In addition, the system experience designer may want to include the detailed design of specific user interfaces. It is highly beneficial, but not required, to have the same individual "owning" the system experience as well as the specific component interface designs.

Chapter 8: Conclusion

If I were to continue research on this topic, I would conduct deeper examinations of specific case studies across a range of industries to further validate the value of systems thinking in the user experience design process. I could also foresee value in establishing a baseline for standard experience design followed by an implementation of my proposed System Experience Design method to validate the applicability of my recommendations.

I would like to conclude by noting the challenges to be faced by the system experience designer. This role is not easy, as it requires the management of conflicting goals from a range of disciplines and personality types. It also requires the integration of wide range of insights from technical, business, and user perspectives. It takes discipline to remain focused on the system experience vision in the face of detailed issues and distractions that inevitably come up along the way. Perhaps more than anything, it requires the ability to create something simple and human-oriented out of something that is inherently complex and technology-oriented. It is this final point that is the sole focus of the system experience designer – to focus not on what the system does, but what the system does for people.

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Appendix A:
"Cross-Disciplinary Perspectives on Design" Survey Outline

Introduction

The following survey is intended to examine the perspectives of managers, engineers, and designers on the development of consumer-facing products, services, and systems. "System" in this context refers to any cohesive set of interacting products and services that come together to create something greater than the sum of its parts. For example, consider Apple's system of multimedia products and services that are designed to work together. For the sake of this survey, please consider "great products" as those that provide customers with an engaging experience, promote customer loyalty, and provide sustained revenue to the organization that created it. This survey should take under 15 minutes. Thank you for your time.

Survey Questions

1. My current role could best be described as:

Management, Business Administration, Marketing, or Finance
Engineering, Manufacturing, or Development
Design or Human Factors
Other

2. My education and professional background have included the following (choose all that apply):

Management, Business Administration, Marketing, or Finance
Engineering, Manufacturing, or Development
Design or Human Factors
Other

3. Years of professional experience:

4. Have you contributed to the development of products or services?

5. If you responded "yes" to Question 4, what percentage of those products were intended to interact with a human user?

6. Of those, what percent could be considered a large scale, complex system or at least part of one?

7. Research & Ideation:

Please rate your level of agreement with each of the following statements, from 1 (Strongly Disagree) to 5 (Strongly Agree) based upon your organization or personal product development experience. Select N/A if the question does not apply.

i. The key to innovative products is technical discovery.
ii. Truly innovative product ideas come from understanding users and their needs.
iii. We fully understand our customer before we begin a project.
iv. All disciplines are involved in developing product ideas
v. I am encouraged to share and explore new ideas for our products or services.
vi. We explore a range of ideas before selecting one and moving forward.
vii. I believe our product ideas are mostly just reactions to the market.

8. Process:

Please rate your level of agreement with each of the following statements, from 1 (Strongly Disagree) to 5 (Strongly Agree) based upon your organization or personal product development experience. Select N/A if the question does not apply.

i. Our original idea is often diluted as it passes through the engineering process.
ii. Designers are free to explore range of design concepts on our projects.
iii. There is a clear vision of what we're building before we begin a project.
iv. Product ideas aren't as important as your ability to implement them.
v. There is clear vision for the product experience throughout our process.
vi. One person should own the product vision throughout the development process.
vii. A validated design vision reduces ambiguity and minimizes engineering iteration.
viii. We generally know the research and rationale behind the product we're creating.

9. Culture:

Please rate your level of agreement with each of the following statements, from 1 (Strongly Disagree) to 5 (Strongly Agree) based upon your organization or personal product development experience. Select N/A if the question does not apply.

i. We would create better products if our designers were more influential.
ii. Engineers make too many product decisions without consulting designers.
iii. Great products come from cross-disciplinary communication and integrated teams.
iv. The creation of great product experiences is a priority for our managers.
v. Great product companies keep their customer and product experience as a priority.
vi. Technical or financial constraints force us to create less innovative products.
vii. Designers do not give adequate concern for constraints of the technology or budget.