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# Value Drivers For Smart Service Technology

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VALUE DRIVERS FOR SMART SERVICE TECHNOLOGY

by

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## ABSTRACT

The service industry is rapidly expanding. Organizations that do not innovate through services will be unable to effectively compete in the current marketplace (Bitner et al., 2008). In response, OEMs have developed smart services. Smart services are preemptive actions that are taken by the manufacturers of connected devices based on information collected from sensors embedded in the machines. The success of this service innovation depends on the vendor's ability to understand and address its clients' value drivers (Spohrer and Maglio, 2008). This study attempts to understand the factors that lead a customer to value and adopt smart services in the building efficiency industry. The results will show that smart services in the building efficiency industry are valued when the offerings are appropriate for a client's size; improve on existing decision making technology; are easy to implement; and are believable and reliable.

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# 1 INTRODUCTION

The service industry is currently in a period of explosive growth (Bitner et al., 2008). A service system, as defined in the research field of service science, is a network of participants, processes, and resources that interact to create value by improving its circumstances and that of others (Vargo et al., 2008). The rising importance of services can be attributed to an increase in the ability to separate, transport, and exchange information outside of goods and an increase in specialization which has enabled outsourcing (Vargo and Lusch, 2008). It has been argued that organizations that do not innovate through services will face "doom" due to an inability to effectively compete and grow (Bitner et al., 2008).

The importance of service innovation has been realized by Original Equipment Manufacturers (OEMs) in North America as these firms have begun shifting their operations away from manufacturing-dominant logic towards a service-dominant logic. OEMs have begun deploying consultants, practitioners, and technologies that are aimed at improving their customers' operations (Ng et al., 2010). In addition to these efforts, OEMs are in the process of developing smart service technology which is designed to automate customers' decision making procedures (Allmendinger, 2008). Smart services are preemptive tasks that are initiated by the manufacturers of connected devices based on information collected from sensors embedded in the machines. These services are automatically initiated when a sensor detects a change in a machine's performance (Allmendinger, 2008). In the building efficiency industry, these services are designed to detect changes in facility equipment sensors (heaters, chillers, ect.) and automatically adjust to reduce energy consumption, initiate maintenance activities, and increase security measures.

OEMs growth through service innovation, however, is not guaranteed with the creation of smart services. According to Vargo et al. (2008), not all service interactions co-create value. When offering a service, vendors deliver a set of value propositions to customers based on their competencies and capabilities. Customers evaluate these propositions against their own competencies and resources and decide whether to adopt or reject the offering. This study will attempt to understand customers' value for smart services by answering the question: what factors drive customer value and adoption for smart services? This research is relevant and persisting as smart service vendors will only able to achieve growth through this service innovation if they understand and address their clients' value drivers (Spohrer and Maglio, 2008). This paper will report on a study of an OEM in the North American building efficiency industry that is currently launching a suite of smart services. The results will show that smart services in the building efficiency industry create value when they align with customers' objectives; building capabilities; and when customers perceive that the service will deliver energy reductions, optimize operations, and improve asset management

This study will contribute to service science research as the description of customer value for smart services will assist with the field's efforts to understand overall service value and value co-creation. This study will also make a prescriptive contribution by recommending sales and marketing strategies to assist vendors in addressing target customers' value drivers. Overall, the results of this study will inform vendors' service design process so they can tailor their offering to match customers' value and therefore drive adoption.

# 2 LITERATURE REVIEW

## *2.1 Rising Importance of Services*

Recent research in both business and academia has identified that services are primarily driving economic activity. Researchers investigating services acknowledge that national economies are shifting away from manufacturing and towards services. A study by the National Academy of Engineering identified that the service sector accounted for more than 80 percent of the US gross domestic product in 2007; employed a large and growing share of the science and engineering workforce; and was the primary user of IT (Bailey et al., 2007). Further, services were responsible for 70% of the aggregate production and employment in the Organization for Economic Cooperation and Development (OECD) nations in 2006 (Berry et al., 2006). Vargo and Lusch (2008) identify two recent changes that are responsible for this shift towards services. They argue that the rising importance of services can be attributed to an increase in the ability to separate, transport, and exchange information outside of goods and an increase in specialization or "unbundling" which has enabled outsourcing.

This shift towards services means that economic growth relies on the ability of firms to develop service innovations or new ways of creating value. Spohrer and Maglio (2008) argue that "there is a tremendous need for service innovations or new ways of creating value with intangible and dynamic resources, to fuel economic growth and to raise the quality and effectiveness of service(s), especially for knowledge intensive industries." At this point, however, services are poorly understood (Spohrer and Maglio, 2008). Specifically, very little research has been done to understand service innovations (Bitner, 2007). As such, the field of service science was created to address issues of service innovation and create a greater understanding of this key economic driver. Pioneers in the field felt it was necessary to create an understanding of how services operate and interact so that future research could create a normative science for what services should do (Vargo et al., 2008).

### *2.2 Foundations of Service Science Research*

Services in general have been studied over the past thirty years; however, these studies rarely address the issue of service innovations (Bitner et al., 2008). Further, these studies have been conducted from multiple disciplines with different definitions of 'service' (Ng et al., 2010). Service research has been primarily conducted in the fields of business management, engineering, social science, and information systems. This fragmented approach has resulted in a debate over the validity and legitimacy of existing studies on service (Ng et al., 2010).

In response, actions have been taken to create one unified interdisciplinary approach to service research. IBM was responsible for naming the field "Service Science, Management and Engineering" (SSME) (Ng et al., 2010). This interdisciplinary field aims to integrate the curricula on service from each discipline to establish an umbrella under which services can be understood. This unified field is centered on Lusch and Vargo's (2008) notion of a service-dominant logic. The service-dominant logic posits that all economies are service economies and innovation is not defined by a firm's output but by their ability to better serve their customers.

### *2.3 Service Science Research and Service Systems*

The field of service science is primarily concerned with developing a general theory of services with "well defined questions, tools, methods and practical implications for society" (Spohrer et al. 2007). To achieve this aim, service science research centres on categorizing and explaining service systems and how these systems interact to co-create value. A service system is a configuration of people, technology, organizations, and shared information that interact by integrating resources and applying competencies to benefit themselves and others (Spohrer and Maglio, 2008). The service system as a whole is a typical unit of analysis in service science research as the interactions between components in a system are just as important as the components themselves (Ng et al., 2010). This definition is consistent with the understanding of a "system" put forth in the field of Systems Research. Systems research posits that there are five elements of a system: a coherent whole, a boundary, a mechanism of control, inputs and outputs and sub-systems and a wider whole (Ng et al., 2010).

The goal of a service system is to co-create value; however, not all systems are successful (Spohrer and Maglio, 2008). Therefore, service science research seeks to understand the process of value co-creation and how this value impacts the success or failure of a service system.

### *2.4 Value Co-creation*

Service science posits that vendors provide customers with value propositions and the customer evaluates these propositions against their own capabilities and competencies to determine whether the services will be useful (Vargo et al., 2008). Under the notion of co-creation, the provision of a service is not enough to create value. The customer must engage with or use the offering in order for value to be genuinely created. This value is defined by Vargo et al. (2008) as “value in use”. Arguments are currently being made that “value in use” should be redefined as “value in context” as value is “uniquely and phenomenologically determined by the beneficiary” depending on the circumstances (Vargo et al, 2008).

If a customer accepts the vendor’s value proposition, the customer demonstrates “value in exchange” by providing the vendor with money for the service. Value in exchange is therefore a tool for measuring value within the context of a system (Vargo et al., 2008). In demonstrating value in exchange, the customer further co-creates value by providing the vendor with capital on which they can further develop their skills and operations. Vargo et al. (2008) argue that it is possible to have value in use without having value in exchange; however, any need to access resources from others necessitates the role of value in exchange. As such, service science researchers argue that the co-creation of value is driven by value in use and moderated by value in exchange.

### *2.5 Service Science Theories and Methods*

As mentioned above, the field of service science is relatively new and comprised of multiple disciplines. As such, this field does not have a well-developed set of theories and models under which services are understood. Service Science researchers are in the process of developing a set of defined questions, tools, methods that can be used to study services across traditional disciplines (Vargo et al., 2008). The absence of a unified set of theories and frameworks, however, means that researchers often combine and apply models from their specific discipline to the study of service science in an attempt to aid understanding (Vargo et al., 2008).

The infancy of this field means that the primary goal of service science is to understand service innovations and their ability to co-create value. Service science research questions centre primarily on describing how service systems interact and what creates value in a service system. Vargo et al. (2008) outline a set of sample questions that are currently being investigated in the service science field (Table 1).

**Table 1: Sample Research Questions in Service Science**

| SAMPLE SERVICE SCIENCE RESEARCH QUESTIONS |
|---|
| What exactly are the processes involved in value co-creation? |
| How can we measure co-created value and value-in-use? |
| How does information technology influence the ways in which value can be created effectively? |
| What approaches do we need to understand the sociotechnical context of value creation? |
| What are the research methods appropriate for understanding value as an emergent quality? |

### *2.6 Areas of Research in Service Science*

As mentioned above, Service Science is an interdisciplinary field comprised of work from four main areas: management, engineering, social sciences and information systems. Within these areas, there are seven main research clusters. The clusters are IT services and solutions, business models for services, computing models for services, healthcare innovation, technology and service delivery, service design, and customer loyalty and relationships (Ng et al., 2010).

The study of smart services falls into both the Management and Information Systems streams. This double classification is appropriate as Information Systems Research is fundamentally concerned with the role that Information Technology (IT) plays in a firm's interaction with information (Bacon and Fitzgerald, 2001). The field of IS research is primarily concerned with understanding how information, and its interpretations, drive the decision making process in the organization. Within the sub-discipline of Management of IS, smart services can be classified into the IT service and solution research cluster. Studies on IT services and solutions are concerned with the value of IT services and how this value impacts a customer's decision to outsource (Earl, 1996).

These classifications are appropriate as smart services are different from traditional services. Smart services are preemptive tasks that are taken by the manufacturers of connected devices based on information collected from sensors embedded in the machines. These services are automatically initiated when a sensor detects a change in a machine's performance (Allmendinger, 2008). The pre-emptive and automated nature of these services sets these offerings apart from traditional services (Allmendinger, 2008). These automated services have the potential to minimize the managerial role in decision processes. In understanding customer value for these smart services, this study will make a descriptive contribution to the Management of Information Systems/IT Service component of Service Science.

### *2.7 Information Systems Models and Theories*

As mentioned earlier, the absence of a unified set of theories and frameworks in Service Science means that researchers often refer to models from their specific discipline when trying to understand service value (Vargo et al., 2008). As such, it is necessary to review existing theories and models in the field of Information Systems.

A large body of work in IS research focuses on user attitudes as predictors of technology utilization (Goodhue and Thompson, 1995). Eight main models have been designed to describe the role of user perception on new technology acceptance rates (Venkatesh et. al, 2003). Three of these eight models (TAM, TAM2, and TPB) are noted to explain approximately 40% of the variance in user propensity to use technology (Venkatesh et al., 2003). The Technology Acceptance Model (Figure 1) by Davis et al. (1989) is one of the most widely applied models for understanding different technology types and users (Venkatesh et al, 2003). TAM claims that technology acceptance is based on the perceived usefulness (PU) of the new offering and its perceived ease of use (PEOU). In this context, usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). The perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis et al., 1989).

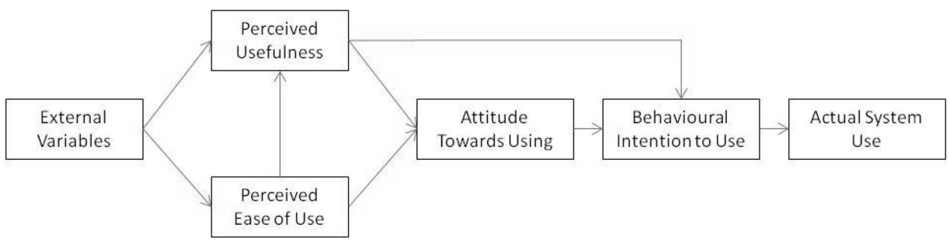


**Figure 1: Technology Acceptance Model, (Davis et al., 1989)**

TAM was extended in 2000 to the TAM2 model which includes the role of the subjective norm. The subjective norm refers to "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). The subjective norm construct was adopted from the Theory of Reasoned Action (TRA) created by Fishbein and Ajzen, which had previously been used to explain customer technology acceptance. In addition to the subjective norm, TRA also included an "attitude toward behavior" construct. This second construct claims that "an individual's positive or negative feelings (evaluative affect) about performing the target behavior" significantly impact the decision to adopt.

The Theory of Planned Behaviour (TPB) incorporates the constructs of TRA (subjective norm and attitude towards behavior); however, this theory also includes the role of perceived behavioural control.

This third construct focuses on the perceptions of internal or external constraints on behavior or "the perceived ease or difficulty of performing the behavior" (Taylor and Todd, 1995). TPB is noted to improve on TAM with respect to the ability to provide more specific information on customer acceptance patterns (Mathieson, 1991). Several scholars have also argued for the integration of TAM and TPB as "neither theory has been found to provide consistently superior explanations or predictions than the other" (Harrison et al, 2001).

IS researchers have recently begun investigating the extent to which user attitude models, specifically TAM, can be applied to automated technologies. The Automation Acceptance Model (Figure 2) is a proposed extension to TAM that attempts to address the issues of trust, self-confidence, workload, and risk that are typically associated with automated technologies (Boyle et al, 2011).

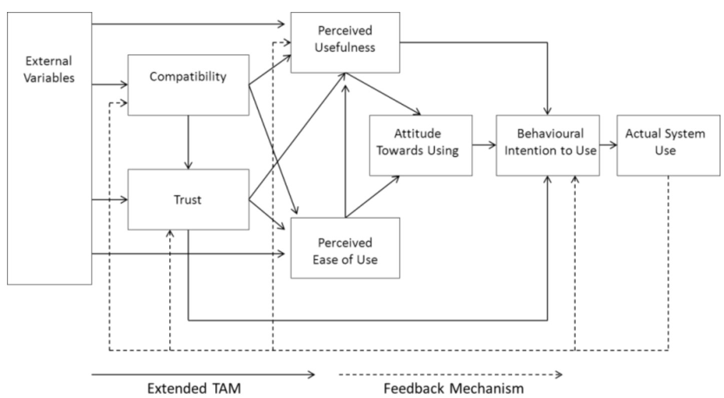


**Figure 2: Automated Acceptance Model, (Boyle et al., 2011)**

This model integrates existing IS work on user attitudes with research in the Cognitive Engineering (CE) field on the role of customers' emotions and attitudes in automated technology acceptance (Lee and See 2004; Muir 1987; Parasuraman and Riley, 1997). CE researchers argue that trust is an important attitude that mediates the relationship between users and the automated technology. Trust in this circumstance is defined as "(having an) attitude that an agent will help achieve an individual's goals in a situation characterized by uncertainty and vulnerability" (Lee and See, 2004). The level of trust held by a user is based on evaluations of the technology's predictability and dependability along with his or her faith in the device or system (Rempel et al. 1985). Users base these evaluations on an automated technology's surface features (aesthetics, real-world feel, information structure) and depth features (performance, observability, and controllability) (Boyle et al. 2011). Overall, users who find an automated technology to be trustworthy value the offering as they demonstrate reliance on the device or system (Lee and See, 2004; Muir, 1987). Conversely, users with a low level or inappropriate level of trust do not value the technology and are likely to misuse or reject it (Parasuraman and Riley, 1997). A high number of risk adverse customers impede the success of a new product launch (Bearden and Shimp, 1982).

### *2.8 Economic Adoption Model - Economic Utility Theory*

Combined, TAM and AAM provide an understanding of the potential factors driving technology value perceptions and acceptance. These models, however, are somewhat limited in providing a specific description of customer value as they centre on customer acceptance as opposed to adoption. Customer adoption decisions are a multi-step process, of which, acceptance is at the beginning of the process and price considerations are at the end. Customers move through a process of initial exposure to the technology, to acceptance, to decision confirmation or purchase (Rogers, 1995). A customer's perception of value has the potential to change once they are provided with price information. Past researchers on computer adoption have argued that price elasticity has a significant impact on information technology diffusion (Hsin-Hui and Luarn, 1999). A study by the OECD on new technologies in the 1990's demonstrated that price is a key driver influencing US firms' spending on Information Systems (Hsin-Hui and Luarn, 1999). The price elasticity for technology customers is highly variable due to a steep learning curve and knowledge barrier. This research identifies the need to consider price when attempting to understand how customers value new technology.

The role of pricing information on customers' value perception is defined as value in exchange. Value in exchange is understood as a customers' willingness to pay or the monetary amount they are willing to give for an offering.  The importance of value in exchange was highlighted by Vargo et al. (2008) when they wrote "value-in-exchange is required for value creation once the resources needed cannot be attained naturally, such as breathing fresh air versus needing an oxygen tank. Co-creation of value inherently requires participation of more than one service system, and it is through integration and application of resources made available through exchange that value is created." Vargo et al (2008) argue that the process of co-creating value for services is driven by value-in-use, but mediated and monitored by value in exchange.

Economic Utility Theory is the primary model used to understand the role of price on adoption decisions (Bowman and Ambrosini, 2000).  Utility Theory measures value based on satisfaction levels.  The theory asserts that customers spend their income so as to maximize the satisfaction they receive from products (Bowman & Ambrosini, 2000).  This theory of value is comprised of two measures: use value and exchange value.  Use value is the evaluation of an offering based on how the specific attributes relate to the customers' needs, i.e. speed of a car, weight of a laptop, ease of use for software.  Chen et al. define it as "a phenomenological experience perceived by a customer interacting with product/service bundles in a use situation" (2010).  Expected Value is measured in the customers' willingness to pay.  Bowman and Ambrosini define it as "the monetary amount realized at a single point in time when an exchange takes place" (2000).  Economic Utility Theory has been successfully used in the past to understand customer value assessments (Bowman and Ambrosini, 2000); however, this theory does not give consideration to the role of trust in customer's value assessment.  Trust is a key consideration for customers of new technology offerings as outlined in the study by Boyle et al (2011).   As such, this model alone is insufficient in describing customer value for smart services.

The Integrated Model of Behavioural Intentions by Varki and Colgate seeks to combine Economic Utility Theory with past use-value based models (i.e. TAM and AAM).  This model posited three arguments regarding the role of price considerations on customer value.

- price perceptions influence customer value more than quality
- favourable price perceptions have a positive effect on customer satisfaction
- unfavourable price perceptions have a negative effect on a customers' behavioral intention

Varki and Colgate's model asserts that service vendors have to consider both price perceptions and quality perceptions when attempting to drive customer retention. This model, however, is limited in its applicability to smart services as it is designed to understand customer value for services in mature, competitive markets (i.e. banking, hotels, airlines, etc.) (Varki and Colgate, 2001). This model is used to understand customer value so that vendors can increase existing customers' consumption rates.

Overall, smart services are different from traditional services and IT-based offerings due to their pre-emptive nature (Allmendinger, 2008). This key difference means that it cannot be assumed that past models can be used to understand smart service value in its entirety. Allmendinger argues that "a company's services must be a wholly different animal than the service offerings of the past, and the customer must perceive them as having entirely new value." Smart services "bend the traditional linear value chain into a 'feedback loop'…whereby the opportunity to add service value exists for suppliers, adopters, and third parties." A value feedback loop is the automatic and continuous stream of information about a client to a vendor without anyone having to "lift a finger". Vendors use this information to continually modify their offering towards a client's needs (Allmendinger, 2008). The departure of smart services from the traditional value chain means that it cannot be assumed that past value models can be deductively applied to fully describe smart services. Past model constructs may still apply to understanding smart services; however, these constructs are general and will be unable to describe specific smart service drivers. As such, this study employs an inductive approach to understand the value drivers that are specific to smart services. This research, however, will incorporate some assumptions of past adoption models. First, this study is prefaced on the assumption of Economic Utility Theory that use value precedes exchange value in the adoption decision. Second, this study incorporates the assumption of the Automated

Acceptance Model that customers' needs precede their trust evaluations. The study's inductive approach will be discussed in greater detail in Section 3.2.

The above discussion highlights that customers' value perceptions are key considerations for any service vendor. There is uncertainty in the literature, however, about the value of smart services as these offerings are innovative and rely on a value feedback loop as opposed to a traditional value chain. Smart service vendors are unable to properly price their offering or create sales and marketing strategies without this information. This study aims to inform these strategies by using an inductive approach to describe customer value specifically for smart services.

### *2.9 Foundations of Smart Services – Big Data, Cloud Computing, and Intelligent Systems*

As mentioned above, service science research attributes the increase of services to an increasing ability to deliver information apart from goods and people and the increase in specialization or "unbundling". These changes have made a significant impact on information systems which has resulted in IT service innovations.

One of the biggest changes in information systems has been the creation of a phenomenon referred to as "big data" (Brown, Chui, Manyika, 2011). Big Data is understood as a proliferation of the quantity and quality of data and information that is available to businesses (Diebold, 2003). The rise of 'big data' is primarily attributed to the increasing presence of cloud technology which serves as a primary platform for data storage (McAfee, 2011). Cloud technology is a set of outsourced service offerings comprised of three core features: infrastructure-as-a-service (IAAS), platform as a service (PAAS), and software as a service (SAAS).

- IAAS provides technology customers with an alternative to traditional in-house server storage systems. IAAS enables the collection of 'big data' as the information collection process is not limited by the physical capacity of the in-house server.

- PAAS provides customers with established platforms under which they can write codes to develop software.
- SAAS provides customers with a suite of applications that enable standard business tasks to be completed, i.e. Google applications.

Cloud providers have identified an opportunity to extend their value propositions by applying proprietary algorithms to the data that is being housed on their servers. The results of these analyses are compiled into reports that deliver meaningful interpretations of the data for their clients (McAfee, 2011). An example of this offering would be the collection of transaction data for retail customers. The POS data would be interpreted using appropriate algorithms and a subsequent report would provide explanations of customer behavior. Current literature in IS suggests that services based on these reports and large stores of data could be valuable to customers at they would have the potential to improve their decision making processes (McAfee, 2011).

### *2.10 Connected Devices and Smart Services*

In addition to traditional cloud service providers, Original Equipment Manufacturers (OEMs) have begun developing services based on connected devices that collect, store, and utilize “big data” (Bughin, et. al, 2011). Connected devices house embedded sensors that continuously collect data on the subject being monitored. The data collected from the device is stored on the manufacturers cloud server and then analyzed according to the vendors algorithms to provide meaningful data outputs. OEMs have begun offering services based on these data outputs (Allmendinger, 2008). These service innovations are referred to as smart services.

Allmendinger and Lombreglia provide an extensive understanding of smart services in their article ‘Four Strategies for the Age of Smart Services’ (2005). Smart services are automated preemptive tasks that are initiated based on the hard field intelligence data that is collected by connected devices. Examples of smart services include automated tasks that respond when a machine is about to fail; a customers' consumables are about to be depleted; or a shipment of materials is delayed (Allmendinger, 2008). The preemptive nature of smart services can result in significant cost savings for customers. The proactive replacement of a machine part prevents the cost impact of the equipment failing and shutting down facilities for extended time periods. The importance of these services is highlighted in a report by The Economist on Smart Systems. The report states that "firms can now send out maintenance crews before things actually break,' says Steve Mills, who heads IBM's software business. '(The ability to make) the old stuff run better will be the most important benefit of such systems in the short run' (2010). Table 2 outlines typical smart service offerings.

**Table 2: Standard Smart Service Applications, (Allemendinger and Lombreglia, 2005)**

| SERVICE APPLICATION | DESCRIPTION |
|---|---|
| STATUS SERVICES | Capture and report on the operation, performance, and usage of a given device or the environment being monitored. |
| DIAGNOSTIC SERVICES | Enable a device to self-optimize or allow a service person to monitor, troubleshoot, repair, and maintain devices |
| UPGRADES | Prevents problems with version control, technology obsolescence and device failure. |
| CONTROL AND AUTOMATION | Coordinate the sequenced activity of several devices. They also cause devices to perform one-off discrete actions. |
| PROFILING AND BEHAVIOUR TRACKING | Monitor variations in the location, culture, performance, usage, and sales of a device. |
| REPLENISHMENT AND COMMERCE | Monitors consumption of a device and buying patterns of the end user. These applications can initiate purchase orders of other transactions when replenishment is needed. |
| LOCATION MAPPING AND LOGISTICS | Track and optimize the service support system for a device. These applications also support supply chain and sales activities. |

Allmendinger (2008) presents a matrix that can be used to better understand the categorization of smart service providers (Figure 3). The first categorization is based on the extent to which smart services are solo vs. team opportunities. Solo smart services are delivered to customers based on data collected by a single vendor from a single device. These solo services are then further categorized by low vs. high activity levels. The low vs. high activity dimension refers to the number of solutions or worthwhile services that can be provided from a device or network of devices. Devices with extensive data collection capabilities are able to deliver a portfolio of services to customers. For example, MRI devices with embedded technology can provide customers with approximately 13 services from diagnosing the need for a patient scan to updating the device software. Low activity devices, however, typically provide customers with a limited number of services. For example, HP printers' sole service is to initiate just-in-time toner orders when the device identifies that the ink is running low.

Team-based services are offered in instances where several distinct devices are connected to each other and value is created from the aggregated body of data. Team-based services are either responsible for either providing raw data to the network or aggregating the data that is collected from other devices in the network. Figure 3 outlines the category matrix for smart services.

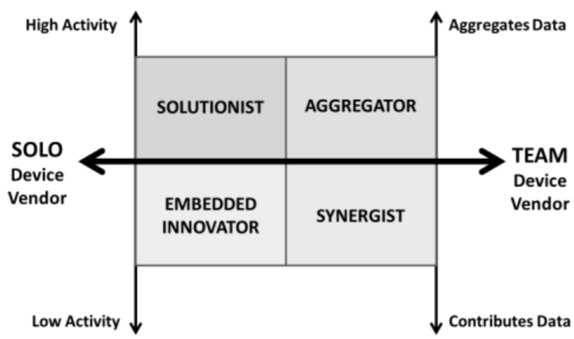


**Figure 3: Categorization of Connected Devices, (Allemendinger, 2010)**

This research study focused primarily on 'solutionist' devices. This selection was based on the assumption that full solution devices provide the greatest overall value to customers. Focusing on devices with the greatest potential value was consistent with the aims of this research study. The building efficiency case used in this study is an example of a 'solutionist' offering. Building efficiency OEMs are using information gathered from sensors embedded in their equipment to provide remote monitoring, diagnostic work, and preventative maintenance to customers (Allmendinger and Lombreglia, 2005). An overview of typical building efficiency smart services is provided in Table 3.

**Table 3: Sample Smart Building Services (BSRIA, 2009)**

| SAMPLE SMART SERVICES FOR BUILDING EFFICIENCY INDUSTRY |
|---|
| Energy Demand Management and Optimization |
| Asset Lifecycle Management (Equipment Maintenance and Repair) |
| Alerts, Remote Monitoring, Event Management |
| Historical Trending, Analyses, Reporting |

Overall, Chen et al. argue that the extension into services is integral for manufacturers' success in the current business environment. They write "to create and deliver value for customers in the age of knowledge, innovation and technology convergence, effective development and delivering of services is a major part of strategy and policy" (2010).

# 3 RESEARCH DESIGN AND APPROACH

### *3.1 Research Question and Goals*

This study is premised on the research question, what factors drive customer value and adoption for smart services? This research is relevant and persisting as smart service vendors will only able to achieve growth through this service innovation if they understand and address their clients' value drivers (Spohrer and Maglio, 2008). The identification of these factors will result in a description of the key value drivers for target customers of smart services in the building efficiency industry. This description will then be used to prescribe recommendations for how smart service vendors can address these factors to drive value and adoption.

The theoretical goal of this study is to make a descriptive contribution to the field of Service Science. Service Science research is primarily concerned with creating an "understanding of services in order to advance the design and scale of service systems for business and societal purposes" (Spohrer and Maglio., 2008). This study's description of customer value drivers for smart services will assist with the field's efforts to understand overall service value and value co-creation. The prescriptive component of this study will contribute to Service Science's overarching goal to aid and advance future contributions to the service economy. Vendors will be able to use the outlined recommendations to improve their service design and marketing plans in a way that addresses target customers' value drivers thereby resulting in higher adoption levels.

### *3.2 Research Approach and Paradigm*

As mentioned above, this study is concerned with answering the question, what factors drive customer value and adoption for smart services? The primary aim of this study is to generate and validate a theory on customer value drivers for smart services. As such, both inductive and deductive research approaches were used to achieve this goal. The first phase of the study uses an inductive whereby observations are used to generate a hypothetical model of customer value drivers for smart services. The second phase of the study seeks uses a deductive approach to validate the hypotheses on which the model is built.

Induction was appropriate for this study as this approach is concerned with creating descriptions of social phenomena in order to answer 'what' questions (Blaikie, 2010). Blaikie (2010) writes, "the inductive research strategy is an essential tool for answering 'what' questions." Induction was also required for this study due to the absence of existing models that could extensively describe smart service value. The field of service science is relatively new, meaning that theories and frameworks on customer value for service innovations have yet to be established. Existing models on technology acceptance (TAM, AAM, etc.) from other disciplines are somewhat limited in their applicability to this study as smart services are innovative offerings that rely on a value feedback loop as opposed to a traditional value chain (Allmendinger, 2008). The innovative nature of smart services means that one cannot assume that general models will provide a specific understanding of smart service value drivers. Therefore, this study employs an inductive approach to develop a model appropriate to the smart service context. This specific model, however, is complemented by assumptions from past generalized models and theories. First, the model incorporates the assumption of Economic Utility Theory that use value precedes exchange value in the adoption decision. Second, this model uses the assumption of the Automated Acceptance Model that customers' needs precede their trust evaluations.

A deductive approach was used in the second phase of the research in order to validate the decision model generated in the first inductive phase of the research study. The deductive approach was appropriate for validating the decision model as this approach focuses on gathering data to test hypotheses and determine whether or not a model accurately describes reality (Trochim, 2006).

This research is positioned under a post-positivist paradigm. This approach assumes that knowledge is subjective and observations are imperfect; however, a measure of objectivity can be given to the observations through internal/external validity (i.e. triangulation) and reliability (Trochim, 2006). This paradigm is appropriate for the research approach as the mixed approach is concerned with finding general descriptions of customer value drivers and then validating these conjectures.

This research uses the constructionist epistemology. This perspective posits that knowledge is a product of people interpreting their interactions with the world and social science knowledge is a result of social scientists re-interpreting this knowledge into technical behavior (Blaikie, 2010). The fallible nature of these observations means that these views and constructions are imperfect. This research takes an idealist approach to the study of smart services. The form of idealism used in this study posits that there is an external reality that places constraints on reality constructing activities. Finally, this study was executed using an interpretivist axiology. Under this perspective, the researcher believes that the study's conclusions have the potential to be value-laden through the data collection and analysis methods that are used.

These assumptions are appropriate for the inductive research question as descriptions created through induction are limited by time and space and are not universal laws (Blaikie, 2010). Blaikie argues that inductive studies limit the study of a phenomenon to a specific location. Therefore, the answers to research questions are limited by background knowledge, previous theories, time and space and cannot be universal.

### *3.3 Scope of Research*

In investigating smart service value this study looks specifically at a case in the Building Efficiency Industry. This industry was selected as organizations in this field were commonly cited as prominent developers of smart service technology (Allmendinger and Lombreglia, 2005; Allmendinger, 2008). A report by The Economist on Smart Systems identified buildings as one of the main contributors to the worldwide total of internet-enabled-device revenue (Appendix 2). The specific organization used in the study was an Original

Equipment Manufacturer (OEM) for heating, ventilating, air-conditioning, refrigeration, and security systems. The organization also executes renewable energy projects including solar, wind and geothermal technologies. The selected company recently launched a unified building solution that features wireless equipment sensors and bundled application services.

This study of smart services focused on target smart service customers as the unit of analysis. Specifically, this study looked at the customers who would be responsible for the decision to adopt smart services in their respective organizations. This unit of analysis was selected as it was appropriate for the research question what factors lead a customer to value and adopt smart services? Understanding how customers evaluate and co-create value is important to understanding whether smart services will be successful innovations (Vargo et al., 2008). The customers in this study were from commercial, healthcare, education, and government backgrounds. The professional types studied were facility managers, information technology managers, and executive management.

# 4 METHODOLOGY

This study used Ethnographic Decision Tree Modeling to produce and analyze the data results. Ethnographic Decision Tree Modeling is a two-step procedure whereby a researcher builds and then tests hypotheses about the factors that impact a customer's decision making process. This methodology was appropriate for this study's research question as it is concerned with describing what drives customers' decisions to adopt (Gladwin, 1989). EDTM is also appropriate for this study's research approach as it is premised on first using qualitative responses to create hypothesis on people's decision making criteria and then validating these hypotheses using quantitative data. EDTM has been successfully applied to numerous studies with a predictability rate from approximately 85% to 95%. These past applications have included studies on farming, fishing, and car purchasing scenarios (Gladwin, 1989).

## *4.1 Stage One: Qualitative*

The first phase of the data collection process was qualitative in nature. The qualitative research process was appropriate for the inductive research question as it enabled the researcher to produce a description of a phenomenon by exploring social actors' meanings and interpretations (Blaikie, 2010). In this instance, the qualitative approach allowed for the researcher to obtain detailed descriptions of what customers' value about smart building services and how this value impacted their likelihood to adopt the offering. This in-depth understanding was integral to the study as smart services' value drivers are relatively unknown.

### 4.1.1 Data Collection Stage One: Interview Design

The first stage of the data collection was through semi-structured interviews. The interview method was appropriate for the inductive research question as this method allowed the researcher to get close to social actors' meanings and interpretations (Blaikie, 2010). The semi-structured design allowed participants to freely comment on their value perceptions, while maintaining a response structure that would enable comparisons across respondents. Each of the fourteen respondents was shown a presentation of "Smart

Building Solution 1.0". This presentation outlined the overall concept and provided a description of the available service applications. Respondents were asked follow up questions on the presentation itself to ensure that they fully understood the service concept. Following the presentation, each respondent was asked a set of questions to uncover their perceptions of the solution. The structured question list is outlined in Table 4. Additional or follow up questions were asked in instances where it was deemed necessary for the respondent to clarify or elaborate.

**Table 4: Qualitative Interview Question Set, (Pricing Solutions Ltd., 2010)**

| Semi-Structured Interview Question Set |
|---|
| What are your perceptions of Smart Building Solution 1.0? |
| What things do you like about the Smart Building Solution 1.0? |
| Do you believe your organization would benefit from adopting Smart Building Solution 1.0? |
| What things do you not like about the Smart Building Solution 1.0? |
| What concerns, if any, do you have about the Smart Building Solution 1.0? |
| Do you feel this innovation will address any specific needs and provide value within your organization? |
| If the Smart Building Solution 1.0 was presented to your organization, how likely is it that you would recommend the adoption of this technology? |
| If the price of the Smart Building Solution 1.0 was $XXX per site, how likely is it that you would recommend the adoption of this technology? |

### 4.1.2 Stage One – Qualitative Data Analysis

A form of content analysis was used to analyze the qualitative data results under EDTM. The procedure was completed as follows:

1. The qualitative interview sets were analyzed to uncover decision making criteria. Decision criteria were considered valid if they were mentioned by a majority of respondents. In the case of smart services, the interview responses highlighted key drivers such as the organization's current capabilities; objectives; and perceived reliability that the services would deliver on energy reduction, optimizing operations, and improving asset management.

2. The researcher then used the criteria identified in the interview responses to build hypotheses about customers' decision making behaviour. The hypotheses were created based on a conjecture of the observed relationships between the identified decision making criteria. In the case of smart services, three hypotheses were created:

   - H1: Customers with the appropriate building capabilities and organization objectives for smart services will be likely to adopt
   - H2: Customers who demonstrate H1 plus a believability that smart services will deliver on energy savings; optimizing operations; and asset management will be likely to adopt
   - H3: Customers with H1 and H2 will be less sensitive to smart service price and more likely to adopt than customers that do not demonstrate H1 and H2

3. A decision model was then created to illustrate these hypotheses. The decision model is illustrated in Figure 4.

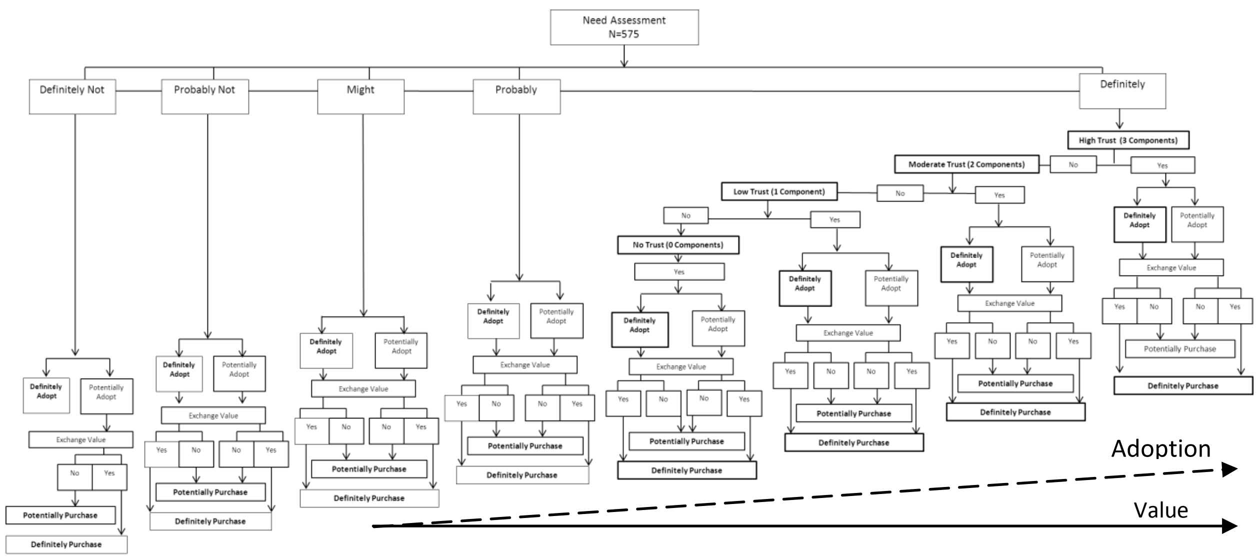


**Figure 4: Decision Model (By All Need Segments and Trust at the "Definitely" Need Level)**

### *4.2 Stage Two: Quantitative*

The second phase of the research was quantitative in nature. The second quantitative phase of the study sought to validate the hypotheses that were created in the first qualitative portion of the study. The use of a quantitative approach was appropriate for the deductive research component as it enabled the researcher to count and measure smart service value drivers (Blaikie, 2010). This measure of validity allowed for the theory ascertained from the qualitative findings to be generalized to the wider population.

### *4.2.1 Data Collection Stage Two: Questionnaire Design*

The second stage of the data collection was the quantitative questionnaire. The use of a questionnaire was appropriate for the deductive component of the study as it allowed for responses to be collected in numbers so that the insights uncovered in the interviews could be measured and validated (Blaikie, 2010). Each respondent completed the questionnaire online with an average response time of twenty minutes. These respondents were also given an overview of the services and asked questions to verify that they understood the concept.

The questionnaire was designed following the completion of the qualitative interviews. Some of the questions were similar to the questions used in the semi-structured interview. Additional questions were included in the survey based on insights that were given in the interview. The question sets were designed with the intention that the responses would validate the hypotheses created in first qualitative phase of the study. The question set is outlined in Table 5.

The second portion of the questionnaire used a discrete choice design to understand and quantify smart service adoption rates and sales package preferences. Discrete choice is understood as a decision between two or more mutually exclusive alternatives. Discrete choice models present respondents with a set of product options and ask them to identify their most preferred choice (Rohr, 2006). A discrete choice method was appropriate for the research question as these models are used to understand what service attributes and the set of available offerings influence customers' purchase decisions (Rohr, 2006). In this exercise, respondents were presented with a list of thirteen services and were given the option to purchase the services as a full suite, bundle, or custom package. Each package was displayed with the prices for adopting the services using SaaS or SaaP. The custom packages displayed were based on earlier selections that customers made regarding the three applications they find most valuable. In the discrete choice exercise, respondents were also given the opportunity to forgo making a purchase. In total, respondents participated in eight purchasing scenarios. The prices increased from 50% to 90% following the first base-case scenario. Appendix 1 provides a sample scenario screen. The application names have been removed for proprietary confidentiality.

**Table 5: Quantitative Survey Question Set, (Pricing Solutions Ltd., 2010)**

| Quantitative Survey Questions |
|---|
| Which statement best describes how much you like SMART BUILDING SOLUTION?<br>1. Like extremely well<br>2. Like very well<br>3. Like somewhat<br>4. Neither like or dislike<br>5. Dislike |
| What aspects of SMART BUILDING SOLUTION do you think you would dislike?<br>Please be as specific as possible.<br>What aspects of SMART BUILDING SOLUTION make you feel indifferent?<br>Please be as specific as possible. |
| Which statement best describes how well SMART BUILDING SOLUTION would solve a problem or fulfill a need for your organization?<br>1. Definitely would solve a problem or fulfill a need<br>2. Probably would solve a problem or fulfill a need<br>3. Might or might not solve a problem or fulfill a need<br>4. Probably would not solve a problem or fulfill a need<br>5. Definitely would not solve a problem or fulfill a need |
| What problem(s) or need(s) do you foresee SMART BUILDING SOLUTION addressing in your organization? |
| Which statement best describes how you feel about the believability or certainty of the claims made about SMART BUILDING SOLUTION regarding…?<br>1. delivering energy savings,<br>2. optimizing operations<br>3. improving building asset management.<br><br>1. Very believable<br>2. Somewhat believable<br>3. Not very believable<br>**4.** Not at all believable |
| Which statement best describes how likely you would be to advocate for the adoption and use of the SMART BUILDING SOLUTION in your organization?<br>1. Definitely would<br>2. Probably would<br>3. Might or might not<br>4. Probably would not<br>5. Definitely would not |

#### 4.2.2 Quantitative Analysis

The quantitative data analysis procedure sought to validate the hypotheses and decision making model using counts of "If…Then" statements. The procedure is outlined below.

1. The researcher selected the survey questions that best validated the hypotheses and decision model. For example, the following questions help determine the presence of the need, trust, and pre-price and post-price adoption:

   - Which statement best describes how well smart building solution would solve a problem or fulfill a need in your organization?
     - Definitely would fulfill a need
     - Probably would fulfill a need
     - Might fulfill a need
     - Probably would not fulfill a need
     - Definitely would not fulfill a need

   - Which statement best describes how you feel about the **believability or certainty** of the claims made about SMART BUILDING SOLUTION regarding…?
     1. **delivering energy savings,**
     2. **optimizing operations**
     3. **improving building asset management**.
        - Very believable
        - Somewhat believable
        - Not very believable
        - Not at all believable

   - Which statement best describes how likely you are to advocate for the adoption and use of smart building solution in your organization?
     - Definitely would adopt
     - Probably would adopt
     - Might adopt
     - Probably would not adopt
     - Definitely would not adopt

   - Below you will see three available smart building solution packages with prices. Which of the following packages are you are most likely to purchase? Please select "forgo purchase" if you do not wish to adopt a service package.[1]

[1] This question was used in the discrete choice scenario section of the questionnaire. Therefore, the respondent answered this question seven times as the prices of the packages changed. The analysis of the responses looked at the total number times out of seven that the respondent made a purchase. Respondents who purchased in all seven scenarios were coded as "definitely purchase". All remaining respondents were coded as "potentially purchase".

1. Full Suite Package @ $X
2. Bundle Package @ $X
3. Build Your Own Package @ $X
4. Forgo Purchase (Do not adopt)

2. The researcher then generated "If…Then" statements to count the number of times a hypothesis was successful in the quantitative data i.e. the number of respondents who demonstrated need and trust drivers and a high likelihood to adopt both before and after prices. For example:

    a. "If…Then" Statement to test H1:
        i. ***"If definitely would fulfill a need AND Definitely Adopt THEN GOAL"***
    b. "If…Then" Statement to test H2:
        i. ***"If definitely would fulfill a need AND very believable AND definitely would adopt THEN GOAL"***
    c. "If…Then" Statement to test H3:
        i. ***"If definitely would fulfill a need AND very believable AND definitely would adopt AND purchased (full suite package or bundle or build your own) THEN GOAL."***

The hypotheses were validated by the number of quantitative responses that adhered to this "if…then" logic statement.

3. If the majority of respondents[2] followed the "if…then" statement, the hypothesis was seen as valid. The validation of the hypotheses means that the criteria do in fact impact the customer's decision process.

Hyper Research software was used to conduct the EDTM process outlined above. Hyper Research is an analysis tool that enables a researcher to retrieve and code qualitative data and build theories based on the information. The steps for using Hyper Research are outlined in Appendix 3.

Overall, EDTM improves on traditional quantitative models as it considers customers decisions from a holistic perspective (Gladwin, 1989). EDTM is based on the notion that people make decisions based on a

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[2] Traditional EDTMs can have an error rate up to 15-20% (Gladwin, 1989)

relative comparison of alternatives as opposed to ranking or coming up with separate utilities. Gladwin argues that "no one assigns weights to several variables and then adds them up to determine which of several outcomes is better; people compare alternatives one dimension at a time" (1989). The strength of this approach also lies in the fact that it is empirically grounded through a test against customer choice data. This process tests the model's ability to predict the customer's decisions. Past quantitative models (linear programming models, expected value and expected utility models) were not tested against choice data and instead served to inform people of how they should make decisions (Gladwin, 1989).

### *4.3 Data Sources*

Qualitative and quantitative data were used to identify adoption drivers and develop an appropriate decision model. The data was acquired during two research studies conducted by Pricing Solutions Ltd. (PSL), a pricing strategy consultancy. The data sets were the result of two separate studies on building efficiency smart services in North America that were completed from November 2010 – December 2011. Qualitative respondents were recruited from the client's customer database. Quantitative respondents were recruited via a B2B and B2C panel provider.

The data was collected from individuals in government, healthcare, and commercial sectors in North America. Respondents from these sectors were further categorized into high, medium, and low complexity building types. PSL recruited samples of three professional types within each of these sectors: Facility Managers, IT Managers, and Strategic Leaders. Respondents from each of these professional types were selected because they were identified as responsible for the decision to adopt smart services in his or her organization. The role of each respondent in the decision making process was confirmed during the screening process. Each respondent was asked:

> "Which of the following best describes your involvement in your organization's decision to adopt the smart building solution 1.0?"
>
> - Sole decision maker
> - Part of a committee or group that makes a decision

- Provides guidance or feedback on a decision
- None of the above

Respondents who answered “none of the above” were excluded from the study.

Overall, the data sets were comprised of 14 semi-structured interview participants and 575 survey respondents. This sample size was selected as it allowed for proper representation of individuals from all building types, building complexities, and professional roles. The quantitative sample included at least three individuals from each segmentation background (i.e. three IT managers from a high complexity commercial building; three facility managers from a medium complexity healthcare facility, etc.). The inclusion of at least three individuals from each categorization allowed for data triangulation. The only segmentations excluded from the sample were K-12 Schools with high complexity and Colleges/Universities with low complexity. The absence of these segments was due to the fact that building types of these sizes are atypical. The exclusion of these segments, however, did not affect the data results as the distribution of building types and sizes reflects the natural distribution of these segments in North America. The breakdown of the respondent profile is provided in Table 6.

**Table 6: Respondent Profile for Questionnaire**

| TYPE OF BUILDING: | PROFESSIONAL TYPES | | | |
|---|---|---|---|---|
| | FACILITY MANAGER N= | IT N= | STRATEGIC LEADER N= | TOTAL N= |
| K-12 SCHOOL | 36 | 13 | 20 | 69 |
| COLLEGE/UNIVERSITY | 22 | 24 | 11 | 57 |
| HEALTHCARE | 34 | 29 | 46 | 109 |
| COMMERCIAL BUILDINGS | 50 | 56 | 44 | 150 |
| CORPORATE CAMPUS | 27 | 44 | 31 | 100 |
| GOVERNMENT | 26 | 20 | 44 | 90 |
| TOTAL | 195 | 186 | 196 | 575 |

# 5 FINDINGS

The data analysis identified that smart service adoption is typically dependent on several factors that drive a customers' perception that they need and trust smart services. The value drivers underlying a customer's need for smart services are the size of the building; pre-existing Building Automation Systems; the age of the building, building owner control of the building, and the level of training that a customer would require. The value drivers underlying a customer's trust in smart services are a belief that the services will deliver energy reductions; be able to optimize operations; and be able to improve asset management. Customers who exhibit these factors demonstrate lower price sensitivity and greater adoption patterns. Vendors who are able to address these value drivers will be better able to lower target customers' price sensitivity and increase adoption rates. The results were validated through the second hypothesis testing phase of the EDTM process (Figure 4). The results validate that the customers with specific need and trust drivers are less sensitive to price as they are more likely to adopt both before and after receiving price information.

These findings will be explained in greater detail below. It should be noted that the complete decision model to describe smart service adoption is intricate. As such, the model will be presented in two parts to clearly illustrate the role of each adoption factor. A general matrix describing the value drivers for smart services is provided in Figure 5.

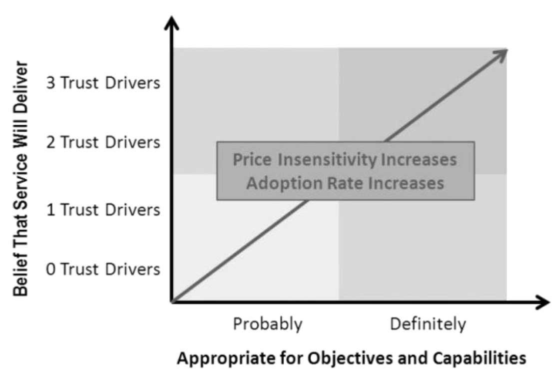


**Figure 5: General Model of Smart Service Value Drivers**

It is also important to note at the outset that these factors did not vary significantly between business and professional types. Any observed variances were minor and did not prove to be statistically significant.

### *5.1 Customers' Need Drivers*

#### *H1: Customers with the appropriate building capabilities and organization objectives for smart services will be likely to adopt*

Customers' needs were identified as key drivers behind the decision to purchase smart services. The qualitative interviews uncovered that respondents were likely to demonstrate a purchase interest if they felt that the services would address existing issues in their organization. For example, after reviewing the service capabilities, an IT Consultant commented that "*a company would have to see what the system can do that currently is not being done and then calculate whether it is worth the investment. Can they save energy; can the system deliver automated services currently not getting done by maintenance staff?"*

Customers' perceived need for the services was based on an evaluation of their organization's current operating capacity. Two general themes emerged from this need assessment. The first theme centered on a whether a respondent felt the services were suitable for his or her organization. Customers were unlikely to adopt if they had a building automation system currently in place or if they felt their building was too small to warrant the system. Organizations with an automated building efficiency currently in place felt unlikely to require additional assistance with their building's operations. Further, organizations with a small building space felt better able to oversee and control operations through human activity. This effective hands-on control limits the need for human-technology co-agency, which is the interplay between human and technology activity (Hollnagel and Woods, 2005).

The second theme within the need assessment centered on the system's implementation process. Respondents were less likely to perceive a need for the services if they felt that implementing the supporting system would be difficult. Three main circumstances were identified that would affect effective system implementation. Respondents were less likely to adopt the services if they had older buildings that would require retrofitting; if they were building owners and their individual tenants were responsible for controlling utilities; or if they perceived that training and educating users would be difficult. Conversely, qualitative respondents who felt the services would address a problem identified nine objectives that could be solved by using smart building services. The objectives are outlined in Table 7.

**Table 7: Customers' Needs Addressed by Smart Services**

| NEED ADDRESSED BY SMART SERVICES |
|---|
| Reducing Energy Cost |
| Increasing Control of Building(s) |
| Improving Machine Reliability |
| Increasing Security |
| Reducing Operating Costs |
| Greater Integration of Buildings |
| Improving Tracking and Reporting |
| Remote Monitoring |
| Improving Scheduling and Organization |

The importance of these nine identified objectives was tested and validated using the quantitative survey results. The quantitative study asked respondents who identified that the services would "definitely fulfill a need" (N=226) to describe the needs that would be addressed by adopting this system. An analysis of these responses identified that reductions in energy consumption and cost are the foremost important needs being addressed by these services. Overall, 43% of the "definitely need" segment were most interested in services that would help them to achieve their goal to reduce overall utility consumption and spend. The interest in energy reducing services was followed by a need for services that help users to increase their control over their building facilities (30%); increase security measures (17%); improve machine reliability (17%); and reduce overall operating costs (15%). The respondents were less likely to express a need for services that improve scheduling and organization (3%) and provide remote monitoring (7%). Chart 1 illustrates the prevalence for all specified needs.

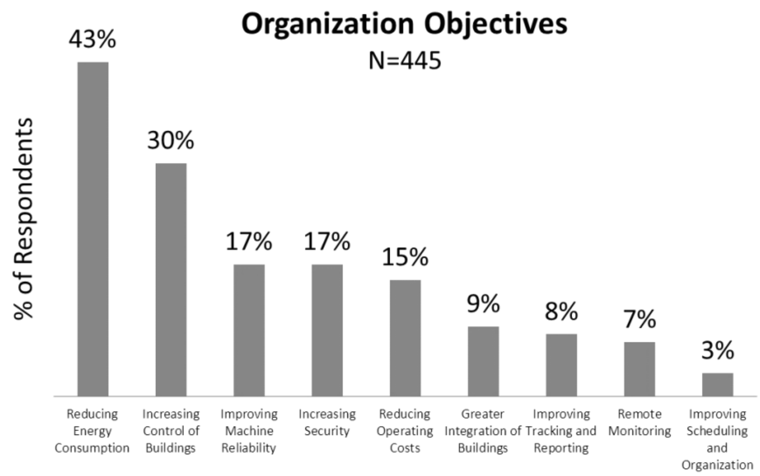


**Chart 1: Significance of Objectives**

The quantitative results confirm that respondents with appropriate objectives and capabilities for smart services were more likely to consistently adopt the services both before and after seeing prices (Figure 6). Before seeing prices, respondents who identified that the services "definitely fulfilled a need" were the most likely (76%) to adopt smart services. This adoption rate is compared with "probably fulfill a need" at 20% and "might fulfill a need" at 1%. After receiving price information, respondents who identified that the services "definitely fulfilled a need" purchased the system 78% of the time. This figure is compared to those who felt the services "probably" or "might" fulfill a need at 56% and 26%, respectively. The breakdown of pre-price adoption and post-price purchase rates are illustrated in Figure 6.

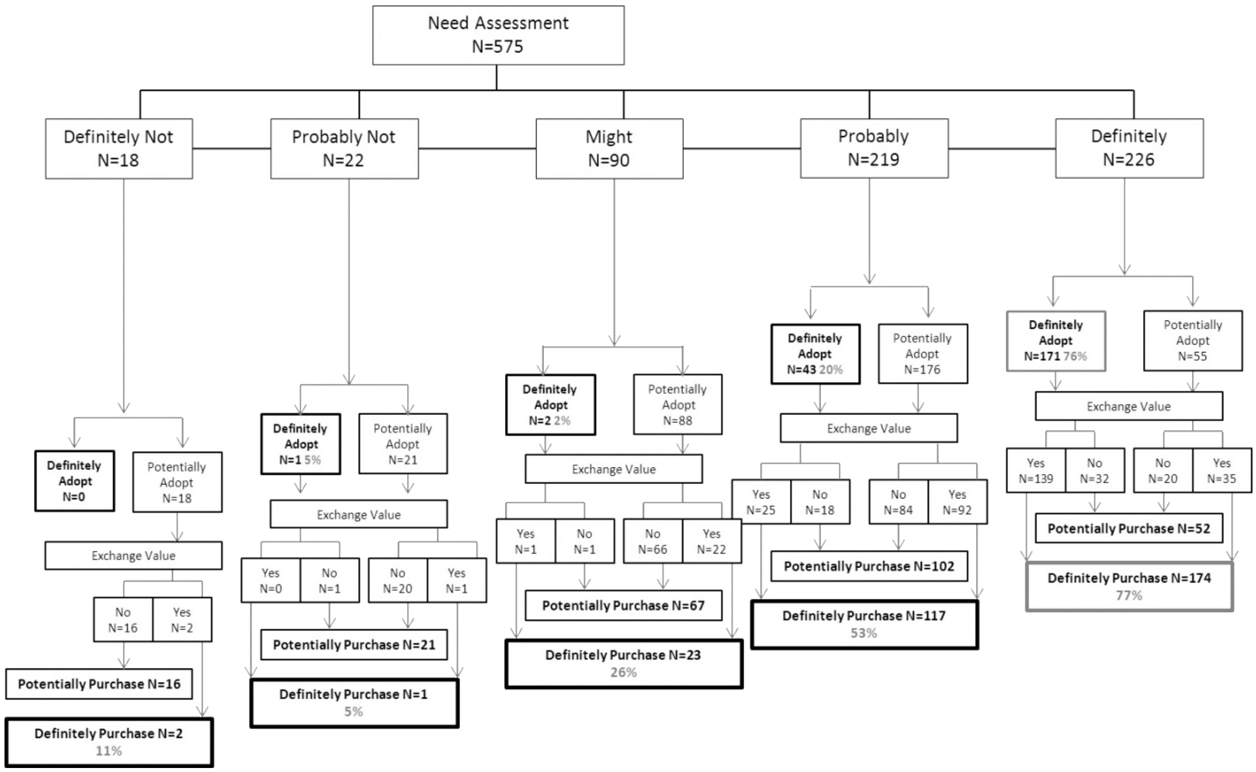


**Figure 6: Decision Model Part A: Adoption by Need Segment**

Overall, the qualitative and quantitative findings highlight the important role that need drivers play in smart service adoption. A customer's need perception will be based on whether the services are appropriate for their organization's capabilities and if the customer is seeking ways to reduce energy costs or increase their control over their facilities. The respondents who identified these key need drivers were more likely to adopt smart services.

These results are further clarified in Table 8 which provides the results of a T Test of customer need by adopter vs. non-adopter segments. Table 8 demonstrates that adopters have greater need for smart services (1.22) than non-adopters (2.36) [where 1=definitely need and 5=definitely do not need]. The difference between these groups is statistically significant at the 99% confidence interval. These results are further emphasized in Table 9 which provides the descriptive statistics for customers' needs by adoption segment. Customers in the definitely adopt segment demonstrate higher mean score for need (1.22) than all other segments [probably (1.95), Might (2.83), Probably Would Not (3.71), and Definitely

Would Not (4.23)]. The low standard deviation of the definitely adopt segment indicates that these results do not vary significantly between customers in this segment.

**Table 8: Customers' Level of Need by Adopter vs. Non Adopter Segments (T Test)**

| Level of Need by Adopter/Non-Adopter | | | | |
|---|---|---|---|---|
| **Adoption Coded** | **N** | **Mean** | **Std. Dev** | **Std. Error Mean** |
| **Adopters** | 216 | 1.22 | .459 | .031 |
| **Non Adopters** | 359 | 2.36 | .979 | .052 |

**Table 9: Customers' Level of Need by Adoption Segment (Descriptive Statistics)**

| Level of Need by Adoption Segment | | | |
|---|---|---|---|
| **Adoption Segment** | **N** | **Mean** | **Std. Dev** |
| Definitely Would Adopt | 216 | 1.22 | 0.46 |
| Probably Would Adopt | 229 | 1.95 | 0.63 |
| Might Adopt | 100 | 2.83 | 0.91 |
| Probably Would Not Adopt | 17 | 3.71 | 0.85 |
| Definitely Would Not Adopt | 13 | 4.23 | 1.36 |

### *5.2 Customers' Trust Drivers*

***H2: Customers who demonstrate H1 plus a believability that smart services will deliver on energy savings; optimizing operations; and asset management will be likely to adopt***

The analysis results also identified that issues surrounding customers' trust in smart services were impacting their likelihood to adopt. Trust is defined in this study as the believability that a service will actually deliver its intended benefits. This finding expands on the first concept of need by suggesting that customers who have specified needs for the services also require assurance that the services would be able to satisfy their proposed objectives before they will pursue adoption.

The role of trust on adoption decisions was first identified in the qualitative interview responses. When asked about willingness to adopt smart building services, one respondent answered, *"(yes) assuming we determined that the system is robust. Would I be able to see it in action elsewhere first?*

*Could I speak to other people who have used it?  If I could, then this is my answer: Certain."* Trust was further identified as a factor in smart service adoption through an analysis of qualitative respondents' answers to the question "what concerns, if any, do you have about the Smart Building Solution?" Customers' trust in smart services is comprised of three main drivers: a belief in energy reduction; a belief in optimizing operations; a belief in improving asset management.

The first theme was skepticism that the services would actually reduce energy consumption and cost.  For example, one participant responded that *"(it is) only when it's installed and you can prove that they will save $X /sf over the course of your lease that people will look at it more seriously".* Respondents felt that it was difficult to prove this benefit primarily due to fluctuating weather patterns.

The second trust theme was uncertainty about the services' ability to optimize operations.  This uncertainty stemmed from customers' awareness of the system failures that are typically associated with technology products.  For example, one responded argued, *"This solution depends on technology like computers. Computers inherently screw up. This type of automated control goes haywire it can drag so many other systems down. One system affects another, too risky".* Another respondent commented, *"How could your sensors be defeated? Is it wireless? Could I go in there and blind those sensors, how would they react if they were blinded? If the sensors are blinded, what happens to the overall system?"*

The third trust theme involved the ability of the system to improve asset management. Respondents voiced disbelief over services that could detect and troubleshoot equipment faults.  Several respondents felt uncertain that these services would eliminate the need for human oversight and management of equipment.  This theme is exemplified in the following response: *"it looks a little Utopian, like there is no human interaction needed and I would be a little skeptical about it. Like you don't need a property manager on site to trouble-shoot? Some of it seems like a stretch."*

Quantitative data responses were used to validate the role of these three trust issues in the adoption decisions for smart services.   The analysis focused on how respondents answered the questions, “to what extent do you believe that the services will deliver on energy savings/optimizing operations/improving asset management”. The quantitative analysis focused primarily on the answers of respondents who felt the services would definitely fulfill a need (N=226). This segmentation stabilized the role of need in the decision process so that the impact of trust alone could be observed. Respondents were classified into four trust levels: high (believe the services will deliver all three objectives); moderate (believe the services will deliver two of the three objectives); low (believe the services will deliver one objective); and absent (do not believe the services will deliver any of the objectives) (Appendix 7).

The quantitative data results demonstrate that the customers who felt smart services would deliver on all three trust driver were more likely to adopt (Figure 7). Within the high need segment, adoption rates declined significantly as customers’ trust weakened. The data showed that respondents with high need and a belief that smart services would deliver on all three trust drivers were more likely to adopt (87%) before seeing prices than all other trust levels. The data also showed that customers’ adoption rates before they receive price information decline with each subsequent trust level (Moderate, 61%; Low, 48%; Absent, 42%) (Figure 7). This observed decline held consistent in customer adoption rates after receiving price information (High Trust, 81%; Moderate Trust, 66%; Low Trust 48%; Absent Trust, 50%) (Figure 7).

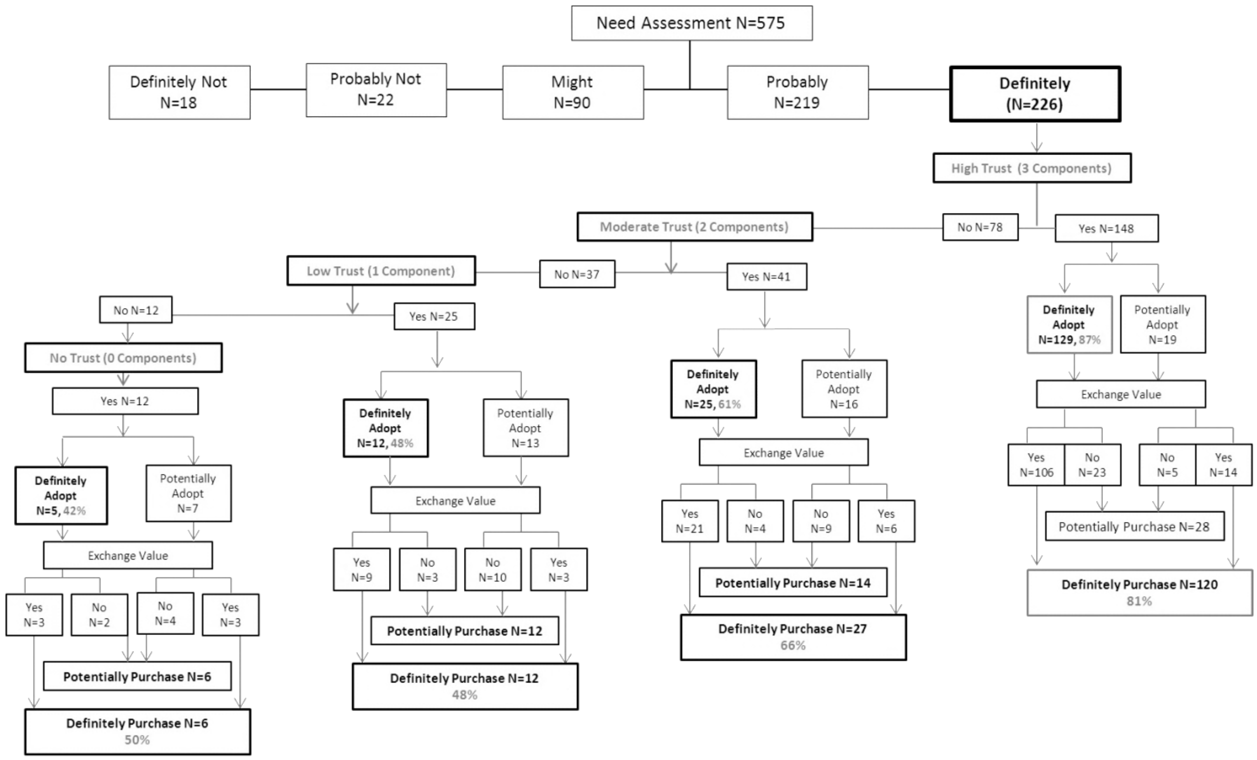


**Figure 7: Decision Model Part B - Smart Service Adoption by Need/Trust Segment**

The results indicate that customers who believe that smart services will deliver on all three trust drivers are primarily responsible for driving the overall rate of adoption for the high need segment. Table 10 further clarifies these finding by outlining the results of a T Test of customers' level of trust by adopter vs. non-adopter segments. Table 10 demonstrates that adopters are more likely to believe that smart services will deliver on all three objectives (2.5) than non-adopters (1.22) [where 3=high trust and 0=absent]. The difference between these groups is statistically significant at the 99% confidence interval. These results are further emphasized in Table 11 which provides the descriptive statistics for customers' trust by adoption segment. Customers in the definitely adopt segment demonstrate higher mean score for trust (2.5) than all other segments [Probably (1.54), Might (0.74), Probably Would Not (0.29), and Definitely Would Not (0.49)]. The low standard deviation of the definitely adopt segment indicates that these results do not vary significantly between customers in this segment.

**Table 10: Customers' Level of Trust by Adopter vs. Non Adopter Segments (T Test)**

| Level of Trust by Adopters vs. Non-Adopters | | | | |
|---|---|---|---|---|
| **Adoption Coded** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| **Adopters** | 216 | 2.50 | .846 | .058 |
| **Non-Adopters** | 359 | 1.22 | 1.179 | .062 |

**Table 11: Customers' Level of Trust by Adoption Segment (Descriptive Statistics)**

| Level of Trust by Adoption Segment | | | |
|---|---|---|---|
| **Adoption Segment** | **N** | **Mean** | **SD** |
| Definitely Would Adopt | 216 | 2.50 | 0.85 |
| Probably Would Adopt | 229 | 1.54 | 1.13 |
| Might Adopt | 100 | 0.74 | 1.08 |
| Probably Would Not Adopt | 17 | 0.29 | 0.85 |
| Definitely Would Not Adopt | 13 | 0.46 | 0.97 |

### *5.3 The Impact of Need and Trust Drivers on Price Sensitivity*

***H3: Customers with H1 and H2 will be less sensitive to smart service price and more likely to adopt than customers that do not demonstrate H1 and H2***

The above findings demonstrate that a customer's value perception for smart services is determined by the presence of several need and trust drivers for smart services. Customers who perceive that the services will be appropriate for their facilities; meet their organizations' objectives; and will deliver on the intended objectives demonstrate higher adoption likelihood. The results, however, only address a customer's use value. Use value is "a phenomenological experience perceived by a customer interacting with product/service bundles in a use situation" (Chen et al., 2010). As such, the relationship between customers' value drivers and adoption must be considered with pricing information as well. Adoption rates under prices are referred to as a customer's 'exchange value'. Exchange Value is a customers' willingness to pay. When making a purchase decision, customers evaluate their willingness to pay against the price of the product (Kahneman and Tversky, 1979; Thaler 1985). A customer perceives adopting the service as a gain in instances where the service price matches or is lower than his or her willingness to pay. Conversely, customers view a loss if the offering is priced above his or her willingness to pay.

Customers who have more prominent need and trust factors have higher perceived value which will result in a higher willingness to pay and lower sensitivity to price. These customers demonstrate higher adoption rates after receiving price information. Respondents who felt the services "definitely fulfilled a need" are more likely to be insensitive[3] to price (62%) than any other need segment (Figure 8). This 62% adopted the services before seeing prices and sustained their purchase likelihood after receiving price information. This insensitivity towards pricing decreases as customers' need value is reduced (Probably, 11%; Might, 1%; Probably Not, 0%; Definitely Not 0%). These results are further demonstrated within the trust segments. Customers with higher trust are more insensitive (71%) to actual service prices than all other trust segments (Moderate, 51%; Low, 38%; Absent, 25%) (Figure 9).

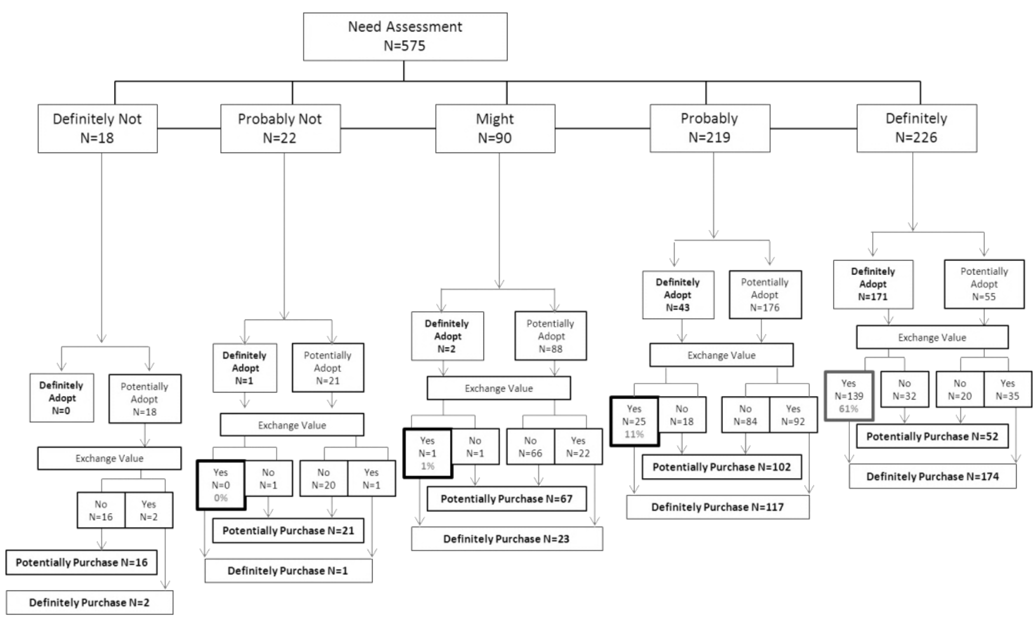


**Figure 8: Price Insensitivity by Need Drivers**

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[3] Insensitive customers are those who said they would "definitely adopt" before prices and continued to purchase smart services in all scenarios at tested prices

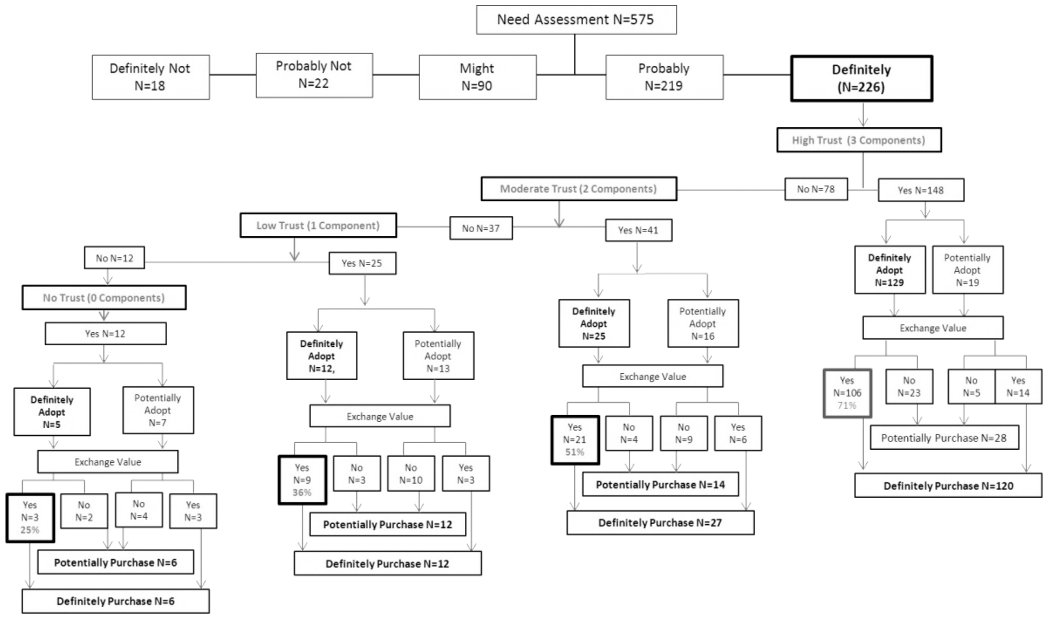



**Figure 9: Price Insensitivity by Trust Drivers**

The relationship between value and price sensitivity is further demonstrated by customers' sales package adoption between trust segments. The quantitative data demonstrates that a customer's level of trust impacts their willingness to pay which determines the package size (number of applications) that he or she purchases. Respondents were presented with three possible sales packages: A full suite, a bundle, and a customized package. A full suite of applications is double the price of bundle package and triple the price of a custom set of applications. High trust customers who definitely adopt the service are more likely (61%) to buy a full suite of applications and spend more in one transaction than all other trust segments (compared with moderate trust, 37%; low trust, 36%; absent trust, 33%). These observations are supported by a study by Lichtenstein et al. (1988) which found that "when customers view the product as being highly relevant, they (are) more concerned with the product attributes relative to its price, and thus should have higher levels of acceptability."

The above discussion of the findings is best summarized using the decision matrix first presented in Figure 5. The populated matrix (Figure 10 and 11) demonstrates that the customers' with greater need drivers (appropriate building capabilities; organizational objectives) and trust drivers (belief in the services' ability to deliver energy savings; optimize operations; and improve asset management) demonstrate higher adoption rates both before and after prices. Figure 12 shows that these segments are also less sensitive to price as a higher percentage (72%) say they will "definitely adopt" before prices and maintain their purchase likelihood after prices.

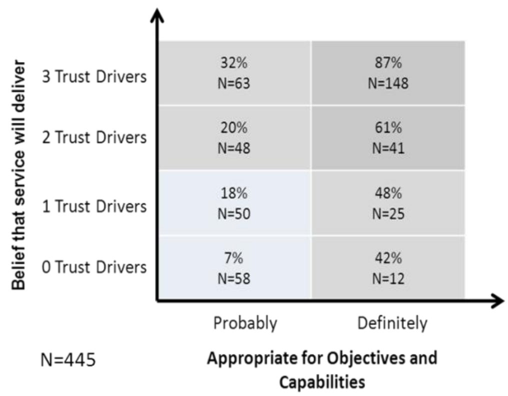



**Figure 10: Adoption Rates by Value Segments Before Prices**

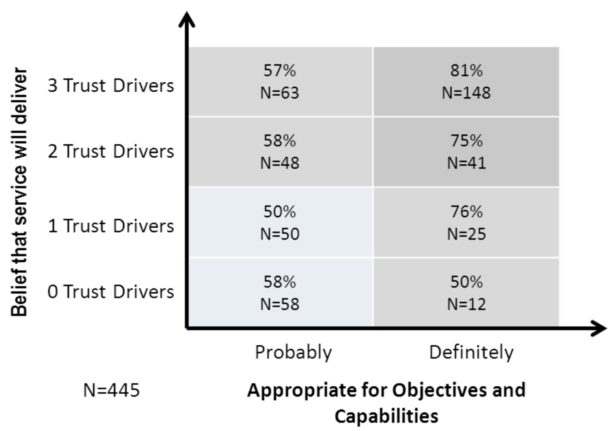



**Figure 11: Adoption Rates by Value Segments After Prices**

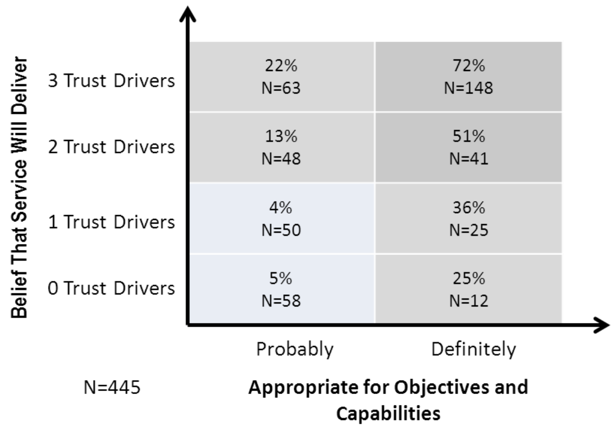



**Figure 12: Price Insensitivity by Value Segment**
(% Claim Definitely Adopt Before Prices and Maintain Purchase Likelihood with Prices)

# 6 DISCUSSION, RECOMMENDATIONS AND FUTURE RESEARCH

## *6.1 Discussion*

The above findings identify that customers engage in a decision process that is driven by several need and trust factors. Customer adoption rates have proven to be the highest amongst individuals who perceive the services to be appropriate for their organization. Smart services are valued by a customer when they are suitable for the size of the building or organization; improve upon existing automated services; and when customers perceive that the offerings will be easy to implement. Value is further driven by an organization's aim to reduce energy consumption and increase overall building control. This value is further strengthened by several trust factors. Customers are more likely to value a service if they believe that it will deliver the intended results. Specifically, customers have high value for smart services when they believe that the services will deliver energy savings, optimize their operations, and improve asset management. The results demonstrated that customers' trust in a service is dependent on their level of familiarity and comfort with the automated service offerings.

The presence of these need and trust factors result in high customer value for the service offerings. This value increases customers' willingness to pay and decreases their price sensitivity (Figure 6 and 7). Customers' with high value and low price sensitivity are likely to adopt smart services.

These results have implications for the field of Service Science research. The findings create an understanding that value propositions for smart services should focus on addressing customers' building capabilities and increasing customers' familiarity with the offering. The value propositions should suggest that a service is appropriate for an organization's size; improves on current decision making processes; and aligns with the organization's objectives. These propositions should also enforce the believability that the services will deliver the intended results and their reliability. The customers who accept these value propositions will have a higher willingness to pay and lower price sensitivity which will encourage them to adopt the service offering.

### *6.2 Recommendations*

These results have significant implications for smart service vendors. The relationship between these value drivers suggests that service vendors should devise strategies to maximize the applicability and reliability of their offerings to potential customers. In expanding their value propositions, vendors will help drive customers' value in use which will diminish customer price sensitivity and drive overall adoption. The following will outline recommended strategies to drive value.

***Objective One → Support the wide applicability of smart services to maximize customers' perception of need***

In order to drive adoption, service vendors will first need to convince prospective customers that the services are appropriate for their organization's size and current operating capabilities. Customers will demonstrate a higher willingness to purchase if they perceive that the service offerings will benefit their organization.

| ***RECOMMENDATION ONE:***<br>***Create versioned service packages that suit a range of building sizes and capacity levels*** |
|---|

The data results demonstrated that customers were unlikely to see a need for the services if he or she belonged to a small organization. As such, it is recommended that service vendors tailor their service offerings and packages to suit a wide range of building sizes in order to maximize transactions. It is advised that service vendors use a versioning technique when designing their sales packages to maximize the applicability of the offering. Versioning occurs when a vendor offers a product or service in different configurations for different market segments (Shapiro and Varian, 1999).

In this context, the product packages would vary based on the number of available services and their overall comprehensiveness. The full suite offering should be maintained as it was highly appealing to customers who perceived the services as highly valuable (61% of high need/trust customers purchased a full suite). The value of a full suite is exemplified in the following respondent insight, *"(the services) would all be valuable to different people within my organization. My building infrastructure wouldn't pick the same applications that I did, he would pick others that are more important to him…But still, all these apps are obviously appealing."*

It is also advised to decompose the full suite and bundles into individual applications. This version makes the system seem less overwhelming and more applicable to smaller organizations. The need for a smaller version is exemplified in feedback from one qualitative respondent. When asked to describe what he disliked about the building services, the respondent answered, *"they (service providers) have to give me the option to buy one package at a time and to be able to expand it one at a time. I may like everything they have, but I don't want to be obliged to buy it as a package. It should be a piece-by-piece offering. This is the best and in fact, only way to sell this product."*

Vendors should ensure that they include energy saving and fault detection applications in the individual service packages. The energy saving application is important as the need to control energy consumption and cost was commonly cited objective of potential service customers (Chart 1). Fault detection applications may also prove to be successful amongst small business customers. These detection applications have the ability to uncover minute problems before they can be detected by human managers. As such, the services will provide use even in small organizations regardless of their high level of managerial oversight.

### *RECOMMENDATION TWO:*
### *Differentiate OEM Services from Building Automation Systems*

Survey respondents expressed hesitation in adopting smart services if they had an existing Building Automation System (BAS) in place. In order to overcome this objection, smart service vendors will need to promote the improvements that their offerings provide over existing building automation systems. Existing

BAS' are typically provided by technology firms that are independent of the building equipment's OEM. The separation of these software providers from the actual equipment means that they are more limited than OEMs with respect to the service offerings that they can provide. For example, software vendors would be unable to provide automatic maintenance services and would metered data for tracking and reporting services (Allmendinger, 2008).

An OEM's (i.e. the case organization) enhanced capabilities provide them with a competitive advantage as they can offer customers a total solution that integrates the machines with the services. Glen Allemendinger argues "the OEM remains in the catbird seat because it possesses the field intelligence upon which others will base their offering" (2008). The advantage of OEM services was highlighted by several respondents. One commented, *"I like the fact, that this is an integrated system. It has always been an issue in the past when we have to work with different service providers".* Another respondent answered that, *"there are energy management systems, but they are basically web managed programs that property managers can access remotely. But this system seems different- it is more comprehensive, like the way it calculates and controls managing energy during peak periods. It figures out when to ramp up cheap electricity and to somehow store it or get the building cooled before it becomes too expensive. It also troubleshoots automatically."* These insights reinforce that promoting these services as a differentiated offering will help encourage target customers with limited existing Building Automation Systems to upgrade.

### *RECOMMENDATION THREE:*
### *Develop strong training and education programs*

The qualitative analysis identified that customers need to feel capable of implementing and operating smart services before they will commit to adoption. One key mechanism for promoting ease of use is for the service vendor to provide extensive training and education programs. Respondents have identified that training is a key consideration when making an adoption decision for these services. One respondent exemplifies this requirement in the response, "t*raining will be huge on this software. You need someone there who has the knowledge. You will be frequently changing things, so training is 95% of the ballgame."*

The importance of training and education is supported in the research on IS adoption. A study by Michael Gallivan (2001) on the assimilation of complex technological innovations found that company-sponsored training; resource support; hiring new employees; or hiring consultants experienced with the technology to serve as mentors impacted the use of new technologies in organizations. The successful implementation of a new technological innovation by the case organization in Gallivan's study was primarily attributed to the strong training and education programs that were employed. This study suggests that smart service users will be more likely to engage with the overall system if they are provided with highly comprehensive education support.

***Objective Two → Increase customer familiarity with smart services to drive perceptions of reliability and trust***

The decision model identified that customers who believe that smart services will deliver energy savings; optimize operations; and improve asset management are more likely to adopt. As such, smart service vendors must work to maximize customers' believability in the services and overall system. In maximizing these three trust drivers, smart service vendors will be able to drive transactions and average sales figures.

| ***RECOMMENDATION FOUR:***<br>***Implement a relationship building process with potential clients*** |
|---|

The need for relationship building is based on the argument that customers' reliance on a product or service can be directly influenced by their trust in the provider (Boyle et al, 2011). The study data also demonstrated the importance of the client-vendor relationship. One interview respondent commented, *"Who will my contact be; will they communicate easily and efficiently with me? A trial offer would be very intriguing to me – it means the company is confident about their product. Other information like white* *papers might be interesting, but I really want to speak to someone knowledgeable and see what the system can do for us."*

Traditional relationship building processes have centered on one-way communication strategies. These strategies create relationships based on information that the vendor supplies to the customer regarding their brand quality. Vendors use size, reputation, sales force, and the physical attributes of their store as brand signals (Andreou et al, 2001). Contemporary relationship building, however, needs to be a more interactive process that centers on understanding and adapting to customer feedback. By engaging in this process, vendors will be able modify their services offerings based on the insights that customers provide. This information exchange enables vendors to respond to customer needs therefore driving value perceptions. Davison et al (1999) support this idea when they argue that "IS specialists will need to establish and maintain relationships with the community of current and potential users in order to understand and anticipate their needs. Such a relationship will also be the basis for building up the credibility of the IS department and function and creating trust between developers and users."

**_RECOMMENDATION FIVE:_**
**_Increase potential clients' access to information on the services and their capabilities_**

The second trust initiative involves building customers' level of familiarity and comfort with the automated service offerings. Customers' level of trust and reliance on a product or service increases with experience (Boyle et al, 2011). To build initial familiarity, service vendors must provide customers with an extensive introductory process whereby they can increase their understanding of the service offerings and gain experience with the system.

Smart service vendors should start to increase target customers' familiarity by developing and disseminating information resources. Vendors can use advertising and linkages to other websites to increase customer awareness (Gefen et al, 2003). One respondent emphasized the importance of this information by responding, *"(I would like to see) industry papers, white papers, and writing online. I'd like to see information in social networking groups that I belong to."*

Study respondents also identified that gaining access to customer references and testimonials would also help increase their confidence in the vendor and the service offerings. Respondent commentaries highlighted the importance of case examples. One interview participant commented, *"If you could put some information about testing the product it would be better. It would be good to hear from someone who has actually used the system."* Another respondent commented, *"Does the company have referrals to help us implement and decide on purchase? We need more actual examples of usage, less theory."*

Customers' hands-on experience with the services is also integral to building trust. In the short term, trial periods are effective mechanisms to provide customers with initial experience. This trial would help overcome respondents' hesitations to adopt the system because they have "never used it before". For example, one respondent provide the insight that "*it's good to be able to test drive it even if you have to pay a premium for that first. You don't want to get locked into something without trying it. Even a 3 month trial would be enough. You need to see how it interacts with existing systems like HVAC. Are they compatible? A product compatibility sheet might be a good idea."*

In the long term, vendors can further build trust by engaging in a "value verification" process with their customers. Value verification is a set of practices that measure and report the gains that the customer has achieved and the value that has been created (Storbacka, 2011). Vendors should provide a routine report to each customer that quantifies their experience with the services. This report would identify the cost savings achieved and any operations improvements that have been accomplished. This report will give customers solid evidence of the services' capabilities which will result in higher trust. This information will help overcome objections similar to the respondent who said, *"(it is) only when it's installed and you can* *prove that they will save $X /sf over the course of your lease that people will look at it more seriously".* Overall, the creation of long term trust will be integral for long term customer subscription and additional service purchases (Storbacka, 2010).

### *6.3 Future Research Opportunities*

The strategies and recommendations outlined above provide a foundation for further research. These strategies were developed primarily from the respondents' insights on the sales approaches that would encourage them to adopt smart services. The next step in this process will be for vendors to test these strategies as they launch smart systems. A study should be conducted to assess whether the use of these strategies did in fact result in increased adoption.

This study was conducted based on customers in the North American market. Future research should be conducted in additional global markets to determine if value perceptions for Smart services vary on a geographic basis. It may be that other geographic markets are more receptive to Smart services based on different building sizes and characteristics, different energy saving initiatives, and different familiarity with cloud-based services.

The price component of this study is an additional area for further research on smart services. There is uncertainty in the literature on smart services about their cost and value. Without this information, smart service vendors are unable to properly price their offering. As such, significant research opportunities exist to describe service costs, explain customer price reactions and prescribe appropriate pricing strategies for smart services. This paper's discussion of customers' value (need and trust) suggests that value based pricing would be an appropriate price strategy for vendors. This prescription, however, needs to be tested based on accurate production cost information and a comparison against other pricing strategies. Potential also exists for future research on appropriate revenue models for smart services. Sample research questions would be:

- *What is an appropriate pricing strategy for smart services?*
- *What is an appropriate revenue model for smart services?*

In keeping with the overarching objective of this paper, it is suggested that future research in these areas seek to understand if and how the selection of these specific price strategies or revenue models can affect customer adoption rates.

# 7 CONCLUSIONS

The insights provided in this study make a descriptive contribution to the field of Service Science research. This study effectively describes the key factors that drive customers' value of smart services and result in adoption. Customers express a need for smart services when the offering is appropriate for their building size; improves on existing decision making technology; and is easy to implement and control. It was identified that customers find services geared towards energy reduction and increased building control most valuable in their respective organizations. With respect to trust, the innovative nature of smart services can deter customers due to a lack of familiarity and comfort. Therefore, customers are more likely to value smart services if they perceive that the offerings are reliable and will deliver the intended results. These value factors influence a customer's willingness to pay. Customers with higher value, as delivered through the above factors, will have a higher willingness to pay which will lead to a higher adoption likelihood.

This study uses these descriptions to prescribe several sales and marketing strategies for smart service vendors. In implementing a more comprehensive, tailored marketing and sales approach, vendors have the opportunity to address a wider range of customer capabilities and increase target customers' familiarity with smart services. Increasing the applicability and reliability of smart services for target customers will help to further drive customer value resulting in higher adoption levels.

This study, however, does have some limitations. In uncovering the importance of trust in this study, I would have included additional questions in the quantitative portions of the survey to better understand and validate customers' trust perceptions. Specifically, I would want to gain greater insight on what factors drive trust. This information could have been collected using a single open-ended question that asks all respondents "what factors impact your belief that the services will deliver on their objectives?"

The quantitative responses could have been used to validate the qualitative interview insights on why customers do not trust the services.

In identifying the relationship between need and trust, I would have re-worded the questions on customer need to focus specifically on the need construct and remove any implication of trust. The question was written as “which statement best describes how well Smart Building Solution would fulfill a need or solve a problem in your organization”? The wording of this question could have been problematic as it includes two constructs: need fulfillment and the ability to solve a problem. Including the ability to solve a problem brings an implication of trust into the measurement of need. In order for a customer to feel that a service will solve a problem, they have to believe that it will work. I would have reworded to only include the “ability to fulfill a need” construct. Removing the “ability to solve a problem” construct would have eliminated any implications of trust in the question. I also would have included questions on the respondent’s building metrics and sustainability goals and initiatives. These metrics would have given more explicit validation to the hypotheses that were being tested in the deductive portion of the study.

Overall, this study successfully provides smart service vendors with description of key value drivers for smart services and a set of recommendations to further address these value factors. Vendors who tailor their sales approach towards these factors will increase customers’ use and exchange value. This increased value will reduce customers’ price sensitivity leading to higher adoption rates. Therefore, the smart service vendors who promote the applicability and reliability of smart service will be best able to successfully innovate and experience growth.

# 8 APPENDIX

## Appendix 1: Sample Purchase Scenario Screen

| | SMART BUILDING SOLUTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Applications | Full Suite | | Security Bundle | | Your Own Bundle | | |
| | Application One | √ | | √ | | √ | | I would not purchase any of these options |
| | Application Two | √ | | | | | | |
| | Application Three | √ | | | | | | |
| | Application Four | √ | | | | | | |
| | Application Five | √ | | √ | | √ | | |
| | Application Six | √ | | | | | | |
| | Application Seven | √ | | | | | | |
| | Application Eight | √ | | √ | | √ | | |
| | Application Nine | √ | | | | | | |
| | Application Ten | √ | | | | | | |
| | Application Eleven | √ | | √ | | | | |
| | Application Twelve | √ | | | | | | |
| | Application Thirteen | √ | | √ | | | | |
| Purchase Methods | SaaS [Software as a Service] | ACTIVATION FEE $X MONTHLY FEE $X | o | ACTIVATION FEE $X MONTHLY FEE $X | o | ACTIVATION FEE $X MONTHLY FEE $X | o | o |
| | SaaP [Software as a Product | INSTALL FEE $X | o | INSTALL FEE $X | o | INSTALL FEE $X | o | |

## Appendix 2: Drivers of Internet-Enabled Device Revenue (The Economist, 2010)

**Appendix 3:Steps for EDTM Using Hyper Research**

***Steps for Completing the Qualitative Analysis:***

1. Each qualitative interview transcript was entered into individual notepad documents
2. Each document was uploaded into Hyper Research as a separate case
3. Every case was then analyzed to identify emerging themes or important insights on the decision making process. Each unique theme or insight was given a code.
4. The cases were then compared to determine common themes.
5. Common themes were then collapsed into one overarching category (i.e. Need, Trust, Value in Use (Pre-Price Adoption), Value in Exchange (Post-Price Adoption). These categories were then considered to be the decision making criteria.
6. Hypotheses were then created based on the identified criteria and the observed relationships between the criteria.
7. A decision model was then created to illustrate these hypotheses. The decision model is illustrated in Figure 4. The trust component of the model is only illustrated for the definitely need construct.

Hyper Research software was then used to test the validity of the decision model. An illustrative example of this process is provided in Appendices 4-6.

***Quantitative Process:***

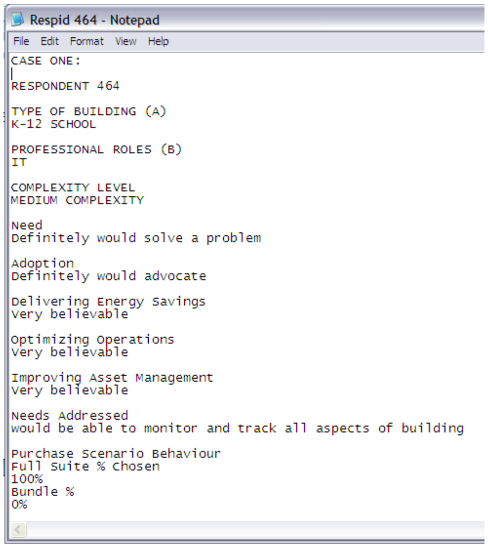
1. The survey data for each respondent was entered into individual notepad documents (Appendix 3)
2. Each document was saved as an individual case and uploaded into Hyper Research with a unique case number
3. The survey responses in each case were coded based on the constructs from the decision model (Figure 4), i.e. "definitely need", "probably need", "definitely adopt", ect. The code list is provided in Appendix 6.
    - It should be noted that respondents were coded for the trust construct based on the number of objectives that the respondent felt were believable. For example, high trust respondents said delivering energy savings, optimizing operations, and improving building asset management were all "very believable"; moderate trust

respondents said two of these three objectives were believable; low trust respondents said only one objective was believable; absent trust respondents did not find any of the objectives believable.

- It should also be noted that for the post-price adoption construct, respondents were coded as either purchasing in all seven purchase scenarios (“definitely purchase”) or not adopting in all seven scenarios (“potentially purchase”).

4. A set of if-then statements were then designed to test the hypotheses created in the qualitative process
5. The if…then statements were then entered into Hyper Research’s “Theory Builder” to test the logic and validity of the model. The list of all if…then statements is outlined in Appendix 8.
6. Hyper Research then counted the number of cases that supported each the If…Then statement. Recall from above that the larger the number of cases that support the ‘If…Then’ statement, the more valid the hypothesis.
7. These results were used to fill in the decision model.

# Appendix 4: Sample Questionnaire Responses in Notepad



Respid 464 - Notepad

File Edit Format View Help

CASE ONE:

RESPONDENT 464

TYPE OF BUILDING (A)
K-12 SCHOOL

PROFESSIONAL ROLES (B)
IT

COMPLEXITY LEVEL
MEDIUM COMPLEXITY

Need
Definitely would solve a problem

Adoption
Definitely would advocate

Delivering Energy Savings
Very believable

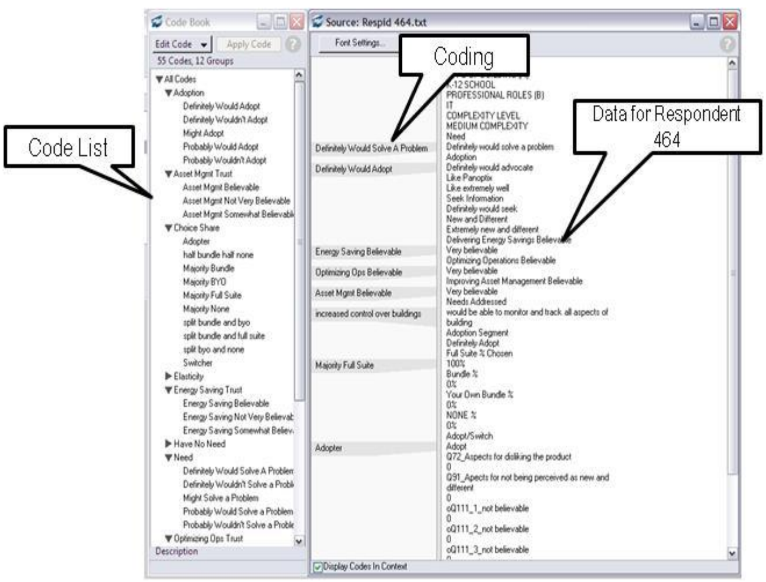
Optimizing Operations
Very believable

Improving Asset Management
Very believable

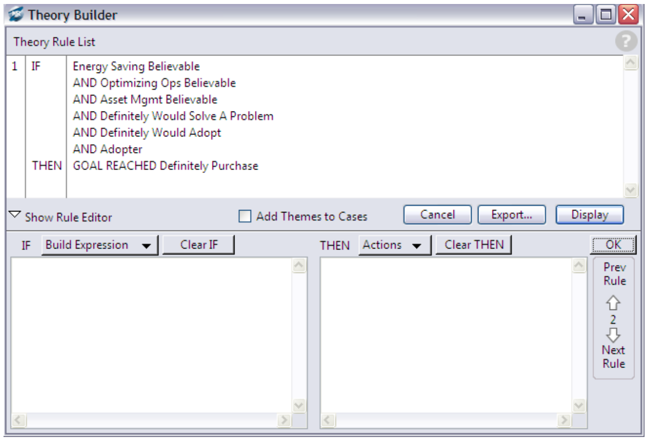
Needs Addressed
would be able to monitor and track all aspects of building

Purchase Scenario Behaviour
Full Suite % Chosen
100%
Bundle %
0%

# Appendix 5: Sample Coding of Survey Response in Hyper Research



## Appendix 6: Sample of If...Then Statement Development



## Appendix 7: Hyper Research Code List

| Construct | Decision Criteria | Question Response(s) |
|---|---|---|
| Need | Definitely Would Fulfill a Need | Definitely Would Fulfill a Need |
| | Probably Would Fulfill a Need | Probably Would Fulfill a Need |
| | Might Fulfill a Need | Might Fulfill a Need |
| | Probably Would Not Fulfill a Need | Probably Would Not Fulfill a Need |
| | Definitely Would Not Fulfill a Need | Definitely Would Not Fulfill a Need |
| Needs Addressed | N/A | Reducing Energy Cost<br>Increasing Control of Building(s)<br>Improving Machine Reliability<br>Increasing Security<br>Reducing Operating Costs<br>Greater Integration of Buildings<br>Improving Tracking and Reporting<br>Remote Monitoring<br>Improving Scheduling and Organization |
| Trust | High Trust | Energy Savings Believable<br>Improving Operations Believable<br>Improving Asset Management Believable |
| | Moderate Trust | Energy Savings Believable<br>Improving Asset Management Believable<br>(Improving Operations Somewhat Believable OR Improving Operations Not Believable) |
| | | Energy Savings Believable<br>Improving Operations Believable<br>(Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) |
| | | Improving Operations Believable<br>Improving Asset Management Believable<br>(Energy Savings Somewhat Believable OR Energy Savings Not Believable) |
| | Low Trust | Energy Savings Believable<br>(Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable)<br>(Improving Operations Somewhat Believable OR Improving Operations Not Believable) |
| | | Improving Asset Management Believable<br>(Energy Savings Somewhat Believable OR Energy Savings Not Believable)<br>(Improving Operations Somewhat Believable OR Improving Operations Not Believable) |
| | | Improving Operations Believable<br>(Energy Savings Somewhat Believable OR Energy Savings Not Believable)<br>(Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) |
| | | |

| | | |
|---|---|---|
| Value in Use (Pre-Price Adoption) | Definitely Adopt | Definitely Adopt |
| | Potentially Adopt | Probably Adopt |
| | | Might Adopt |
| | Probably Would Not Adopt | Probably Would Not Adopt |
| | Definitely Would Not Adopt | Definitely Would Not Adopt |
| Value in Exchange (Post-Price Adoption) | Definitely Purchased | Purchased All Seven Scenarios |
| | Potentially Purchased | Purchased Less Than Seven Scenarios |

## Appendix 8: If...Then Statements for Decision Model

| If… | Then… |
|---|---|
| **Recoding into Trust Segments** | |
| Energy Savings Believable AND Improving Operations Believable AND Improving Asset Management Believable | HIGH TRUST |
| Energy Savings Believable AND Improving Operations Believable AND (Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) | MODERATE TRUST |
| Energy Savings Believable AND (Improving Operations Somewhat Believable OR Improving Operations Not Believable) AND Improving Asset Management Believable | MODERATE TRUST |
| (Energy Savings Somewhat Believable OR Energy Savings Not Believable) AND Improving Operations Believable AND Improving Asset Management Believable | MODERATE TRUST |
| (Energy Savings Somewhat Believable OR Energy Savings Not Believable) AND (Improving Operations Somewhat Believable OR Improving Operations Not Believable) AND Improving Asset Management Believable | LOW TRUST |
| (Energy Savings Somewhat Believable OR Energy Savings Not Believable) AND Improving Operations Believable AND (Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) | LOW TRUST |
| Energy Savings Believable AND (Improving Operations Somewhat Believable OR Improving Operations Not Believable) AND (Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) | LOW TRUST |
| (Energy Savings Somewhat Believable OR Energy Savings Not Believable) AND (Improving Operations Somewhat Believable OR Improving Operations Not Believable) AND (Improving Asset Management Somewhat Believable OR Improving Asset Management Not Believable) | NO TRUST |
| **Decision Model Part A– Need and Adoption** | |
| Definitely Solves a Need AND Definitely Adopt | GOAL |
| Definitely Solves a Need AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Probably Solves a Need AND Definitely Adopt | GOAL |
| Probably Solves a Need AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Might Solves a Need AND Definitely Adopt | GOAL |
| Might Solves a Need AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Probably Wouldn’t Solve a Need AND Definitely Adopt | GOAL |
| Probably Wouldn’t Solve a Need AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Definitely Wouldn’t Solve a Need AND Definitely Adopt | GOAL |
| Definitely Wouldn’t Solve a Need AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| | |

| Decision Model Part B – Need/Trust and Adoption | |
|---|---|
| Definitely Solves a Need AND High Trust AND Definitely Adopt | GOAL |
| Definitely Solves a Need AND High Trust AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Definitely Solves a Need AND Moderate Trust AND Definitely Adopt | GOAL |
| Definitely Solves a Need AND Moderate Trust AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Definitely Solves a Need AND Low Trust AND Definitely Adopt | GOAL |
| Definitely Solves a Need AND Low Trust AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |
| Definitely Solves a Need AND No Trust AND Definitely Adopt | GOAL |
| Definitely Solves a Need AND No Trust AND Definitely Adopt AND Purchased All Seven Scenarios | GOAL |

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