4-26-2016

An analysis of the factors associated with adoption of electronic supply chain management (e-SCM) procurement systems within the U.S. automotive industry

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An Analysis of the Factors Associated with Adoption of Electronic Supply Chain Management (e-SCM) Procurement Systems Within the U.S. Automotive Industry

By

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Dissertation

Submitted to the College of Technology

Eastern Michigan University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

Technology

Concentration in Engineering Management

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May 26, 2016

Ypsilanti, Michigan

Dedication

To all of my family, friends, and loved ones, for those present and those who are with, and including, my Father who art in Heaven. Thank you ever so much for your love and support, all by which this journey has been made possible, for I am ever so blessed.

A special note to my son, Connor; please know that this Ph.D. earned by your Dad helps to show that ANYTHING you want to accomplish is truly possible if you stay humble, always be thankful, helpful and loving to others, and are willing to work hard enough for your goals. Use the many gifts that God gives you, knowing that we are so very blessed in so many ways. I love you always, Dad

Acknowledgments

I would like to express my sincere gratitude to Dr. McAllen, chair of my dissertation committee, for her professional support, encouragement, guidance and valuable input throughout the dissertation process.

I would also like to thank the other dissertation committee members Dr. Dugger, Dr. Bellamy, and Dr. Lee, for their valuable advice, support, and feedback throughout this process.

I am grateful to all faculty members, both present and past, at the College of Technology who have taught me throughout the Ph.D. program, both within and outside of the classroom. I am also grateful to all of the industry participants who completed my survey and made this study possible.

Abstract

The U.S. automotive industry is a vitally important industry to our nation; over 7,000,000 individuals directly rely on this industry for their livelihood (Hill, K. (2014). *Just How High-Tech is the Automotive Industry?* Ann Arbor, MI: Center for Automotive Research (CAR)). This study investigated the use of electronic supply chain management (e-SCM) system usage within this industry and its influence on work-related procurement outcomes. An electronic questionnaire was used to gather perceptions consistent with the constructs of the technology acceptance model, or "TAM" (Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems: theory and results. Published Doctoral Dissertation, Massachusetts Institute of Technology, Cambridge, MA.) It examined e-SCM systems used in the automotive industry to test whether factors such as ease of system use (EOU) and perception of organizational usefulness (PU) are factors in regarding a decision to use e-SCM systems within the procurement function of their own organizations.

The results of the survey analysis showed that the perceptions of organizational usefulness, as well as the ease of system use, are each variables affecting the final adoption of such systems within individual organizations. Further findings showed that these variables, along with other factors, including individual experience, educational level, and gender, were important in predicting work outcomes within this industry, in terms of overall results and predicting organizational decision outcomes. As such, this research offers an understanding of the factors that are critical to achieving continued innovation and corresponding industry success for organizations and individuals alike, transacting business at all supply chain levels within the U.S. automotive industry.

Further research efforts should focus on the examination of the usage of this same model and corresponding survey instrument toward other manufacturing-based U.S. industries (such as aerospace/defense or pharmaceutical/medical) as well as other countries' automotive industries, such as Germany and Japan, for generalizability perspectives.

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Chapter I–Introduction

Introduction

The purpose of this research study was to identify, within the domestic automobile manufacturer supply chain, factors associated with the decision to adopt an electronic supply chain management procurement system (e-SCM procurement system). This was completed through an electronic questionnaire administered to industry professionals through their individual organizations (via professional email addresses). The surveys used competency areas from the Technology Acceptance Model ("TAM": Davis, 1985). These competency areas include user acceptance of new technologies and factors associated with the likelihood of using such new technologies (Davis, 1985). The initial TAM concept was originated as an extension of the original Ajzen and Fishbein work with the Theory of Reasoned Action ("TRA"; Ajzen & Fishbein, 1975). The TRA model examined those factors which drive individual behavior and are driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior and subjective norms surrounding the performance of the behavior. This model was then later examined likewise by way of an Information Systems (IS) perspective (Ajzen & Fishbein, 1980).

This first chapter will focus on the problem statement, the significance of the problem, objective of the research, research questions, limitations, delimitations and assumptions of the study. Definitions used in this project are also provided. Chapter II presents the literature review of pertinent subject matter and previous applicable studies; Chapter III presents the research methodology utilized for this study. Chapter IV

provides an analysis of the research data collected via electronic survey methodology, and Chapter V provides a conclusion and implications with discussions for further research opportunities via future studies.

Background

The automotive industry in the United States is currently at a point of advanced overall volume recovery with a record-selling year of 17.5 million vehicles being sold in the United States in 2015, breaking the former record of 17.4 million vehicles in 2000 (Phillips, 2016). This volume of sales is occurring not that long after being in a state of great peril, as shown by the relatively recent United States Government loan programs awarded to General Motors Corporation and Chrysler, LLC., thereby saving each individual corporation from economic extinction (Cooley, 2011). This low-point of automotive sales within the United States was during 2009, with national sales bottoming out at 10.4 million vehicles (Ward's Auto, 2016). This up and down volume trend is in a long-standing history of an industry that has continually been marked by a boom-or-bust cyclical nature (Hill, 2014). In addition to the bankruptcy filings and reorganization of these same companies, there were also filings via others within their supply chain, including several multi-billion dollar direct suppliers of automotive components (Weddell, 2011). Looking at the financial impact of these bankruptcies and the correlated "Great Recession of 2007-2009", these and other similar events (such as other federal programs like the "Cash for Clunkers" program, which was implemented in order to try and grow U.S. automotive sales) help to show why the automotive manufacturing industry in the United States has been under heavy scrutiny, via political and economic means. Such political examination was on display in a very public

manner when Congress had each of the Big Three automotive companies' leaders testify on Capitol Hill in 2008 and 2009, prior to providing "bailout" packages in excess of $80 billion to both the General Motors Corporation and Chrysler, LLC. collectively (Hitt, 2008).

The U.S. automotive industry has continued to be in an economic decline, as witnessed by the loss of market share, share price**,** and most notably, domestic jobs as these companies have downsized dramatically in recent years. This decline has resulted in over 800,000 automotive jobs lost in the state of Michigan alone since 2000 (Vlasic, 2009). Most recently, General Motors Corporation, once the world's largest company, declared bankruptcy on June 1st, 2009 (General Motors Company [GM], 2013). According to GM's bankruptcy filing, the company had assets of $82.3 billion, and liabilities of $172.8 billion, which made GM's bankruptcy the fourth largest U.S. bankruptcy on record (Putnam, 2013).

In addition to the Original Equipment Manufacturers ("OEMs") or vehicle manufacturers, one can similarly examine suppliers within the automotive supply chain, especially those at the Tier 1 level or suppliers who sell directly to the automakers themselves. As such, Delphi Corporation, once one of the largest Tier 1 automotive suppliers, declared bankruptcy on October 8th, 2005, causing extreme negative ramifications to the over 200,000 Delphi employees worldwide (Delphi, 2015). This bankruptcy lasted over four years, similar to the previous filing by fellow direct "Tier 1" automotive supplier Federal-Mogul Corporation, a bankruptcy that lasted over six years. Each organization has since been able to resume operations as a publically traded company via the New York Stock Exchange (NYSE) or NASDAQ (NYSE; Putnam,

2013). The U.S. automotive industry has been under heavy criticism from other industries, both economically and operationally, "…due to the numerous inefficiencies and old ways of conducting business" (Bennett, 2009). The operational methodology style that was used by the U.S. automotive industry is one that is non-innovative, and is often referred to a "laggard" in regard to the innovation aspect of this industry (Rogers, 2003). As a result of corporate globalization, a trend that continues to this day, competition within the automotive industry was perhaps at its greatest point. As a result, U.S. automotive corporations continue striving to cut expenses with tools used to counter the imbalance of labor costs with various methods of cost savings both internally and externally within their supply base to the automakers. As such, in order to be cost-competitive, OEM manufacturers need to continually look for such cost-saving opportunities throughout each organization.

One of the largest cost areas for automakers is directly-purchased components from their supply base (Tracey, M., Fite, R., & Sutton, M., 2004). In 2000, several automakers (Ford, GM, DaimlerChrysler, Renault, and Nissan) worked collaboratively to address this issue and combined their efforts to form a standard electronic marketplace for the automotive supply chain, named Covisint (Comer, J., Grewal, R., & Mehta, R., 2001). As of early 2016, Covisint is still the chosen e-SCM software for procurement transactions for automotive companies such as General Motors, Ford Motor Company, Daimler AG (parent of Mercedes-Benz), Jaguar, Land Rover, Peugeot-Citroen, and Mitsubishi (Covisint, 2015). Covisint's Tier 1 automotive suppliers include: BorgWarner, Faurecia and Delphi Corporation (Covisint, 2015).

This study focused on the U.S. automotive industry, and more specifically, the

use of electronic technology within the supply chain sourcing/procurement function (e-SCM). This study analyzed the factors associated with the adoption of such e-SCM systems located within the procurement function of the automotive industry. As part of the collection of pertinent data from individual respondents, this study also provided further demographic analyses of those individuals and organizations for which such electronic procurement actions are performed in this industry.

For global competitiveness, many organizations within the automotive industry, such as General Motors Corporation, have recently used more advanced technological means in order to streamline previous processes (Dziczek, 2015). Many OEMs of automobiles, such as GM and Ford Motor Company, are moving toward final assembly processes only and pushing manufacturing of automotive parts and accessories to sub-tier suppliers (Thompson & Merchant, 2010).

Prior to the recent United States' Government's bailout actions, an aura of adverse attitudes and corresponding actions have contributed to this industry's long-term downslide (Gehm, 2007). As such, this adverse attitude as well as the resistance and/or delay to change are major factors that caused unnecessary problems within the domestic automotive industry. These are both items that many other industries have moved beyond in order to create change rapidly within their own organizations, often having large supply chain systems and a corresponding reliance on suppliers, such as Dell within the computer information industry (Ayers, 2006). Herein lies the problem: maintaining competitiveness within a global economy while being reluctant to adopt new technologies, ones that would aid in streamlining operations; this reluctance is often the case for the U.S. automotive industry (Hill, 2014).

Focusing specifically on supply chain management systems in regards to the procurement function, the automotive industry will likely to continue to shift to a more dynamic and innovative strategy, using many of the changes practiced elsewhere (Gehm, 2007). This is quite apparent when comparing the use of advanced techniques (such as e-procurement software) in the U.S. automotive industry versus other manufacturing-based industries. Examining this issue with the assistance of the TAM Model provided a theoretical framework for this study, which provided practical insight specific to the U.S. automotive industry. The Technology Acceptance Model is based on two main precepts: perceived usefulness and perceived ease-of-use. This model was originally intended to test the relative success and corresponding rationale for new end-user information technology systems within organizations (Davis, 1985). Survey research data were collected and analyzed in order to measure these constructs, a methodology that has been replicated in this study.

Problem Statement

As part of the literature review, a stringent and overall investigation of prior work on this subject matter was completed to verify the originality of this study. It was concluded that an analysis of those factors associated with whether organizations adopt electronic supply chain management (e-SCM) systems within the U.S. automotive industry and whether those organizations utilize such systems within their procurement functions of their supply base has not been adequately addressed. As such, the results of this study add to the collective body of knowledge for both the U.S. automotive industry and academia.

Nature and Significance of the Problem

With recent advances in technology and intense competition in manufacturing, there is a great need to educate and employ qualified manufacturing professionals. Due to the combination of increased automation and greater productivity, manufacturers have adopted new management techniques that require more sophisticated, qualified, and adapted workers. These manufacturing advances have led to increased skill level expectations of employees by their employers as compared to earlier eras. (Mital & Pennathur, 2004).

According to Womack (2002), lean business and manufacturing practices, along with high quality manufacturing, are the items expected to save those U.S. industries faced with intense global competition. To retain U.S. manufacturing plants, as well as the numerous jobs that are interrelated amongst the OEM automotive industry, it is absolutely critical that technological innovation and cost-competitive actions become paramount objectives within the U.S. automotive industry (Society of Manufacturing Engineers, [SME], 2013). It is the review, evaluation and corresponding adoption of such advanced technology as researched here in this study, that will continue to aid in stemming the tide of lost jobs due to the fact that "…the industry's total workforce has fallen by 17 percent since 2000" (Motor & Equipment Manufacturers Association [MEMA], 2014).

It is critical that automotive industry professionals-especially practicing engineers, procurement personnel, and their corresponding management, understand the principles and practical applications of electronic Supply Chain Management (e-SCM) systems (Grewal, 2002). Such a base understanding of such systems is also a key

foundation to students of manufacturing, engineering and management. There has been more recent emphasis in this industry concerning the use of electronic systems for supply chain management procurement processes, as witnessed by the advent of SCM-focused procurement software such as: Covisint, SAP, SupplyOn, and FreeMarkets (Tracey, et. al, 2004). Hence, professionals and researchers alike within the automotive industry need to know, and further understand, those factors that support or inhibit the adoption of such technology. It is the goal of this study to add to the body of knowledge within this industry, providing additional insight: to students who will become future employees within this industry; to educators who also will work within this industry and academia and lastly, industry practitioners who will take this information back to benefit their own automotive organizations.

The U.S. automotive industry has been more reluctant to adopt new technologies and corresponding business methods than other industries as witnessed most recently in 2009 by bankruptcy filings by both General Motors Corporation and Chrysler Corporation, LLC., both historical leaders in global automotive production (McAlinden, 2010). As this industry employs millions nationally within its multi-level suppliers, support companies, dealership and manufacturing ranks, this scope economically corresponds to over 3% of the U.S. national GDP (McAlinden, 2003). As this is our country's largest manufacturing industry (both in terms of employment and revenue generation) as well as the world's largest automotive industry, it is imperative to our country's economic well-being that the automotive industry remains an integral and vibrant base to provider of income to millions of families. It is also important to note that those factors that are associated with the adoption of these technologies (including electronic supply chain

management software, e-SCM) specific to the U.S. automotive industry and its corresponding supply base are currently unknown via existing research. Additionally, research within this industry based on the efficiencies gained via streamlined procurement operations and overall business processes by using such systems within this framework, are currently unknown. This research study works to rectify the aforementioned gap that exists within this industry and prior studies. Combining the importance of this industry to our nation with the innovation that e-SCM procurement systems provide organizations in terms of gained efficiencies is paramount to future industry and American economic growth. This is likewise why this study is so imperative: to further understand those factors that assist in adoption of this technology and, moving forward, to promote these factors in the organizations that implement such technologies, which fosters growth in this industry.

Objective of the Research

The purpose of this research is to identify those factors associated with the adoption of e-SCM systems among organizations within the U.S. automotive industry. To guide this effort, the theoretical constructs developed within the TAM framework were used, such a study had not been previously addressed or completed specific to the U.S. automotive industry (Personal interviews with F.D. Davis, Sept. 7, 2009; June 27, 2011). These constructs include: the attitudes toward using such systems by means of perceived ease of use and perceived usefulness (internal organizational benefit). The corresponding survey guidelines as it relates to prospective respondents were followed (Archer, 2005). From Archer's survey approach, it was determined that the respondents for this study followed in a likewise similar pattern to those in "Innovative

Organizations" (Rogers, 1963). Due to this discovery of response rates and timing, those surveyed as part of this study were examined via the *Diffusions of Innovations* framework as formulated by Rogers (1963) in order to further investigate innovative characteristics within the automotive supply chain.

When examining the model on which this study was based (Figure 1), this research study examined factors that determined the organizational decision as to whether or not to adopt e-SCM procurement systems within their own automotive industry organization. The study examined some of those factors in this organizational decision-making process along with the corresponding perceived benefits. This research was framed on an individual basis, as each potential respondent was representative of their corresponding organization, with their corresponding demographics likewise collected and examined. Lastly, this model summarizes this study and further examination of the following research questions and hypotheses.

Research Questions

This study concerning automotive industry professionals and their use of e-SCM addressed the following research questions:

- Is the ease of system use a factor associated with the decision to utilize e-SCM procurement technologies among U.S. automotive suppliers?
- Does the perception of organizational usefulness a factor associated with the decision to utilize e-SCM procurement technologies among U.S. automotive suppliers?
- Does the organization's size play a factor in whether or not a company utilizes e-SCM procurement technologies?

- Does gender play a factor in how such systems are viewed and/or perceived?

Hypotheses

The following hypotheses were tested based on the survey results of this research:

H1: The decision to use an e-SCM procurement technology system has a significant positive association with ease of system use.

H2: The decision to use an e-SCM procurement technology system has a significant positive association with organizational internal usefulness.

H3: The larger the organization, the more apt or greater the acceptance is to utilize an e-SCM procurement technology system.

H4: The use of an e-SCM procurement technology system by certain gender (women) within the U.S. automotive supply chain has a significant positive association with ease of system use.

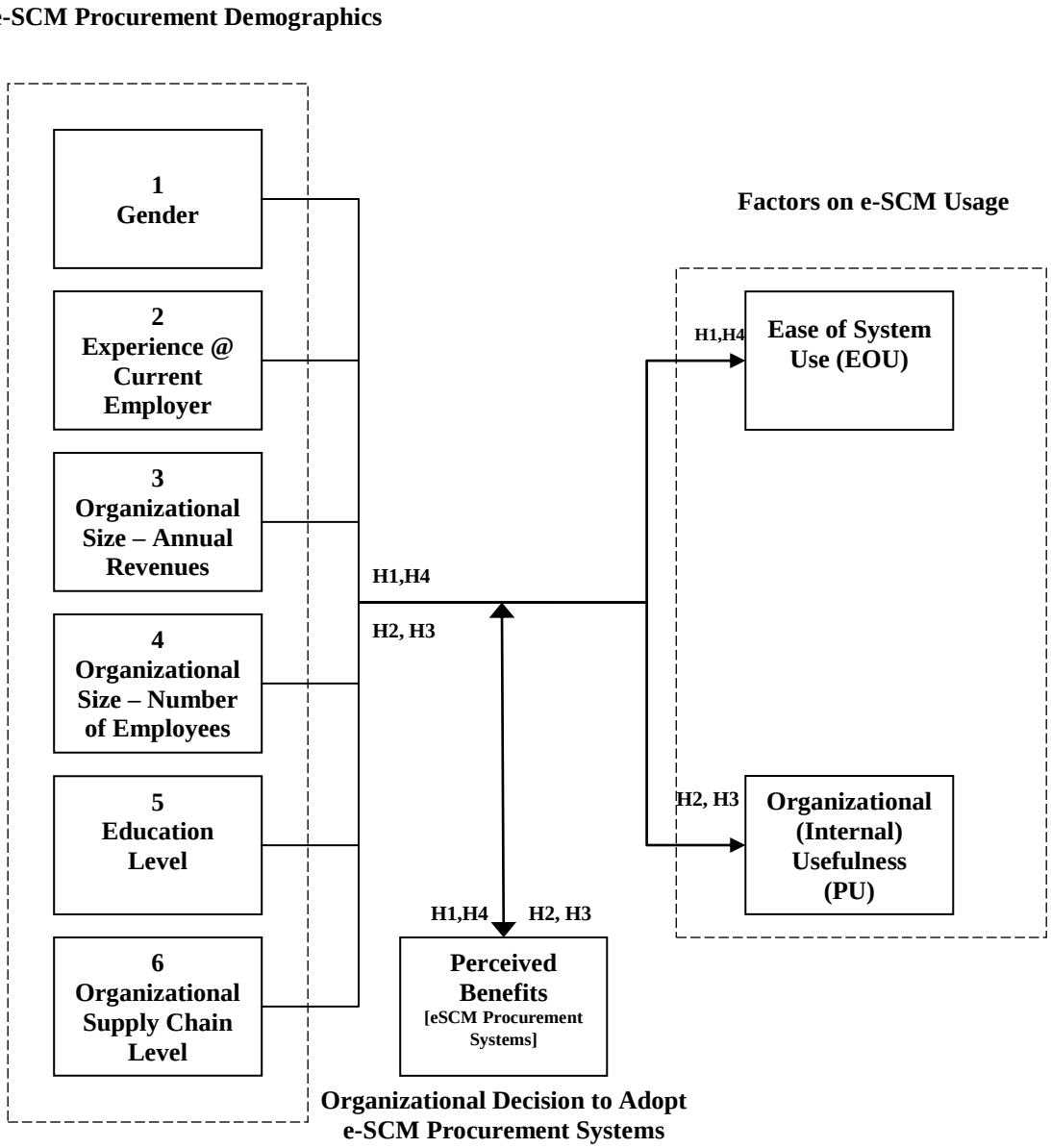

Figure 1: Proposed Research Model to Test Relationships Among Various Factors on e-SCM Procurement System Usage

Assumptions

It is assumed that the sample respondents in this study will be:

1. Appropriately knowledgeable in supply chain systems and will be honest and non-biased in their responses.
2. Representative of the population at a professional level in terms of geographical location, educational background, and industry type.
3. Representative of the population at a subject matter expert level in terms of supply chain management (SCM) procurement systems, educational background, and the automotive industry.

Delimitations and Limitations

The results of this study are applicable to the U.S. automotive industry and its corresponding supply chain. In addition, this industry-specific study can also be extended geographically to create an international survey. Because of time and resource limitations, as well as the need to keep the study at a manageable size, this research did not consider other potential factors such as: organizational factors, cultural factors, and market factors.

Delimitations: This research has purposely focused on domestic U.S. automotive original equipment manufacturers (OEMs) and their suppliers which constitute this industry's supply chain. Despite these limitations, the corresponding results may also be useful to other manufacturing and non-manufacturing organizations,

such as colleges and universities, whereupon the educational need of such applied and pertinent subject matter is prevalent. Delimitations inherent in the directed sampling method of randomly using individuals who were professional industry-affiliated meant that those who didn't belong to a given professional industry organization such as SAE, AIAG, etc., were not eligible for this study. These items are further evaluated in Chapter V as part of the summary and conclusion section of this research study.

Definition of Terms

AIAG. The Automotive Industry Action Group is a globally recognized organization founded in 1982 by a group of visionary managers from Chrysler, Ford Motor Company, and General Motors. Their purpose is to provide an open forum where members cooperate in developing and promoting solutions that enhance the prosperity of the automotive industry. AIAG's focus is to continuously improve business processes and practices involving trading partners throughout the automotive supply chain. (Automotive Industry Action Group, 2012).

Automation Alley. Automation Alley is a non-profit organization that drives growth and economic development through a collaborative culture that focuses on workforce and business development initiatives. Automation Alley attracts the creators and consumers of diverse technologies from a variety of industries around the world. Automation Alley, Michigan's largest technology business association, drives growth in Southeast Michigan's economy. Automation Alley was founded in 1999 and is Michigan's leading technology business association, connecting companies and organizations with talent, resources and funding to accelerate innovation and fuel Southeast Michigan's economy. The Automation Alley region encompasses the

counties of Genesee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne. (Automation Alley, 2015).

Center for Automotive Research (CAR). The Center for Automotive Research is a non-profit industry organization that drives growth and economic development through a collaborative culture that focuses on workforce and business development initiatives with a focus on the research specific to the automotive industry. To fulfill its mission as an impartial voice of the industry, CAR maintains strong relationships with industry, government agencies, universities, research institutes, labor organizations, media, and other major participants in the international automotive community since its inception as a standalone non-profit entity in 2003. (Center for Automotive Research, 2016).

Competency. The knowledge, skill, and ability in a specific subject area or skill set to perform a specific set of related tasks successfully to meet a specified standard. (Institute for Supply Management, 2014).

Cronbach's Alpha. A measure of the extent to which variables believed to measure the same underlying concept are consistent or "hang together." It also measures the extent to which an index composed of such variables is said to demonstrate internal reliability. The minimal acceptable level to justify the combination of variables in a single index or scale is 0.70. The statistic has a possible range of values from 0 to +1.0. (Pearson, 2010).

ISM. The Institute for Supply Management™ (ISM) is the world's largest supply management association as well as one of the most respected. ISM's mission is to lead the supply management profession through its standards of excellence, research,

promotional activities, and education. Founded in 1914, ISM is a non-profit association whose membership base includes more than 40,000 supply management professionals with a network of domestic and international affiliated associations. (Institute for Supply Management, 2014)

Information systems (IS). The term information systems refers to the use of, often, an electronic information system (informative data processing) that assists an organization or individual's collective useful data processing and analysis. Please note that the human part of the system should also be "developed" in order to ensure the existence of the information system. This very important and necessary aspect for successful information systems development, is often lacking in university and industry courses, papers, and books, as well as in the professional/corporative MIS development. This fact would explain most of the IS practical failures by professionals within a network of domestic and international affiliated associations. (Callaos, N. & Callaos, B., 2002).

Lean Manufacturing. An overall methodology that seeks to minimize the resources required for production by eliminating waste (non-value added activities) that inflate costs, increase both lead times and inventory requirements, and emphasizes the use of preventive maintenance, quality improvement programs, pull systems, flexible work forces and production facilities. (Society of Automotive Engineers, 2014).

Original Equipment Manufacturer (OEM). OEM is a term used to describe those automobile manufacturers who directly assemble and sell automobiles to the domestic U.S. marketplace. Those suppliers who sell to the OEMs are then categorized by level of purchasing, i.e., direct suppliers who sell to the OEMs are considered "Tier 1

suppliers", those that sell to the Tier 1 suppliers are considered "Tier 2 suppliers" and so on throughout the entire automotive industry. Due to their direct involvement with the OEMs, Tier 1 Suppliers often have additional supplemental costs due to the OEMs requirements, such as the need to be ISO/TS-16949 certified within their organization, for example (Original Equipment Supply Association, 2014).

Original Equipment Supply Association (OESA). OESA is an industry organization that exclusively represents and serves manufacturers of automotive vehicle components, tools and equipment, automotive chemicals, and related products used in the production, repair, and maintenance of all classes of motor vehicles. OESA offers its members superior global intelligence, leading-edge market research, international business support, government representation, industry networking, and commercial services (Original Equipment Supply Association, 2014).

Society for Automotive Engineers (SAE). SAE is a non-profit, practitioner-based organization dedicated to cultivating understanding, analysis and exchange of productivity methods and their successful application in the pursuit of excellence within the global automotive industry (Society of Automotive Engineers, 2014).

Society of Manufacturing Engineers (SME). SME is the professional society that supports manufacturing education and promotes an increased awareness of manufacturing engineering by keeping manufacturing professionals up to date on leading trends and technologies (Society of Manufacturing Engineers, 2014).

Society of Petroleum Engineers (SPE). SPE is the professional society that supports petroleum-based research and corresponding education and promotes an increased awareness of manufacturing engineering by keeping manufacturing

professionals up to date on leading trends and technologies (Society of Petroleum Engineers, 2012).

Spearman's Rho (ρ). A non-parametric statistic (named after Charles Spearman) measuring the strength of association of two ordinal-level variables. Also known as Spearman's Rank Order Correlation Coefficient. The statistic has a possible range of values from -1.0 to +1.0. (Pearson, 2010)

Supply chain management ("SCM"). Supply chain management encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and logistics management activities. Importantly, it also includes coordination and collaboration with channel partners; channel partners can be suppliers, intermediaries, third-party service providers, and customers. Supply chain management can also refer to supply chain management software, which include tools or modules used in executing supply chain transactions, managing supplier relationships and controlling associated business processes. (Institute for Supply Management, 2014).

Technology acceptance model (TAM). The technology acceptance model was first theorized by Fred D. Davis of the Massachusetts Institute of Technology in 1985 as a model to test the relative success and corresponding rationale for new end-user information technology systems. The technology acceptance model is based on two main precepts: usefulness and ease-of-use, used in a perceived context (from the user's perspective). Therefore, the technology acceptance model and corresponding literature will refer to perceived organizational usefulness (PU) and perceived ease of use (EOU). This model has been used in several applications, often based on industry or student affiliation, in order to draw inferences for the remaining population (Davis, 1985).

Chapter II–Review of the Literature

This chapter provides a summary of the current literature relevant to important concepts relating to those pertinent items that this study addresses. More specifically, this includes a review of the current literature relevant to the U.S. automotive industry, suppliers to the U.S. automotive industry, corresponding pertinent professional industry organizations, the technology acceptance model, automotive industry fiscal impact and survey research methodology.

The technology acceptance model, or TAM, is an adaptation of the theory of reasoned action (TRA), which was specifically introduced to explain individuals' computer usage behavior within an information systems (IS) background. TAM uses TRA as a theoretical basis for identifying the strong causal links between two key beliefs-(i) perceived usefulness (PU) and (ii) perceived ease of use (EOU). Therefore, TAM is a causal model that studies the covariance of these constructs to determine if there exists a causal relationship among them (Davis, 1985).

Generally, the goal of TAM is "…to provide an explanation of the determinants of computer acceptance that is, in general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified." (Davis, 1985, p. 985).

This research study was undertaken to assist in addressing the possible connections between electronic supply chain management systems (e-SCMs) and the decision to adopt such systems within a given organization, focusing specifically within the automotive industry. The focus on the automotive industry is one of great interest to the researcher as it has provided much of his professional career in several organizations,

in addition to being paramount to this university's local domain in Southeast Michigan. Much like the U.S. in general, this regional locale has recently seen immense decline in terms of both employment and economic impact, yet, despite this recent decline, this region is still very relevant in the automotive industry. In fact, "Southeast Michigan has the highest number of advanced automotive industry jobs, accounting for 9.3 percent of all advanced automotive jobs in the U.S. nationally" (Automation Alley, 2015). In addition, the need for such a study and corresponding further research within e-SCM and this industry is paramount for both the economies of the United States and more regionally, within the State of Michigan (Dziczek, 2015). The questions for the study were derived from the previously validated study concerning the technology acceptance model, first proposed by Davis as part of his original dissertation at MIT (Davis, 1985).

In order to stay likewise consistent with previous survey research instruments applying the TAM model to organizational level adoption decisions (Grandon & Pearson, 2004), the items for ease of use focused on the decision maker's perception of their own ability to use e-SCM procurement systems. The mediating variable "perceived usefulness (PU)" is a mix of the decision maker's perception of the usefulness to themselves and to the organization (Grandon and Pearson, 2004). For example, sample questions posed to prospective respondents included: "Using e-SCM systems would improve my job performance" and "Using e-SCM systems would enable my company to accomplish specific tasks more quickly". For consistency, likewise, all usefulness items in the developed instrument addressed the usefulness of e-SCM to the respondent's organization. The study was performed in a survey format with survey respondents being practitioners in the field, gathered from various levels within the automotive

supply chain. This includes purchasing, engineering, and related personnel directly employed by the automakers as well as their direct suppliers (e.g., "Tier 1 suppliers", "Tier 2 suppliers"), and so on. These organizational departments of the individual study respondents were captured via the demographics section of the research survey. Collectively, this group is referred to as the "automotive supply chain" (Institute for Supply Management, 2014).

The survey used a five-point Likert scale and was distributed via electronic means (via email) by way of a link to the survey using SurveyMonkey software. A pilot study was performed with a small group of industry professionals and from this initial pilot study, response data from this was analyzed in order to determine prospective questions for the final survey instrument. This final survey instrument was then validated prior to distribution to the final prospective survey population. The prospective survey population was sampled from various pertinent industry associations of which the researcher is a practicing member, i.e., SAE, ISM, AIAG, OESA, and SME. The utilized sample included those employed within the United States automotive industry supply chain, selected randomly among those who are members of the automotive industry via professional affiliation (e.g, SAE, ISM, SME, AIAG, OESA).

In addition to collecting the desired survey data that addresses usage concerns, this survey also collected the corresponding demographic information that was used to further define those individuals who are currently working specifically within this industry and their corresponding background and professional experience/makeup. Additional further analysis of this study's respondents' demographics occur as part of the data analysis and results as well as discussion sections found later in this study.

Survey Research Methodology–Avenue for Success

Personnel surveys that utilize current industry as prospective respondents have been carried out in the past utilizing both standard postal mail and electronic web-based surveys. Due to various factors, such as cost and time, however, it is becoming increasingly common to use Internet-based tools for survey delivery as using the Internet provides an effective method of collecting data (Dillman, 2000). Raymond (2005) suggested that it still may be necessary to use conventional mail to establish contact with survey recipients. He also recommended that it is equally important to evaluate the questionnaire for compatibility with Internet delivery. Several advantages of Internet surveys include the following (Archer, 2005; Raymond, 2005).

1. Complete elimination of paper, postage, mail out, and data entry costs.
2. Reduced time required for implementation.
3. International population can be accommodated in the survey with little to no extra cost.
4. Reminders and follow-up on non-respondents are relatively easy (as opposed to prospective postal mail respondents).
5. More dynamic interaction with respondents can be obtained.

Likewise, based on prior literature, the limitations of Internet surveys can and often include (Archer, 2005; Dillman, 2000):

1. Since everyone does not have access to the Internet, this method will not work for all populations.
2. Computer literacy of respondents is necessary. (Stated in Research Assumptions)

3. Screen configurations may appear significantly different from one respondent to another based on individual settings of the computer.
4. It is likely that Internet surveys may be detected as "junk" mail due to the sophistication of modern email programs and/or corporation firewalls.

Since research studies typically consist of 75-200 job related phrases, the questionnaire becomes lengthy and poses a challenge to Internet delivery, especially given the fact that most respondents will complete the survey at their employment location (Archer, 2005). As such, a general rule of thumb for Internet questionnaires is that they be no less convenient to complete than those printed on paper (Raymond, 2005, p. 35). Dillman (2000) outlined the following design principles for web based questionnaires:

1. Introduce the Web questionnaire with a welcome screen that is motivational, emphasizes the ease of responding, and instructs respondents about how to proceed to the next page.
2. Provide a PIN number or other sign-in method for limiting access only to people in the sample.
3. Present each question in a conventional format similar to that normally used on paper self-administered questionnaires.
4. Restrain the use of color so that figure/ground consistency and readability are maintained, navigational flow is unimpeded, and measurement properties of questions are maintained.
5. Provide specific instructions on how to take each necessary computer action for responding to the questionnaire, and give other necessary instructions at

the point where they are needed.

6. Use drop-down boxes sparingly, consider the mode implications, and identify each with a "click-here" instruction.
7. Do not require respondents to provide an answer to each question before being allowed to answer any subsequent ones; Use "skip logic" if possible.
8. Provide skip directions in a way that encourages marking of answers and being able to click to the next applicable question.
9. Use graphical symbols or words that convey a sense of where the respondent is in the completion process, but avoid those that require significant increases in computer resources.
10. Exercise restraint in the use of question structures that have known measurement problems on paper questionnaires, such as check-all-that-apply and open-ended questions. (pp. 377-398)

In addition to these recommendations, Raymond (2005) has suggested the following regarding questionnaire format and administration:

1. Use a cover letter that describes the purpose of the study, how respondents were selected, and how confidentiality will be maintained. Indicate the time required to complete the questionnaire, the date to respond by, and how to return it (when using mail questionnaire). When feasible and/or necessary, use official letterhead and a personally signed letter from a trusted authority.
2. Plan on at least two and up to four distributions/e-mailings that includes a thank you/reminder postcard, followed two to three weeks later by a second questionnaire mailing to non-respondents.

3. The font should be large enough to read easily. Minimize uppercase-only text. Use features such as bold, italics, and underlining consistently.
4. Give the survey a tidy and navigable appearance. Avoid squeezing too much text onto a page to make the questionnaire appear shorter
5. For stand-alone questions (e.g., demographics) with ordinal scales, use a vertical arrangement of response options. A two-column page layout is easier to read and uses space in a better way. (p. 36)

A major item of concern when conducting survey research involves the rate of response of prospective respondents. Archer (2005) conducted a study to determine the effect of the number of reminders on response rate of web-based surveys. The study concluded that reminders sent on day seven of the survey produced the largest increase in responses. The study also recommended using three total contacts with the respondents that includes: initial invitation, first reminder, and final reminder. This guideline provided a standardized practice followed by this researcher in terms of data collection for this study. It is within Archer's framework that this survey data was distributed and collected for further analysis and delineated in subsequent sections. It was from the respondent results as compared against Rogers' Diffusion of Innovation Theory (1963), a theory that works to describe the similar innovative goals of the U.S. automotive industry, that a similar distribution of respondents was witnessed in this study, a noteworthy similarity that speaks to the innovativeness within the automotive industry. The use of electronic media and corresponding survey software (SurveyMonkey®) was the mechanism by which the respondent survey data was collected and tabulated along with corresponding options for respondents to receive

completed survey results.

TAM and Survey Research Methodology–Historical Aspects

A further examination into survey research methodology shows that the literature has witnessed the trends that this form of research has undergone, originating from the validity of mail and other media by which surveys have been previously delivered to prospective respondents to now being delivered predominantly via an online format (Evans, 2005). In addition, due to increased opportunities for wider data collection with often limited funds economically (as often with graduate students), the online medium by which surveys and survey research methodology exists has provided researchers a very economical manner to collect information. In regards to this medium, Dillman (2000) notes, that "no other method of collecting survey data…offers so much potential for so little cost" (p. 400).

From a historical perspective, the TAM model has been utilized and validated in various organizational environments to measure both individual as well as organizational usage intentions (Doll, W., Hendrickson, A. & Deng, X., 1998). As such, TAM traces how external variables affect individuals' internal decision processes within a technological aspect. As a whole, in order to comprehensively understand individual acceptance of technology, one needs to interpret user behavior within at least four major perspective contexts: the cultural (national) context, organizational (implementation) context, individual context, and system (technology) context.

The cultural (national) context refers to the macro environment in which the investigated user acceptance behavior may occur and the specific organization is located. For the purposes of this study, the cultural (national) and organizational context are

focused solely upon the United States and the automotive industry supply chain contained within. From a nationalistic perspective, culture has been defined as a set of core values that shape the behavior of individuals as within as well as well as the whole society. As such, culture does have an impact on an individual's decision making process towards use of a system and was previously analyzed to show, for example, that the TAM model may not hold true for a Japanese culture (Straub, D., Keil, M. & Brenner, W., 1997).

The organizational (implementation) context aspect refers to the specific environment where the individual is employed and the investigated technology acceptance takes place. A system is usually deployed in an organizational setting; thereby individual adoption of a system is a secondary adoption decision-making event (Chin & Gopal, 1995). This essentially means that the decision is made by individual users once the organizational decision to adopt such a system initially occurs. In order to increase the user's acceptance of a particular information system (IS), organizations have to create a favorable environment to support and encourage usage of such IS at, and within, the workplace. Such support can be found within the organization's information technology (IT) computing policy, along with overall management support and encouragement, both of which have empirically been proven to be very important (Callaos & Callaos, 2002). Many researchers have drawn attention to effects of the training on user acceptance of a given information system (IS). Traditional training, role-playing game format training, or a specifically designed training program for specific user groups does help users to increase their knowledge about the information system (IS) in their organization, so that they are more likely to have a positive intention

to use it in their work (Venkatesh & Morris, 2002).

Examining from a group aspect, workers in a team or community could get benefits from informal training, just as knowledge sharing in the group could increase willingness to use a system. This factor is very crucial today since most workers operate in a team environment (Gallivan, 2000). Through research from an additional IS study, Cooper (1994) found that the organizational cultural role was also significant in new IT implementation. The interpretation of TAM in the organization context will help us examine the effects of organizational factors on individual behavior. Organizations' as the first adopter of the system have to create a secondary adoption environment that is closely related to individual behavior. The usage of such a specific system by an individual is shows their desire to improve his/her job performance within that given organization, and as such, would then be expected to receive beneficial operational additional positive feedback from related organizations. Measurements or factors that increase user acceptance in one organization may not function well in another organization; thereby individual organizational decisions are not necessarily broad-based or indicative of similarly likewise organizations within a given industry, such as the automotive industry, for example.

The individual context refers to those essential characteristics of individual users that are often inherent or germane to system usage. An individual may exhibit characteristics completely different from others in various organizations and from different cultures. Individual differences refer to user factors that include traits such as personality and demographic variables, as well as situational variables that account for differences attributable to circumstances such as experience and training (Agarwal &

Prasad, 1999).

Demographic variables, such as age, gender, and level of education; personality variables related to computer technologies, such as computer anxiety, computer self-efficacy, computer skills, cognitive style, etc.; and situational variables, such as employment categories, prior experience with IS and computers; and experiences of general computer usage or specific system usage etc., have all been empirically examined as being important factors that influence individual technology acceptance behavior (Venkatesh & Morris, 2002). As such, some of these described demographics of respondents were captured within this study by way of the survey instrument. In terms of this study, the "individual" is considered to be the user, or alternatively, the one who takes action to perform the adoption behavior. The individual context defines the boundary that one user's perception and assessment of using a system is not the same as that of others. As such, the TAM postulate aggregates these differences in most cases within organizations. Such aggregation may segment users into similar groups and help organizations to design proper promoting measurements or environments to assist in increasing usage. Therefore, the interpretations of TAM from the individual context clarify the importance of individual characteristics in determining resulting usage behavior within the organization.

The e-SCM procurement system (technology) context refers to the end-user computing technologies under investigation by any organization; whereas in the case of this study, this would refer to such organizations which belong to the U.S. automotive industry supply chain. Such technologies are information systems applications, communications systems, and similarly, any information technology (IT) innovations.

The system context defines the factors of a system and their effects on usage behavior. System factors include a system's usability, interface, interaction style, and system quality, etc. For systems related to Internet technologies, the characteristics of web-page design, response time, information location on the web, etc., have been tested in empirical studies. For organizational communications technologies, factors such as the system social presence and information richness, system accessibility, etc., has significant impact on user's beliefs about using the systems (Karahanna & Limayem, 2000). Here, the TAM model takes technology as the focus; with the system being the target of the user's adoption behavior (Davis, 2000). Without the system context, TAM could potentially lose its basis of applicability and corresponding frame of reference. The interpretation of TAM from the system context has allowed the researcher to distinguish the results of one organization's "apple" from another organization's "orange", while each likewise providing validation for the specific information system (e-SCM procurement system) that is in use within that given organization.

Comparatively, the cultural (national) context serves as a sort of macro-environment, the individual context defines the microenvironment and the organizational context is in the middle, with system context circling the target of individual technology acceptance behavior. The understanding of these contexts and their effects on user behavior has provided a solid base to explain why users either accept or reject a system in a specific environment. From a national standpoint, additional TAM study examinations have been performed based on TAM within a given nation, including a multicultural, three-country study using the same TAM instrument for airline industry respondents in Switzerland, Japan, and the United States (Straub, et. al., 1997). Whereas

the findings were similar for the respondents in Switzerland and the United States, cultural norms may speak to the non-symmetry of the Japanese respondent results. As such, this study is focused on the U.S. automotive industry and its corresponding supply chain. Likewise, then, the recognition of these contexts may possibly limit generalization of findings from one study to other cases, but, alternatively, give additional merit to industry-specific studies toward furthering the body of knowledge within that given industry or nation.

Extrapolation of TAM

The original TAM model and corresponding research has been extended in many studies, mainly by examining the effects of external variables on internal beliefs, attitude and behavioral intention, both from an individual and organizational perspective. The extension of perceived usefulness (PU) constructs highlights its important role in determining user acceptance behavior, with the chronological dimension of usage behavior helping to improve our understanding of how beliefs and attitudes change over time. This helps to explain how factors initiating first-time usage differ from those which influence post-adoption behavior (Davis, 2000). In addition, it is imperative that organizations take great care prior to implementing such innovations internally by means of planning, training, and related work processes. These actions all help to lessen and to best avoid the potential pitfalls of unintended, or unanticipated, outcomes due to such implementations internally within an organization, causing great costs financially and also individual and organizational decline from a performance perspective (Bellamy, 2007).

The limitation of TAM calls for considerations of its applicability to complex

and modern systems and to professional user groups, such as industry organizations as SAE or SME, for example. As mandatory use becomes popular in organizations, the importance of social norms, and likewise, review of application context in determining user behavior should be reinforced in future studies as it is intended here. Another application of the TAM framework utilized in a different perspective came from a set of studies of the acceptance of telemedicine technology by individual physicians in Hong Kong (Chau & Hu, 2001), which revealed an insignificant link between EOU to attitude and behavioral intention. The more recent results of an exploratory study by Chau and Hu (2002) found compatibility of telemedicine technology with physicians' working practice was a significant predictor of PU and had a very strong indirect effect on physicians' behavior intention through PU. The authors argued that TAM is a proper model to explain and predict physicians' intention to use telemedicine technology, but TAM has to be supplemented by other theories in order to gain more insights into factors influencing physicians' behavior. There are differences between a physician's micro-working environment and work practice and those of common users or knowledge workers in other business organizations. Another review of the TAM model as it relates to a different industry, information technology (IT), shows that this model and its premise that perceived usefulness (PU) and ease of understanding (EOU) are variables within the steps toward organizational decision-making in a procurement setting (Benamati & Rajkumar, 2008). As the researcher investigated this particular study further, including interviewing Dr. J. H. Benamati, additional support of the TAM model to investigate other industries was found, including usage within not-for-profit organizations (Dr. J.Benamati, personal communication, June 27th, 2009). Additional

interviews were likewise conducted with Dr. Fred D. Davis, the architect of the TAM model based on his initial research at MIT. From these personal telephone interviews with the founder of the TAM model (Dr. F. Davis, personal communications, September 7th, 2009 and June 27th, 2011), additional verification of the originality of this study (beyond the literature review) within the automotive industry was furthered with these subject matter expert interactions. As part of the literature review, a continued interest in this model exists, as commonalities across organizations occur for procurement and organizational decision-making, the primary drivers within this study. Looking at the various ways in which the TAM model can be applied, one must still do so with investigative caution, as not all applications can be defined under the TAM context. Hence the limitations of generalizability across all organizations as previously mentioned, yet the furthered value contained within a given industry or usage methodology (such as procurement systems). Therefore, the role of compatibility in determining an individual professional's acceptance behavior should likewise always be considered in relation to the resulting corresponding perceptions.

As the primary components of the TAM model and framework, PU and EOU, these factors have been postulated as fundamental determinants of individual technology acceptance behavior. Social norm postulates from TRA (Ajzen & Fishbein, 1975) in conjunction with additional compatibility from Rogers' Innovation Diffusion theory (Rogers, 1963) have reinforced their determining power as individual usage becomes more and more mandatory in nature and users are professionals, thereby using such determinants within industry. The furthered extensions of TAM by other theorists throughout time since the original model formation have proven to be both relevant and

applicable (Davis, 2000), a measure by which additional new research such as the study here seeks to extend its scope.

The U.S. Automotive Industry–A Positive Trend

The U.S. Automotive Industry has signaled a resounding comeback from the 2008-2009 "Great Recession" as witnessed by the record levels of automobiles purchased in 2015 and the general attitude of the American public shifting to a more positive manner concerning the U.S. Treasury Department's publically funded automotive bailouts in 2009 (Pew, 2012). This industry has been historically cyclical in nature, working within the ebbs and flows of consumer demand in conjunction with the American economy, providing citizens with mobile freedoms to travel the country that were first on display during the early 1900's and were grown exponentially with the President Eisenhower-era Interstate Highway System, while likewise declining during the 1970's American oil crisis and corresponding inflation (Ingrassia, 2008). Such a detailed examination of the cyclical nature of this industry is apparent when examining annualized U.S. automotive industry sales from the past forty years (as seen in Figure 2).

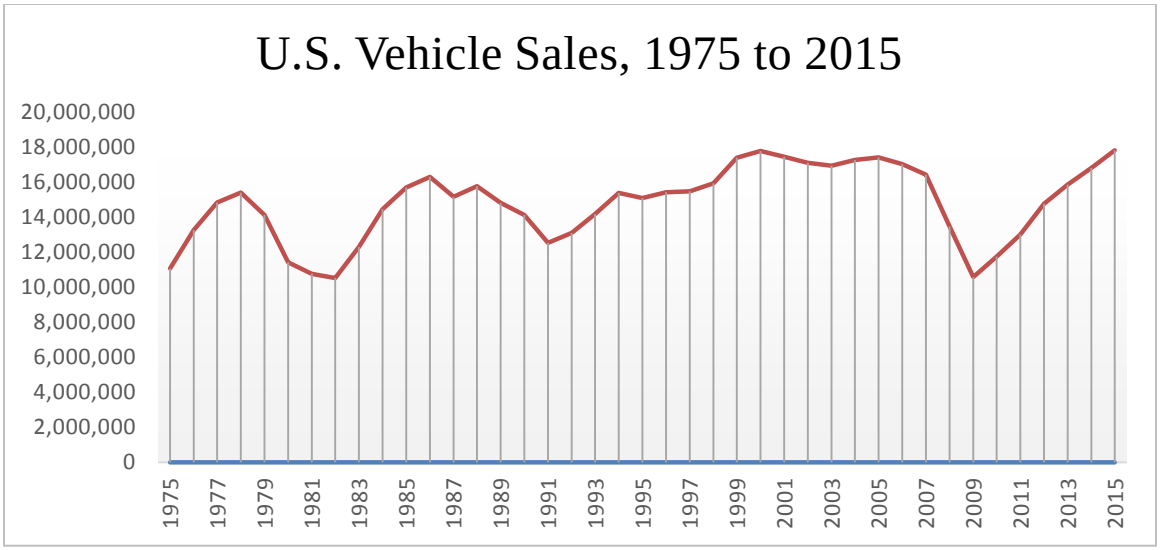

Figure 2: U.S. Vehicle Sales, 1975 - 2015

Source: Ward's Auto (2016). "U.S. Vehicle Sales, 1975-2015."

As the U.S. automotive industry has risen and fell, its corresponding suppliers have followed suit, as over half of the automotive supplier industry were in bankruptcy danger within the 2008-2009 timeframe (Bailey, 2009). This industry had many examples of Tier 1 Suppliers going into bankruptcy during the 2000s (see Figure 3) that furthered both the numbers of unemployed in our country and in our state, figures that are only recently showing a trend upward, yet not to the level previously seen pre-auto bailout (Hill, 2014).

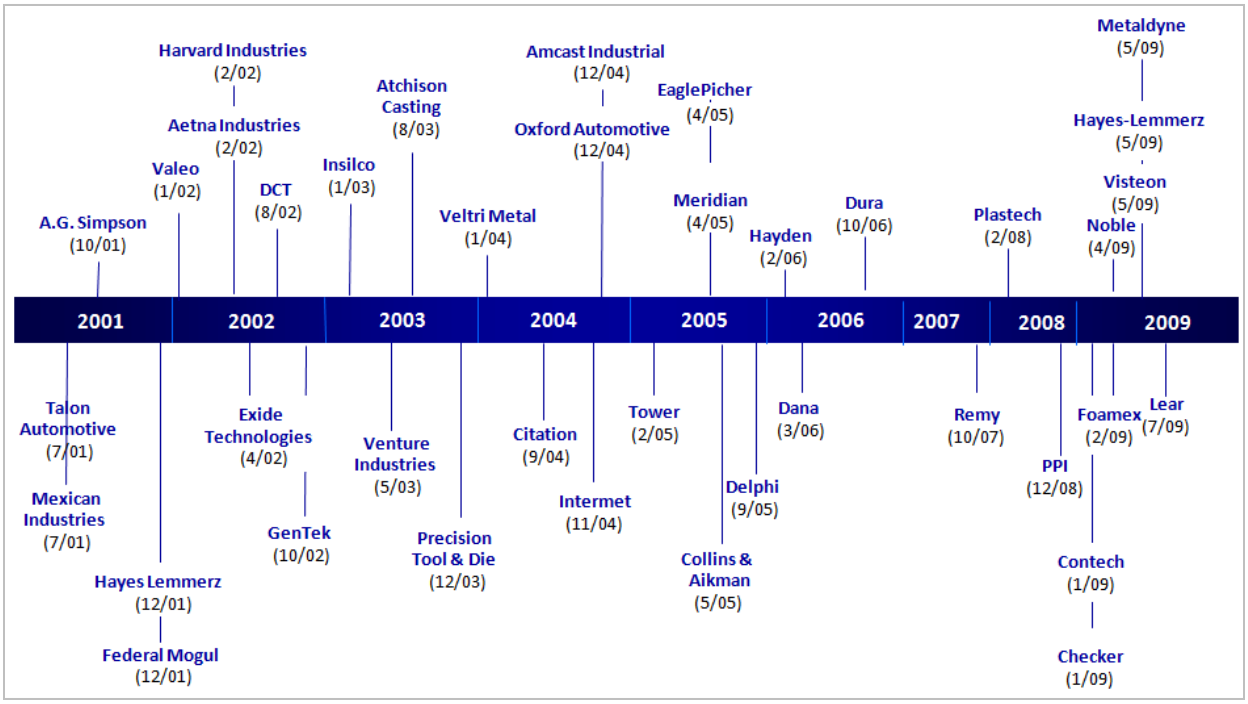

Figure 3: Major Tier 1 automotive supplier bankruptcies, 2001-2009

Source: Hill, K. (2010). Contribution of the automotive industry to the economies of all fifty states and the United States. *Center for Automotive Research*, 21.

By examining the fiscal impact, regionally, in terms of areas such as the Midwest and the South within the United States of America, and then collectively reviewing the overall national reach, one can further understand the economic importance of this industry to our nation as a whole. Regionally, the state that has been historically (and continues to be) most economically impacted by the automotive industry is Michigan (Hill, 2010). Extrapolating this local perspective to a national one, according to the Center for Automotive Research (CAR), the auto industry historically contributes 3–3.5 percent to the overall United States' Gross Domestic Product (GDP) along with the following additional fiscal measures (CAR, 2015). The industry directly employs more

than 1.7 million people engaged in designing, engineering, manufacturing, and supplying parts and components to assemble, sell, and service new motor vehicles. Approximately 4.5 percent of all U.S. jobs are supported by the strong presence of the auto industry in the U.S. economy. People in these jobs collectively earn over $500 billion annually and generate more than $70 billion in tax revenues (Hill, 2014). In addition, from an investment perspective, American automotive companies spend an average of $1,200 per vehicle toward research and development funding (Hill, 2014), a figure that helps to aim this industry in an innovative path. Rogers (2003) has described that, "…innovators and early adopters have favorable attitudes toward new ideas and more actively search for innovations. They also possess more resources and thus can adopt higher-cost innovations that later adopters cannot afford" (p. 457). As this industry has proven its importance over time to be a major economic component of the United States' economy, this study was likewise performed to add to the collective body of knowledge for researchers and industry members alike.

Through this literature review, several concepts were introduced to the reader, including the innovative organizational model addressed through TAM, the usage of information systems (IS) within organizations, and the continued value of the U.S. automotive industry within our nation. As this study focused on the U.S. automotive industry supply base, specifically those associative factors that affect the adoption of e-SCM procurement systems, an item that warrants further investigation is the usage and corresponding adoption of e-SCM systems within other organizational functions, such as design or product engineering. As it is not clear what factors affect the implementation of such e-SCM systems within the engineering function within the original equipment

supply base within the U.S. automotive industry, there exists a divide in the research. Therefore, it is through additional research that can be performed to help address this is needed to close this gap and add to the collective body of knowledge in this area.

Chapter III–Methodology

Research Design

This descriptive research study was conducted using a questionnaire given electronically to practitioners in the field, gathered from various levels within the automotive supply chain being prospective and eventual final respondents. This includes purchasing, engineering, and related personnel directly employed by the automakers as well as their direct suppliers (e.g., "Tier 1 suppliers", "Tier 2 suppliers"). Collectively, this group is referred to as the automotive supply chain.

Population, Measurement, and Sample

The overall survey population for this study was based on various pertinent automotive industry associations of which the researcher is a practicing member, e.g., SAE, ISM, AIAG, OESA, SME. Recent data from the Bureau of Labor Statistics shows that current U.S. automotive industry employment is greater than 674,000 (2013). From this group, approximately 35,000 are employed in positions related to supply chain management (Institute for Supply Management, 2014). From this figure, the prospective survey pool included those employed within the United States automotive industry supply chain, selected via convenience sampling from among those who are members of the automotive industry via professional affiliation (i.e., SAE, ISM, SME, AIAG, OESA). A convenience sampling of 80 prospective respondents were selected from each of the five listed professional organizations, resulting in a collective initial sample size of 400 individuals. From this sample group of 400 prospective total respondents, email requests were then sent out to all potential survey respondents, using their professional email addresses (based on individual company/organization).

Instrument Development

The survey instrument for this study was based on a prior study (and corresponding previously validated survey instrument) that focused on the TAM framework of technology acceptance and was distributed to a prospective sample that is reflective of those individuals who meet pre-established pertinent qualifications, i.e., industry personnel employed in a position involving the supply chain management aspects of their organization. Davis' original TAM study survey instrument was adapted for this study by way of specificity to e-SCM procurement systems. Those survey questions from Davis that addressed an "IS System" was replaced with nomenclature that addressed an "e-SCM procurement system." A survey pretest (pilot study) was given to a smaller sample (ten) of those industry subject matter experts, so as to verify content validity for this given industry type (automotive industry) sample as well as to review survey length. It is based on this initial pilot study and corresponding subject matter expert responses that the original TAM survey was adapted for the purposes of this specific study and also shortened to its final length.

The validation of the original finalized survey (which was partially replicated here) was validated using two main steps: first, exploratory factor analysis (EFA), in order to establish the validity of the survey instrument, and secondly, simple linear regression techniques for both content and construct validity (Davis, 1985). As an additional measure of internal reliability, the original finalized survey was tested using Cronbach's Alpha (α) (Davis, 1985).

After the pilot study and completion of the final survey instrument, this

instrument was likewise tested using Cronbach's Alpha (α), prior to the distribution of this specific study's final survey. This is due to the fact that α generally increases as the intercorrelations among the survey test responses increase (Santos, 1999).

Human Subjects Approval

Lastly, as this study involved collecting data from human subjects, a "Request for Human Subjects Approval Form" was submitted with the corresponding process controls and was then summarily approved for this study via the Eastern Michigan University Graduate School. This approval letter is located in Appendix A within this document.

Data Collection and Final Population

Using a sample size of 400 individuals in this group, email requests went out to all potential survey respondents. Upon the initial contact, 97 potential respondents were deemed to have incorrect email addresses, for reasons such as "did not work at that organization anymore" or "company no longer exists." Using Archer's (2005) study and corresponding schedule for prospective respondent follow ups, his study concluded that reminders sent on day seven of the survey produced the largest increase in responses. The study also recommended using three total contacts with the respondents that includes: initial invitation, first reminder, and final reminder. These guidelines as established by Archer (2005) were likewise followed for this study, resulting in the study's final survey responses. This survey was administered to the potential sample participants in an electronic web-based format, using SurveyMonkey survey software. Based on this distribution and follow-up information, the collected completed survey response rate was approximately 48% or 144 respondents (out of 303 total potential

survey respondents).

Characteristics of the Survey Instrument

The instrument provided an introduction to potential respondents by stating the purpose of the study, explaining both confidentiality and risks, informing prospective respondents of voluntary participation, acknowledgement of the Eastern Michigan University Human Subjects Review Board review and approval, and the offer of an incentive for participation, which included a copy of the final statistical report (if requested by the respondent). The instrument consisted of four separate sections, utilizing the technology acceptance model as its underlying theme. Section 1 reviewed the perception of the ease of system use while Section 2 sought perceptions concerning perceived usefulness from prospective respondents based upon the usage of e-SCM procurement systems within each respondent's corporation. These initial two sections were assumed to be independent of one other. Section 3 included individual respondent demographics. Sections 1 and 2 utilized a five point Likert-type scale to capture respondent perceptions. The scale anchors included: strongly disagree, disagree, neither agree nor disagree (no opinion), agree, and strongly agree. The measuring instrument is located within Appendix B. Section 4 included the conclusion section of the survey instrument, which provided the respondents with an opportunity to add comments, the opportunity to request a summary of survey results, and the contact information of the researcher.

Data Analysis

The completed surveys were collected and the corresponding individual question responses likewise tabulated and coded within Excel for statistical review purposes.

Using these question results, standard descriptive statistical analyses were then performed using Excel, while examining the results for trends and/or outliers, assuming normally-distributed data.

The statistical analysis of the research data included initial coding and marking of the survey data with standard calculations for mean, mode, median and standard deviation along with skewness and kurtosis for descriptive statistical analysis. Further statistical analysis included looking for trends and/or outliers within the data, assuming normally-distributed data. Lastly, statistical analysis of the data collected was also reviewed for Kurtosis and Skewness, measures that assist in determining corresponding normalcy. Because the survey contains questions previously validated using regression analysis, further investigation of the inferential aspects of the collected data and the research instrument were performed by means of internal reliability via Cronbach's Alpha (α). As such, these examinations further investigate the correlations between the potential factors within the automotive industry. Lastly, as a major determinant utilizing additional statistical analyses, P-value calculations and correlation analyses were performed via Spearman's Rho (ρ) Rank Correlation Coefficients in order to test these hypotheses, as they utilized ordinal data (as in H1 through H4) for hypothesis testing and corresponding validation.

Qualifications of the Researcher

The researcher has obtained a Bachelor of Science degree in Mechanical Engineering (Minor in English) from the School of Engineering and Computer Science at Oakland University in Rochester, Michigan, an ABET-accredited program. After completion of this undergraduate degree, he then initiated his professional career within

the U.S. automotive industry at Ford Motor Company. As such, the researcher's professional career has now spanned over twenty years in various technical and management positions within the U.S. automotive industry supply chain, via Tier 1 suppliers and below. He is currently employed within the U.S. automotive industry at a Top 50 Tier 1 automotive supplier located in Metropolitan Detroit. During his professional career he has also completed a Master's of Science degree in Administration with a concentration in Industrial Management from Central Michigan University in Mount Pleasant, Michigan. Current and previous academic experience includes adjunct professor positions at Lawrence Technological University, Ferris State University, and Concordia University (MI) within industrial technology and business management curricula.

Materials. Standard office supplies such as paper, envelopes, and file folders were used throughout the research work. Additional materials included printed corresponding journal articles and other referenced resources. In addition, supplemental research files were kept via electronic media, with respondents being able to request final completed studies. Likewise, keeping respondent confidentiality was paramount.

Equipment. A personal computer with corresponding survey software ("SurveyMonkey" software) was used to prepare the questionnaires for the survey that were sent electronically to potential respondents. In addition, corresponding statistical analyses were also performed using Microsoft Excel statistical software, with additional software by means of Microsoft Word and Powerpoint for text and presentation capabilities, respectively.

Facilities. Several libraries, including Eastern Michigan University's Halle Library, the Concordia University Library, the Howell Carnegie Library, and the Oakland University Kresge Library provided the physical sites for much of the gathered research, with additional professional resources (i.e., industry association journals, industry statistics, professional industry association resources) were used for collecting the data for the research work.

Personnel. No additional support personnel were needed for this research, as all research was performed by the researcher, utilizing survey feedback and corresponding data collection from automotive industry professionals gathered by means of industry associations. Continuous professional experience and current industry associations of the researcher aided in the compilation of potential respondents with the association of being automotive industry practitioners.

Research Methodology Summary

The initial chapters of this research study and corresponding methodology provided a short introduction to the growing and streamlined nature of today's U.S. automotive industry with respect to its supply chain and the usage of e-SCM procurement systems in alignment of that same goal. Also described was a need to help facilitate a greater role in providing potential strategic advantages such as advanced technologies in supply chain management. Using such technologies can help organizations in this industry to become and maintain a leadership role in the highly competitive global marketplace. Automotive manufacturing in the United States has become a very cost-driven process that needs advanced technologies applied throughout its entire supply chain and corresponding process flow in order to best optimize the

potential and kinetic advantages throughout. This study has analyzed what factors aid in the adoption of such needed technologies in this industry with recommendations for further investigation.

This study was purposely focused to review those factors that are associated with the adoption of electronic procurement systems within the U.S. automotive industry. It is through the distribution, collection, and statistical analysis of a pre-established, content-validated survey instrument to those within the automotive industry that was designed to review these factors. Once collected and data tabulated, corresponding statistical techniques such as t-tests have further investigated the correlation of these factors. These were completed by using comparisons of means of the resulting data per each question within the survey instrument as proposed in the original research. Likewise, as performed in the original research, statistical analysis by means of P-values and Spearman's Rho correlations (used for ordinal data) were completed and reviewed for better understanding of the overall hypotheses raised and summarily found to be both significant and likewise supported for Hypotheses 1, 2, and 4, with the lack of correlation of Hypothesis 3 concerning company (organization) size when examining size based on number of employees and corresponding e-SCM procurement system adoption. Inversely, Hypothesis 3 is supported when examining company size based on annualized sales and corresponding e-SCM procurement system adoption. It is this researcher's hope that this study will be beneficial to all organizations within the automotive supply chain and can be used to determine whether or not to adopt electronic supply chain management (e-SCM) procurement systems within their own organizations. It is by means of a focus to the future that the resulting professional and

academic desire of the researcher that this study and its corresponding results have been compiled into a summary that will be available to all those who fully participated in the survey process. This study is also available to others in academia, industry, as well as others who want to learn more concerning this topic as a basis for future research, an important point that is further discussed in Chapter V.

Chapter IV–Analyses and Results

The purpose of this chapter was to review and share the results of the analyses of the survey responses collected from the respondents. In addition, the results derived from the survey respondents in this study were used to help delineate the research questions and the corresponding hypotheses that this study intended to answer. The chapter was organized using the following headings: characteristics of the instrument, descriptive statistics for demographics, descriptive statistics for the factors, results for hypotheses testing, and lastly, a corresponding summary of the findings.

This study was devised with the intention of furthering the body of knowledge concerning the U.S. automotive industry, an industry that, much like manufacturing within our country domestically, has seen highs and lows in terms of overall economic impact, domestically and internationally (National Association of Manufacturers, 2014). Based on prior model development concerning technology acceptance (Davis, 1985) and innovation adoption (Rogers, 1963), respectively, a survey instrument was initially derived and pilot tested by being administered to a small group of automotive industry practitioners. Based on results of the pilot testing, the resulting survey was shortened and then distributed to prospective respondents for final distribution by means of SurveyMonkey® software. The final survey instrument was then tested for internal reliability via the Cronbach's Alpha technique. The reliability (internal consistency) of the items comprising each dimension (construct) within the final field test (final survey instrument) was examined using Cronbach's Alpha. Following the guideline established by Nunnally (1978), an alpha score of higher than 0.70 is generally considered to be

acceptable. Within this study, when examining the variables measured, each of the corresponding individual Alpha scores were 0.925, 0.928 and 0.907. When looking at the aggregate for Cronbach's Alpha, this results in a mean Alpha score that was calculated to be 0.92, further verifying reliability of the final survey instrument.

Data were then collected via SurveyMonkey into an Excel® format with initial coding taking place for the collected data, taking great care in the continuance of maintaining respondent anonymity and corresponding confidentiality. Prior to data gathering, an analysis of pertinent web-based survey techniques was reviewed, with a standard protocol chosen to be mirrored in this study (Archer, 2005). Using this technique (Archer, 2005) to reach out to prospective respondents, the researcher tracked the timing and follow up necessary in collecting the full study data. As part of the data gathering, an analysis concerning the return rate and subsequent re-sending in order to complete the full data set was examined and, as such, a similar pattern was determined that was interestingly similar to that of the Innovation Adoption model from Rogers (1963) as shown in Table 1. Following a pattern much like Rogers' initial innovation adoption model, data were completed by respondents in a similar distribution, whereas initial respondents could be considered "Innovation Adopters", with following responders shifting into similar categories ("Mainstream adopters" and "Later adopters"), with final responders creating a "Laggards" category of analysis. Based on these categories, the initial respondents of the survey were of a larger quantity than what would be statistically categorized as "innovators" ("those first to adopt a new technology or innovation"), with the later categories following suit in relation to the trends in percentages to Rogers' likewise analysis (see Table 1 below).

Table 1.

Respondent Group Categories Based on Timing–Diffusion of Innovations

Group Category	e-SCM Study Response Frequencies*
Innovators (2.5%)	(9.0%) – Response within 1 week of survey distribution
Early Adopters (13.5%)	(19.4%) – Response within 2 weeks of survey distribution
Early Majority (34%)	(31.9%) – Response after follow up email and 3 weeks of survey distribution
Late Majority (34%)	(27.1%) – Response after follow up email and 4 weeks after survey distribution
Laggards (16%)	(12.5%) – Response after 1 month and two follow-up emails

Note: *This refers to the respondents and the amount of each category based on the frequency and order in which they responded to the survey request(s) at their respective companies, following the web-based survey protocol established by Archer (2005). Total respondents (n=144) within full survey collection.

Per Rogers (2003), the stages by which a person adopts an innovation, and whereby diffusion is accomplished, include awareness of the need for an innovation, decision to adopt (or reject) the innovation, initial use of the innovation to test it, and continued use of the innovation. There are five main factors that influence adoption of an innovation, and each of these factors is at play to a different extent in the five adopter categories.

1. Relative Advantage-The degree to which an innovation is seen as better than the idea, program, or product it replaces.
2. Compatibility-How consistent the innovation is with the values, experiences, and needs of the potential adopters.

3. Complexity-How difficult the innovation is to understand and/or use.
4. Triability-The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.
5. Observability-The extent to which the innovation provides tangible results.

It is both interesting and pertinent to see the overall distribution as it relates to the final respondent categories and the time they took in responding back with completed surveys. Much like Rogers' analysis concerning the diffusion of innovations (1963), the study here concerning the "innovation" of e-SCM procurement systems utilized within the U.S. automotive industry had witnessed survey respondents following in a similar, normal pattern. Table 1 shows the corresponding categories from Rogers' work in comparison to the survey respondents from this study, with an overall similar response rate trend toward each of the identified group categories. From an overall industry perspective, the U.S. automotive industry and its corresponding supply chain provides the "diffusion" of the innovation or innovative process by means of the usage of e-SCM procurement systems within a given organization. Furthermore, this it is through the "Innovation-Decision Process," or "the process through which an organization passes from first knowledge of an innovation [here, it is e-SCM procurement systems] to forming an attitude (or perception) toward the innovation, to a decision to adopt or reject the innovation, to implement and use the new innovation with confirmation of this decision" amongst others within the organization (Rogers, 2003, p. 475). This process succinctly describes an automotive supplier's realization and eventual adoption (or rejection) of an e-SCM procurement system within the U.S. automotive industry supply

chain and corresponding usage of such a system within their organization. To further the comparison to this industry and those that are "innovators", Rogers (2003) had described that, "…innovators and early adopters have favorable attitudes toward new ideas and more actively search for innovations. They also possess more resources and thus can adopt higher-cost innovations that later adopters cannot afford" (Rogers, 2003, p. 457), an important point to clarify, as resources that are necessary, are available in the U.S. automotive industry.

Further analysis occurs when examining the resulting data against the backdrop of demographic categories. An overall analysis of each measurement question follows with furthered discussion pertaining to specific demographic results and corresponding review. Such a review helps to examine, in detail, the gathered corresponding demographic results with an eye toward trends and further understanding as it relates to application within the U.S. automotive industry and its corresponding supply chain. In addition, based on the research questions and corresponding hypotheses proposed by the researcher, research-based demographics collected via the surveys collected and investigated helped to analyze both the third and fourth listed hypotheses, concerning overall organization size and respondent gender.

The following section reviews in detail the quantitative means of each individual collected respondent survey question. Further analysis of these means includes a comparison of response means using the t-test statistic, for, "…in general, when comparing two means, the t-test is used" (Fowler, 2009, p. 54). As such, the individual

survey question responses will be subsequently reviewed in the following section (Chapter IV).

Descriptive Statistics for Demographics

When examining the data contained within Table 2 (below) concerning respondent organizational department, one can see that the survey distribution was concentrated primarily amongst purchasing, engineering, sales, and manufacturing personnel, those positions that within the automotive supply chain that interact predominantly with both "up-level" customers (OE level) as well as "down-level" suppliers (located further down the Tier level) whose production is dependent on up-level suppliers. This departmental distribution amongst final survey respondents is important within the automotive industry, and likewise should have been expected from a practical standpoint.

Table 2:

Organizational Department.

Organizational Department	Number of Respondents	Percentage
Purchasing/Procurement	37	25.7%
Engineering/Design	47	32.6%
Sales/Marketing	24	16.7%
Manufacturing/Production	9	6.3%
Human Resources	2	1.4%
Accounting/Finance	3	2.1%
Information Technology	2	1.4%
Quality/Inspection	9	6.3%
All Other, Including Executives	11	7.6%

Table 3 (below) corresponds with respondent experience level based on years of professional industry employment, this study utilized surveys from experience-leaden employees, with over 75% of the respondents having five years or more of experience, further providing merit to responses. In addition, this industry continues to have a wider distribution or spread of experience amongst its workforce, especially in the post-2009 recession that reduced the overall number and percentage of many experienced professionals through employee layoffs and forced early retirements, both at the OEM (vehicle manufacturer) and Tier1 supplier level (Hill, 2010). As such, from an experience standpoint, this study had an overall average respondent tenure directly between 10 to 15 years.

Table 3:

Years of experience.

Years with Organization	Number of Respondents	Percentage
Less than 1 year	12	8.3%
1 to 3 years	12	8.3%
3 to 5 years	12	8.3%
5 to 10 years	37	25.7%
10 to 15 years	26	18.1%
15 to 20 years	18	12.5%
20 or more years	27	18.8%

As the need for furthered education (beyond secondary education) continues in our global economy of today, it is further reflected in STEM-based industries such as the automotive industry. As such, this point was further reflected in this study, as it was completed with an overwhelming majority (96.5%) of respondents having an education

level beyond high school (see Table 4, below). This, too, is a shift in the automotive industry since the 2008-2009 recession, as many positions (such as manufacturing supervisor, computer-based designer, etc.) that previously didn't need a degree to perform the position are now required to have such an entry-level education (CAR, 2016).

Table 4:

Education level.

Education	Number of Respondents	Percentage
High school	5	3.5%
Some College	5	3.5%
Associates Degree	10	6.9%
Bachelors Degree	72	50.0%
Masters Degree	37	25.7%
Doctorate	12	8.3%
Professional Degree	3	2.1%

An additional aspect of the automotive industry comes from the examination of gender within the ranks of those employed. Often a male-dominated arena, the automotive industry has recently seen examples of female high-ranking executives such as Mary Barra, the CEO of General Motors and Toyota's first senior executive, Julie Hamp, who was appointed group vice president and chief communications officer (Levin, 2015). Unfortunately, the U.S. automotive industry has had a dearth of women within its ranks, an underrepresented group much like other STEM-fields (Science, Technology, Engineering and Math) such as female educators within Industrial

Technology (Kasi & Dugger, 2000). As this study received such a low percentage of women respondents (see Table 5 below), it was indicative of the automotive industry population as a whole, the survey target population.

Table 5:

Respondent Gender

Gender	Number of Respondents	Percentage
Male	124	86.1%
Female	20	13.9%

Based on the research data collected, there were respondents from automotive suppliers of all various sizes in terms of number of employees (see Table 6, below). This helped to distribute the corresponding data collected across automotive supplier ranks, from small to large and those in-between in terms of number of employees within the organization. This distribution also helps to show that the automotive supply chain consists of a wide array of companies whose resources internally are likewise varied.

Table 6:

Company size (Based on number of employees)

Number of Employees*	Number of Respondents	Percentage
Under 100 employees	20	13.9%
100 to 500	14	9.7%
501 to 1000	13	9.0%
1001 to 5000	23	16.0%

5001 to 9999	9	6.3%
10,000 to 15,000	13	9.0%
15,001 to 25,000	25	17.4%
25,001 or more	27	18.8%

Note: *This refers to the number of employees at the respondent's respective company.

Based on the research data collected, there were respondents from automotive suppliers of all various sizes in terms of fiscal size (see Table 7 below, company size based on annualized sales). This helped in gathering data across a wide distribution across automotive supplier ranks, from small to large and those in-between in terms of number of overall annualized sales for the organization. This distribution correlates to the likewise seen above distribution in terms of number of employees for respondent organizations.

Table 7:

Company Size (based on annualized sales)

Corporation Income	Number of Respondents	Percentage
Less than $500K	5	3.5%
$500k to $1MM	0	0.0%
$1MM to $10MM	10	6.9%
$10MM to $50MM	22	15.3%
$50MM to $100MM	10	6.9%
$100MM to $1B	39	27.1%
$1B to $5B	27	18.8%
$5B to $10B	11	7.6%
Over $10B	11	7.6%

Based on automotive supplier type (see Table 8, below), this study primarily examined Tier 1 and 2 suppliers, those who are most directly influenced by the U.S. OEM automakers such as GM, Ford, and Chrysler. Additional future studies can be further focused, requesting information concerning the types of systems or components that the respondent's company produces. Examples of this would include studies specific to powertrain or braking system suppliers.

Table 8:

Automotive Supplier Type

Employer Type	Number of Respondents	Percentage
Tier 1 (Direct Supplier to OEM)	79	54.9%
Tier 2	38	26.4%
Tier 3	13	9.0%
Tier 4 or below	7	4.9%
Non-Direct supplier to Auto -OEM Industry	7	4.9%

When reviewing the respondent organizations in terms of e-SCM software, an overwhelming majority currently utilize such software (see Table 9 below). An additional question that may be asked for future studies would include: (for those companies who don't already have such a system implemented in their organization currently) if their organization is looking at implementing an e-SCM software package within their company in the near-term future, with various timeframes given as to when their company will implement such systems internally.

Table 9:

Current Usage

Does organization currently use e-SCM procurement software ?	Number of Respondents	Percentage
Yes	112	77.8%
No	32	22.2%

Results for Hypothesis Statement 1

Examining Tables 10 and 11 show the collective data corresponding to Hypothesis 1 – the decision to use an e-SCM procurement technology system has a significant positive association with ease of system use (EOU). From a correlation standpoint, the use of Spearman's Rho was beneficial as this survey utilized ordinal data (via the five point Likert scale to measure respondent attitude) and collectively had an average mean value of 0.715, showing a strong positive correlation. Likewise, the average of the mean values for each corresponding question in the instrument related to H1 was 3.19, another strong value to support this hypothesis. P-value analysis also provided additional validation of Hypothesis 1 concerning the positive correlation of perceived ease of use for an organization as being a strong positive correlation to automotive organizations determining to adopt such systems internally. Values for skewness and kurtosis were in the acceptable values to consider the test to be relatively symmetric with a smaller offset from data being in the "ideal" normal range.

Table 10:
Descriptive Statistics for H1

H1 Descriptive							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.24	0.99	3	4	-0.55	-0.04
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.92	1.10	3	3	-0.23	-0.65
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.94	1.02	3	3	-0.28	-0.52
EOU1	Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job enables me to accomplish tasks more quickly.	3.27	1.01	4	4	-0.65	-0.21
EOU5	Using e-Supply Chain Management (e-SCM)/e-Procurement systems make it easier to do my job.	3.28	1.06	4	4	-0.70	-0.26
EOU6	I find the e-Supply Chain Management (e-SCM)/e-Procurement system useful in my job	3.38	0.99	4	4	-0.90	0.29
EOU7	Learning to operate the e-Supply Chain Management (e-SCM)/e-Procurement system was easy for me.	3.38	0.99	4	4	-0.92	0.31
EOU8	I find it easy to get the e-Supply Chain Management (e-SCM)/e-Procurement system to do what I want it to do.	3.27	0.91	3	3	-0.17	0.38
EOU9	My interaction with the e-Supply Chain Management (e-SCM)/e-Procurement system is clear and understandable.	3.05	0.85	3	3	0.19	-0.31
EOU10	I find the e-Supply Chain Management (e-SCM)/e-Procurement system to be flexible in operation.	2.89	0.88	3	3	0.09	0.32
EOU11	It was easy for me to become skillful at using the e-Supply Chain Management (e-SCM)/e-Procurement system.	3.26	0.85	3	3	-0.67	0.74
EOU12	I find the e-Supply Chain Management (e-SCM)/e-Procurement system easy to use	3.43	0.80	3	3	-0.35	0.72

Table 11:

Correlational Statistics for H1

H1 Correlation (Spearman's Rho)									
	EOU1	EOU5	EOU6	EOU7	EOU8	EOU9	EOU10	EOU11	EOU12
PU10-12	0.716	0.816	0.802	0.731	0.615	0.607	0.682	0.687	0.782

Results for Hypothesis Statement 2

When examining the data for the Hypothesis 2 – that the decision to use an e-SCM procurement technology system has a significant positive association with organizational internal usefulness, or Perceived Usefulness (PU) as being a factor with a positive correlation toward organizations adopting e-SCM procurement systems within their organization, the researcher used a statistical tool known as the Spearman's Rho correlation coefficient. This statistical tool was chosen as the data being analyzed was ordinal in nature, based on the five-point, equally weighted attitude measurement Likert scale for respondents. It is through the use of the Spearman's Rho calculation coefficient and performing the Spearman's Rho calculation (the average Rho equals to 0.678) better investigate the correlation of perceived usefulness (PU) as a factor in organizations determining to implement e-SCM procurement systems, there is a strong positive correlation, or validation to such a hypothesis. P-value analysis also provided additional validation of Hypothesis 2 concerning the positive correlation of perceived usefulness as being a strong positive correlation to automotive organizations determining

to adopt such systems internally. Values for skewness and kurtosis were in the acceptable values to consider the test to be relatively symmetric with a smaller offset from data being in the "ideal" normal range, although PU7 showed highest skewness and kurtosis values, showing this particular question's higher deviation from symmetry.

Table 12:

Descriptive Statistics for H2

H2 Descriptive							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.24	0.99	3	4	-0.55	-0.04
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.92	1.10	3	3	-0.23	-0.65
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.94	1.02	3	3	-0.28	-0.52
PU2	Using e-Supply Chain Management (e-SCM) systems improve my department's effectiveness.	3.47	0.88	4	4	-0.35	0.11
PU3	Using e-Procurement/e-Supply Chain Management systems allow my department to accomplish tasks critical to the organization.	3.34	0.92	4	4	-0.68	0.10
PU4	Using e-Supply Chain Management (e-SCM)/e-Procurement systems allow my department to reduce costs.	3.41	0.89	4	4	-0.60	0.41
PU5	Using e-Supply Chain Management (e-SCM)/e-Procurement systems help my department meet staffing goals.	3.21	0.79	3	3	-0.39	0.92

PU6	Using e-Supply Chain Management (e-SCM)/e-Procurement systems makes it easier to perform my departmental functions.	3.40	0.93	4	4	-0.66	0.43
PU7	In general using e-Supply Chain Management (e-SCM)/e-Procurement systems are useful.	3.67	0.78	4	4	-0.83	1.17
EOU2	Using the e-Supply Chain Management (e-SCM)/e-Procurement system improves my job performance.	3.26	0.95	3	4	-0.50	-0.09
EOU3	Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job increases my productivity.	3.25	0.99	3	4	-0.65	-0.13
EOU4	Using the e-Supply Chain Management (e-SCM)/e-Procurement system enhances my effectiveness on the job.	3.23	0.98	3	4	-0.61	-0.07

Table 13:

Correlational Statistics for H2 – Perceived Usefulness

H2 Correlation (Spearman's Rho)									
	PU2	PU3	PU4	PU5	PU6	PU7	EOU2	EOU3	EOU4
PU10, 11, 12	0.605	0.594	0.586	0.608	0.592	0.668	0.845	0.799	0.801

Results for Hypothesis Statement 3

When examining the data for Hypothesis 3, which states that "the larger the organization, the more apt or greater acceptance it is to utilize an e-SCM procurement technology system within their organization", the researcher used a statistical examination of the resulting means from the resulting survey questions for each of the company size demographics. As one can see by examining the data in Tables 14-21, there are not large differences between the average of means for company size, negating

the hypothesized larger companies having more acceptance in adopting e-SCM procurement systems than those for smaller companies (and those in between as well). P-value analysis also provided additional little to no support of Hypothesis 3 concerning the concept that the larger the organization, the more apt or greater acceptance it is to utilize an e-SCM procurement technology system within their organization automotive organizations determining to adopt such systems internally. Values for skewness and kurtosis were wider ranging, with many acceptable values to consider the test to be less symmetric with a larger offset from data being in the "ideal" normal range. Of the questions covering Hypothesis 3, survey question PU9 in Table 17 showed by far the highest skewness and kurtosis values, -2.28 and 4.77, respectively, which in turn showed this particular question's higher deviation from symmetry (skewness), with large tailness or Kurtosis, potentially also ruling out this question against the others within the instrument for this respondent group.

Table 14:

Descriptive Statistics for H3 – Organization Size

H3: Annual revenue less than $500,000							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.4	0.89	4	4	-1.3	0.3
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	4.0	0.71	4	4	0.0	2.0
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	2.6	1.82	2	1	0.6	-2.2

PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.6	1.67	3	1	0.5	-0.6
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.4	1.52	2	1	0.3	-3.1

Table 15:

Descriptive Statistics for H3 – Organization Size

H3: From $1 Million to $10 Million							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.5	1.29	4	4	-0.7	-0.4
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.5	1.29	4	4	-1.0	-0.1
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.4	1.12	4	4	-0.9	0.8
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.0	1.18	3	4	-0.9	-0.6
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.3	1.27	4	4	-1.0	0.3

Table 16:

Descriptive Statistics for H3 – Organization Size

H3: From $10 Million to $50 Million							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**

PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.5	0.74	4	4	-0.39	-0.02
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.8	0.61	4	4	0.14	-0.29
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	2.9	1.06	3	4	-0.58	-0.82
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.9	1.11	3	3	-0.73	-0.72
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.7	0.94	3	3	-0.16	-0.75

Table 17:

Descriptive Statistics for H3 – Organization Size

H3: From $50 Million to $100 Million							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.3	0.82	3	3	0.81	1.24
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.7	0.67	4	4	-2.28	4.77
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.1	1.20	3	4	-0.23	-0.37
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.0	1.25	3	4	0.00	-0.91

PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.7	1.06	3	3	-0.66	-0.41

Table 18:

Descriptive Statistics for H3 – Organization Size

H3: From $100 Million to $1 Billion							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.3	0.87	3	4	-0.97	1.37
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.8	0.86	4	4	-1.14	2.56
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.5	0.95	4	4	-0.85	1.06
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.1	1.17	3	3	-0.29	-0.35
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.1	1.07	3	3	-0.49	-0.15

Table 19:

Descriptive Statistics for H3 – Organization Size

H3: Annual Revenue from $1 Billion to $5 Billion							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.5	0.94	4	4	-0.94	1.87

PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.9	0.61	4	4	-0.95	2.91
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.3	0.78	3	3	0.39	0.10
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.8	1.03	3	3	0.02	-0.59
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.0	0.91	3	3	0.00	-0.36

Table 20:

Descriptive Statistics for H3 – Organization Size

H3: From $5 Billion to $10 Billion							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.27	1.10	3	3	-0.65	0.69
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.36	1.12	4	4	-0.89	0.81
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.00	1.10	3	3	0.00	0.42
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.64	1.36	3	3	0.23	-0.97
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.55	1.21	2	2	0.69	0.29

Table 21:

Descriptive Statistics for H3 – Organization Size

H3: Over $10 Billion							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU 8	I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.	3.36	0.67	3	3	-0.59	-0.29
PU9	Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.	3.82	0.60	4	4	0.03	0.41
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.36	0.81	4	4	-0.85	-0.76
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.82	0.87	3	2	0.41	-1.62
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.18	0.75	3	3	-0.33	-0.88

Results for Hypothesis Statement 4

When examining the H4 data, specific to gender type (Table 24), the Spearman's Rho Rank Correlation Coefficient shows the far stronger relationship for females. Likewise, when analyzing the descriptive statistics, the average of the means for both the EOU and PU variables based on question response showed that for females, the average was 3.89 per response, whereas males averaged only 3.09 per response. Based on the prior work completed by Bonett & Wright (2000), it was determined that one needs to have a minimum number of respondents being 20 or more in a prospective study in order to properly have statistical significance and corresponding strength of Spearman's Rho correlation on such a small sample size. As such, this study reached this minimum threshold for sample size. Further data analysis was performed in this study by a method of a test of significance known as a P-value and the use of Spearman's Rho Rank Correlation Coefficient, a correlation statistical analysis tool that was used explicitly in

this study due to the collection of ordinal data. Here the Spearman's Rho values for women were, on average, 0.663, while the same average value for men was only 0.273, a difference of almost 2.5 times the amount.

Table 22:

Descriptive Statistics for H4 – Gender (Female)

H4: Female							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.7	0.66	4	4	0.40	-0.55
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.7	0.75	3.5	3	0.70	-0.76
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	3.7	0.47	4	4	-0.95	-1.24
EOU1	Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job enables me to accomplish tasks more quickly.	3.9	0.55	4	4	-0.08	0.77
EOU5	Using e-Supply Chain Management (e-SCM)/e-Procurement systems make it easier to do my job.	4.0	0.65	4	4	0.00	-0.28
EOU6	I find the e-Supply Chain Management (e-SCM)/e-Procurement system useful in my job	3.8	0.52	4	4	-0.29	0.46
EOU7	Learning to operate the e-Supply Chain Management (e-SCM)/e-Procurement system was easy for me.	4.1	0.55	4	4	0.08	0.77
EOU8	I find it easy to get the e-Supply Chain Management (e-SCM)/e-Procurement system to do what I want it to do.	3.9	0.72	4	4	0.15	-0.88

EOU9	My interaction with the e-Supply Chain Management (e-SCM)/e-Procurement system is clear and understandable.	3.9	0.72	4	4	0.15	-0.88
EOU10	I find the e-Supply Chain Management (e-SCM)/e-Procurement system to be flexible in operation.	3.8	0.70	4	4	0.29	-0.73
EOU11	It was easy for me to become skillful at using the e-Supply Chain Management (e-SCM)/e-Procurement system.	3.9	0.59	4	4	0.00	0.18
EOU12	I find the e-Supply Chain Management (e-SCM)/e-Procurement system easy to use	4.3	0.47	4	4	0.95	-1.24

Table 23:
Descriptive Statistics for H4 – Gender (Male)

H4: Male							
Code	**Question**	**Mean**	**Std. Dev.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PU10	I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.	3.2	1.02	3	4	-0.49	-0.25
PU11	In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.8	1.11	3	3	-0.15	-0.81
PU12	To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.	2.8	1.03	3	3	-0.07	-0.50
EOU1	Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job enables me to accomplish tasks more quickly.	3.2	1.03	3	4	-0.53	-0.44
EOU5	Using e-Supply Chain Management (e-SCM)/e-Procurement systems make it easier to do my job.	3.2	1.06	3	4	-0.63	-0.51
EOU6	I find the e-Supply Chain Management (e-SCM)/e-Procurement system useful in my job	3.3	1.03	4	4	-0.78	-0.05
EOU7	Learning to operate the e-Supply Chain Management (e-SCM)/e-Procurement system was easy for me.	3.3	1.00	4	4	-0.86	0.00
EOU8	I find it easy to get the e-Supply Chain Management (e-SCM)/e-Procurement system to do what I want it to do.	3.2	0.90	3	3	-0.14	0.50

EOU9	My interaction with the e-Supply Chain Management (e-SCM)/e-Procurement system is clear and understandable.	2.9	0.79	3	3	0.16	-0.29
EOU10	I find the e-Supply Chain Management (e-SCM)/e-Procurement system to be flexible in operation.	2.7	0.82	3	3	0.05	0.64
EOU11	It was easy for me to become skillful at using the e-Supply Chain Management (e-SCM)/e-Procurement system.	3.2	0.85	3	3	-0.65	0.65
EOU12	I find the e-Supply Chain Management (e-SCM)/e-Procurement system easy to use	3.3	0.75	3	3	-0.42	1.01

Table 24:

Correlational Statistics for H4 – Gender (Female)

H4: Female Correlation (Spearman's Rho)									
	EOU1	EOU5	EOU6	EOU7	EOU8	EOU9	EOU10	EOU11	EOU12
PU10-12	0.564	0.600	0.560	0.720	0.583	0.663	0.681	0.684	0.928

Table 25:

Correlational Statistics for H4 – Gender (Male)

H4: Male Correlation (Spearman's Rho)									
	EOU1	EOU5	EOU6	EOU7	EOU8	EOU9	EOU10	EOU11	EOU12
PU10- 12	0.249	0.155	0.152	.217	0.383	0.428	0.332	0.304	0.233

When examining the overall results and reviewing the data against the collected demographics, one can also see several indicative trends. An initial review shows that

this U.S. automotive industry study reviewed here was completed by only 14% females, a less than ideal figure, but one that is indicative of this industry and the overall trends in STEM-based fields of industry in the United States. Despite the fact that women make up nearly half of the working population, they continue to remain underrepresented in STEM occupations, as witnessed by the fact that in 2012, only 26 percent of STEM workers were women and 74 percent were men. (BLS, 2013). Additional information culled from the demographics as it relates to educational level, when examining gender, female respondents within this study had on average, higher educational levels than their male colleagues, as noticed by the 5.55 value (corresponding to MS degree or higher) compared to 3.14 (corresponding to BS or equivalent), respectively. This, too, is indicative of the underrepresentation of females in automotive despite being, on average, better educated than their male counterparts as examined within this study.

Table 26:

Correlational Statistics for H1-H4
EOU, PU, Company Size and Gender (Male/Female)

	Males	*Females*		
Hypothesis	*Mean*	*Mean*	*t-test*	*p-value*
H1(EOU)	3.144	3.950	-2.29	.001***
H2 (PU)	3.193	3.740	-1.87	.018*
H3 (Company Size – Annualized Sales)	6.016	6.350	-.860	.043*
H3 (Company Size – Number of Employees)	4.750	5.200	-1.30	.367
H4 (Gender and EOU)	3.091	3.890	-2.76	.008**

*** Significant at the ≤ .001 p-value level
** Significant at the ≤ .01 p-value level
* Significant at the ≤ .05 p-value level

Table 27:

Hypotheses testing summary

Hypothesis	**Supported**	**Significance (p-value level)**
H1: The decision to use an e-SCM procurement technology system has a significant positive association with ease of system use.	**Yes**	**p≤ .001**
H2: The decision to use an e-SCM procurement technology system has a significant positive association with organizational internal usefulness.	**Yes**	**p≤ .05**
H3: The larger the organization (based on annualized sales), the more apt or greater acceptance it is to utilize an e-SCM procurement technology system.	**Yes**	**p≤ .05**
H4: The use of an e-SCM procurement technology system via gender (women) within the automotive supply chain has a significant positive association with ease of system use.	**Yes**	**p≤ .01**

The corresponding P-values help to identify the statistical significance captured in the support of each researched hypothesis. From an overall significance standpoint, Hypothesis #3 is partially supported to the level of strength that will allow this hypothesis to be supported. Based on the data collected and analyzed, the researcher was unable to unequivocally determine that larger organizations when examining

company size by number of employees will have a greater occurrence of acceptance of e-SCM procurement systems within their organization. Interestingly enough, though, based on the data collected and analyzed, this conclusion is verified or supported when examining larger organizations using the variable company size in terms of overall annualized sales. Based on the study performed, those companies that have larger annualized sales will have a greater occurrence of acceptance of e-SCM procurement systems within their organization. The data suggests that the likelihood of acceptance of e-SCM procurement systems is correlated to corporation/organization size in terms of number of overall annualized sales. When comparing means of each respondent's corresponding organization, there were no discernible differences between various organization size and the resulting data, hence, the correlation of company size, as it relates to the number of overall employees as a potential factor on e-SCM procurement system adoption is likewise not supported. Each of these methods by which the data was examined determined that organizational size (only in terms of number of employees, but not in terms of overall annualized sales) was not a factor on e-SCM procurement system adoption, thereby negating Hypothesis 3 as a valid hypothesis using this company size metric (total employees).

When examining hypotheses 1, 2 and 4, the usage of P-values along with the statistical analysis technique of Spearman's Rank Correlation Coefficient was calculated for each of these suggested hypotheses (Tables 11, 13, 24, 25 and 26) resulting in corresponding high levels of significance for along with high values of the Spearman's Coefficient, thereby collectively indicating a strong positive relationship for each of these three hypotheses.

Chapter V–Discussion

This chapter provides the conclusions based on prior results presented in previous chapters, the implications for those involved in automotive manufacturing, the limitations that may impact any interpretations along with, and opportunities for future research that arise from this study.

Conclusions

This study was undertaken to investigate potential factors in relation to the acquisition and usage of e-supply chain management (e-SCM) procurement software within organizations specific to the U.S. automotive industry supply chain. Data were collected using survey research methodology from respondents corresponding specifically within this industry. The instrument constructs were derived from the technology acceptance model (TAM) and included ease-of-use (EOU) and perceived usefulness (PU) from an organizational perspective. In addition, the study collected pertinent respondent demographic information, such as: years of industry experience, department (employment area within an organization), company size (both in terms of annualized sales and number of employees), respondent educational level, and respondent gender.

Based on an analysis of the responses from study, one may be able to conclude that the two constructs (latent variables), the ease of use (EOU) of the e-SCM procurement technology software and the perceived usefulness (PU) of this same innovative technology are correlated with improved performance within the U.S. automotive industry through companies represented by the respondents. The findings of this study are consistent with prior studies covering TAM variables reflective of other

industries (Chau & Hu, 2002; Doll & Deng, 1998; Grewal, 2002).

In addition, organizational size in terms of annualized sales was shown to have a greater affect on e-SCM procurement system usage internally when compared to company size based on the number of employees. The number of male respondents were far greater than female respondents, an item further investigated both here and in additional studies (Eaton-Cardone, 2016) along with the corresponding Bureau of Labor Statistics (2013) data for this industry. When examining responses based on gender, this study showed that women, on average, were more highly educated than their male counterparts, and their responses exhibited a stronger, significant positive correlation to the ease-of-use (EOU) aspect of e-SCM technology. As witnessed via this study and reflective of this industry, women are severely underrepresented, creating the need for more STEM-based opportunities for women, another conclusion previously identified (Dugger & Kasi, 2000).

Organizational Implications

When examining the survey data results, one can see that two factors in determining e-SCM procurement system success are the ease of use, as the original TAM model refers to this factor as EOU, as well as the perceived usefulness, or PU. Likewise, another factor in the adoption of such technologies was determined to be user gender, with the analysis revealing a significant positive correlation for females (when compared to males) concerning the use of e-SCM procurement systems and the ease of system use. Fewer than 20 percent of the respondents to this survey were female, which is reflective of the overall automotive industry. This average is indicative of an underutilization of females and from an organization standpoint, it is advisable for

manufacturing organizations to help recruit females into the pipeline of those technical and STEM-based programs that, in turn, feed the industry's personnel base.

Another factor is company size in terms of overall annualized sales, with larger organizations with larger sales implementing and using such systems at a higher rate than smaller companies. One may conclude that all manufacturing organizations serving the U.S. automotive industry should implement e-SCM procurement systems (if not already having done so internally). From a competitive standpoint, another implication is that those companies who delay or don't eventually implement such an e-SCM procurement system will be behind, both technologically and economically, to their competitive counterpart automotive suppliers who already have implemented such a system within their own organizations.

Industry Implications

Based on the analysis of the demographic sections within this study, some very important STEM (Science, Technology, Engineering, and Mathematics) conclusions and corresponding implications can be drawn within the U.S. automotive industry, an industry that relies and will continue to rely heavily upon STEM-based curricula in K-20 for future prospective employees (Society of Automotive Engineers, 2014). Upon initial review, one of the most glaring aspects of the respondents (and the industry as a whole) is the large proportion of males versus females. This study reflects the overall trend of men outnumbering women in STEM-based positions nationally (Society of Women Engineers, 2013). Several organizations are working to help address the lack of women in this industry versus the general population in the United States, which is currently 52% Women, 48% Men (U.S. Census, 2013). Perhaps one of the greatest of these is the

Society of Women Engineers, an organization founded in 1950 in order to help promote women in the industrial workplace and whose mission is to, "Stimulate women to achieve full potential in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity (SWE, 2013). From a workplace standpoint, women make up 47% of the total U.S. labor force and account for 51 percent of the increase in total labor force growth since 2008 (U.S. Census, 2013). Research gathered here within the automotive industry had a response rate from women of only 14%, further heightening the need for a greater number of females in roles such as was gathered via prospective respondents in the domestic US automotive industry.

This important result reiterates the point and clearly speaks to the need for more STEM-based women graduates and industry members (SWE, 2013), a similar theme of under-representation from earlier studies concerning women, gender equity and STEM-based fields, such as educators within Industrial Technology (Kasi & Dugger, 2000) as well as women and other minorities within the U.S. automotive industry (Burnett, 2016; Eaton-Cardone, 2016).

This research has been undertaken to highlight the significance of electronic supply chain management (e-SCM) tools within the U.S. automotive industry and their influence on the users' perceptions of usefulness and ease of use, the major constructs developed through the technology acceptance model (Davis, 1985). As this research concerning the TAM model has grown over time, so has its applicability to other information systems (IS) based fields, ones that cover many more aspects of organizations as well as organization types than in the original research, clearly showing

how information systems (IS) is continually becoming a driving factor for organizations of all types and sizes (Davis, 2000). This research sought to provide organizations with additional knowledge and techniques to better utilize e-SCM procurement systems within their own organizations, avoiding the potential traps of unanticipated technological outcomes (Bellamy, 2007).

The work that was undertaken within this dissertation has been publicly disseminated by way of a presentation with further opportunities for publication in other scholarly journals and related conferences. This is mentioned in order to show additional support for the current, continual need for the collaboration between academia and industry, working toward bridging the gaps between theory and application, as well as interdisciplinary subject matter, material that this research will add to the existing continual body of knowledge.

Limitations

Upon review of this study, potential limitations were initially addressed by means of both research questions and potential respondents within this particular industry, limiting factors in terms of study completion, due to lack of resources in U.S. automotive industry research and development funding (Cooley, 2011). During the course of this study, both in terms of initial concept, through survey development and distribution, to final data collection and analysis, the U.S. automotive industry, specifically for which this study was devised, had undergone dramatic transformations within this country, as witnessed by the bankruptcies of both former "Big 3" automakers Chrysler and General Motors (Automotive Industry Action Group, 2012). In addition, our country had undergone a serious economic downturn, also known as "the Great

Recession" (Donlon, 2013) of which the severity of is still being felt, especially in hard hit areas such as the Midwest United States region. From a statewide perspective, Michigan and the town that is known as the "Motor City," Detroit was negatively impacted to an extreme degree and felt by individual families and economists alike by means of employment, corresponding population loss (U.S. Census, 2013) and financial disarray. As such, due to inadequate leadership and a large drain of jobs, tax income and overall revenue, the City of Detroit itself was forced to file for bankruptcy protection in 2013 (Bomey, 2014). Collectively, these are major limitations as the U.S. automotive industry funds far less studies (such as this one) than in previous decades (Hill, 2014).

One can further examine this important factor by examining the population of the state of Michigan, the U.S. Automotive Industry's largest employer in terms of individual state locales (AIAG, 2012). The state of Michigan was the only state in the United States that lost citizenry/general population from 2000 to 2010, as these are the last two census periods (U.S. Census, 2013). When examining the impact of this study, this fact is another important aspect as many of the research items that this study discussed and collected in terms of overall industry impact, have become even more valued within the American economic engine, both in terms of gross domestic product (GDP) as well as population layout. Limitations due to convenience sampling occurred within this study as the prospective respondents were purposefully selected based on automotive industry association as opposed to general manufacturing industries.

An additional limitation was that this study did not utilize the newer model, known as "TAM-2", which was developed specifically to address the limitations of the original TAM work by providing a deeper individual user perspective by adding

dimensions addressing social influence and cognitive instrumental processes (Davis, 2000). As such, to help keep this study at a manageable level, the research study here does not address the potential TAM-2 aspect of these respondents. Such an analysis can work toward this collective body of knowledge by way of additional future studies and opportunities for new research.

Lastly, additional limitations are present based on the selection of the population for this study since the respondents were representing only the U.S. automotive industry and not other employers who may benefit from this technology adoption.

Future Research

This study has focused on some of those items within the supply chain that have been shown to assist automakers and their suppliers, namely, the use of electronic supply chain management (e-SCM) software and its benefits for adopting organizations (and corresponding personnel). As such, this study has identified further opportunities for future research in various formats. 1). Additional future research could mirror the survey distributed from this study against additional alternative industries such as aerospace, defense or agriculture, for example, while looking for universal similarities and differences amongst the differing industries. Such similarities in results can work toward finding potential e-SCM solutions in these other industries. 2). Similarly, an additional avenue for future research could include examining other aspects of the supply chain within the automotive industry, looking for other opportunities for process and product savings with adoption of similar innovative technologies beyond the e-SCM systems examined here. 3). Additional opportunities for future research could focus on gender within the U.S. automotive industry supply chain specifically in other core

industry divisions or departments such as engineering, human resources, manufacturing, sales/marketing or distribution. 4). A similar study can similarly be completed with the corresponding U.S. automotive industry aftermarket supply chain. This is an important item that can be addressed with future research studies, providing additional opportunities for graduate students and research journals.

Epilogue

Along with the corporate bankruptcies, several recent American automotive brands have also been dissolved by their parent companies, including: Oldsmobile, Saturn, Hummer, Pontiac, Mercury, and Plymouth (Putnam, 2013). In addition, the United States of America had undergone a serious economic downturn, "…the severity of which is still being felt, by individual families and economists alike, especially in hard hit regions such as Detroit, Michigan" (McAlinden, 2010). This is an important aspect as many of the research items that this study discussed and collected have continued to be valued within the American economic engine through its collective impact. Such research reiterates the importance of the automotive industry on the United States of America, as was once a commonplace American saying, per former GM CEO Charles Wilson, "As General Motors goes, so goes the nation" (Woodhill, 2012).

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Appendices

Appendix A

Request for Human Subjects Approval Form

EASTERN MICHIGAN UNIVERSITY
Education First

March 14, 2011

UHSRC Initial
Application Determination
EXEMPT APPROVAL

To: Joseph Joyce
College of Technology

Re: UHSRC #110209 Category: EXEMPT #2
Approval Date: March 14, 2011

Title: "An Analysis of the Factors Associated with the Adoption of Electronic Supply Chain Management (e-SCM) Procurement Systems within the US Automotive Industry"

The Eastern Michigan University Human Subjects Review Committee (UHSRC) has completed their review of your project. I am pleased to advise you that your research has been deemed as exempt in accordance with federal regulations.

The UHSRC has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. Under our exempt policy the Principal Investigator assumes the responsibility for the protection of human subjects in this project as outlined in the assurance letter and exempt educational material.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit the Human Subjects Study Completion Form (found on the UHSRC website).

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a Human Subjects Minor Modification Form or new Human Subjects Approval Request Form (if major changes) will be required (see UHSRC website for forms).

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to human subjects and change the category of review, notify the UHSRC office within 24 hours. Any complaints from participants regarding the risk and benefits of the project must be reported to the UHSRC.

Follow-up: If your exempt project is not completed and closed after three years, the UHSRC office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

Please use the UHSRC number listed above on any forms submitted that relate to this project, or on any correspondence with the UHSRC office.

Good luck in your research. If we can be of further assistance, please contact us at 734-487-0042 or via e-mail at human.subjects@emich.edu. Thank you for your cooperation.

Sincerely,

Deb de Laski-Smith, Ph.D.
Interim Dean
Graduate School
Administrative Co-Chair
University Human Subjects Review Committee

University Human Subjects Review Committee : Eastern Michigan University : 200 Boone Hall
Ypsilanti, Michigan 48197
Phone: 734.487.0042 Fax: 734.487.0050
E-mail: human.subjects@emich.edu
www.ord.emich.edu (see Federal Compliance)

The EMU UHSRC complies with the Title 45 Code of Federal Regulations part 46 (45 CFR 46) under FWA00000050.

Appendix B

Initial (Pilot Study) Survey for Use in Research and Corresponding Data Collection

Automotive Supply Chain Industry Survey

For the purpose of this survey, suppliers (often referred to as "vendors") are defined as any organization external to your own to which you have in some way transferred responsibility for any type of product or process development efforts. Please note that this definition excludes directly employed contract workers. Also, please remember that questions are valued from 1 through 5:

1–Strongly Disagree, 2 –Disagree, 3 –Neither Agree Nor Disagree, 4 – Agree, 5 – Strongly Agree

Technology Acceptance Model (TAM) Survey

Perceptions of Outsourcing with e-Procurement Systems

Please assess your level of agreement with the following statements relative to supplier development work in your organization.

PU1 Using e-Procurement/e-Supply Chain Management systems improves the purchasing department's effectiveness.

PU2 Using e-Procurement/e-Supply Chain Management systems improves the quality of the purchasing department's IS applications.

PU3 Using e-Procurement/e-Supply Chain Management systems allows the purchasing and IT/IS function to accomplish tasks critical to the organization.

PU4 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to develop more systems than would otherwise be possible.

PU5 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to reduce costs.

PU6 Using e-Procurement/e-Supply Chain Management systems helps the IT/IS function meet staffing goals.

PU7 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to develop systems more quickly than would otherwise be possible.

PU8 Using e-Procurement/e-Supply Chain Management systems makes it easier to perform purchasing functions.

PU9 In general using e-Procurement/e-Supply Chain Management systems are useful.

EOU1 I understand how to use outsourcing.

EOU2 Using outsourcing does not require a lot of mental effort.

EOU3 I find outsourcing to be easy to use.

EOU4 I find it easy to accomplish what I set out to do through outsourcing.

EOU5 Using e-Procurement/e-Supply Chain Management systems makes it easier to share risk with the vendor

AT1 I like using e-Procurement/e-Supply Chain Management systems.

AT2 Outsourcing provides an attractive alternative to in house e-Procurement systems.

AT3 Using e-Procurement/e-Supply Chain Management systems is in general a good idea.

AT4 Using an e-Procurement/e-Supply Chain Management system creates a pleasant project environment.
IN1 Assuming I have an outsourcer for e-Procurement/e-Supply Chain Management systems, I intend to use them.
IN2 Given that I have access to an outsourcer for e-Procurement/e-Supply Chain Management systems I predict that I would use them.
IN3 I intend to increase my usage of e-Procurement/e-Supply Chain Management systems in the future
IN4 I intend to use e-Procurement/e-Supply Chain Management systems as often as needed.
IN5 In order to better interact with my OEM/Tier 1 customers, I would use e-Procurement/e-Supply Chain Management systems frequently.
IN6 To the extent possible, I would use e-Procurement/e-Supply Chain Management systems frequently.
IN7 It is due to the request of my OEM/Tier 1 customers that I would use e-Procurement/e-Supply Chain Management systems frequently.

Perceived usefulness
USE1 Using the e-Procurement/e-Supply Chain Management system in my job would enable me to accomplish tasks more quickly.
USE2 Using the e-Procurement/e-Supply Chain Management system would improve my job performance.
USE3 Using the e-Procurement/e-Supply Chain Management system in my job would increase my productivity.
USE4 Using the e-Procurement/e-Supply Chain Management system would enhance my effectiveness on the job.
USE5 Using the e-Procurement/e-Supply Chain Management system would make it easier to do my job.
USE6 I find the e-Procurement/e-Supply Chain Management system useful in my job.

Perceived ease of use
EAS7 Learning to operate the e-Procurement/e-Supply Chain Management system would be easy for me.
EAS8 I would find it easy to get the e-Procurement/e-Supply Chain Management system to do what I want it to do.
EAS9 My interaction with the e-Procurement/e-Supply Chain Management system would be clear and understandable.
EAS10 I would find the e-Procurement/e-Supply Chain Management system to be flexible to interact with.
EAS11 It would be easy for me to become skillful at using the e-Procurement/e-Supply Chain Management system.
EAS12 I would find the e-Procurement/e-Supply Chain Management system easy to use.
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*

Appendix C

Final (Post-Pilot Study) Survey for Use in Research and Corresponding Data Collection

Automotive Supply Chain Industry Survey

For the purpose of this survey, suppliers (often referred to as "vendors") are defined as any organization external to your own to which you have in some way transferred responsibility for any type of product or process development efforts. Please note that this definition excludes directly employed contract workers. Also, please remember that questions are valued from 1 through 5:

1–Strongly Disagree, 2 –Disagree, 3 –Neither Agree Nor Disagree, 4 – Agree, 5 – Strongly Agree

Technology Acceptance Model (TAM) Survey

Perceptions of Outsourcing with e-Procurement Systems

Please assess your level of agreement with the following statements relative to supplier development work in your organization.

PUR1 Using e-Procurement/e-Supply Chain Management systems improves the purchasing department's effectiveness.

PUR2 Using e-Procurement/e-Supply Chain Management systems improves the quality of the purchasing department's IS applications.

PUR3 Using e-Procurement/e-Supply Chain Management systems allows the purchasing and IT/IS function to accomplish tasks critical to the organization.

PUR4 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to develop more systems than would otherwise be possible.

PUR5 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to reduce costs.

PUR6 Using e-Procurement/e-Supply Chain Management systems helps the IT/IS function meet staffing goals.

PUR7 Using e-Procurement/e-Supply Chain Management systems allows the IT/IS function to develop systems more quickly than would otherwise be possible.

PUR8 Using e-Procurement/e-Supply Chain Management systems makes it easier to perform purchasing functions.

PUR9 In general using e-Procurement/e-Supply Chain Management systems are useful.

EOU1 I understand how to use outsourcing.

EOU2 Using outsourcing does not require a lot of mental effort.

EOU3 I find outsourcing to be easy to use.

EOU4 I find it easy to accomplish what I set out to do through outsourcing.

EOU5 Using e-Procurement/e-Supply Chain Management systems makes it easier to share risk with the vendor

OUT1 Assuming I have an outsourcer for e-Procurement/e-Supply Chain Management systems, I intend to use them.

OUT2 Given that I have access to an outsourcer for e-Procurement/e-Supply Chain Management systems I predict that I would use them.

OUT3 I intend to increase my usage of e-Procurement/e-Supply Chain Management

systems in the future
IN4 I intend to use e-Procurement/e-Supply Chain Management systems as often as needed.
IN5 In order to better interact with my OEM/Tier 1 customers, I would use e-Procurement/e-Supply Chain Management systems frequently.
IN6 To the extent possible, I would use e-Procurement/e-Supply Chain Management systems frequently.
IN7 It is due to the request of my OEM/Tier 1 customers that I would use e-Procurement/e-Supply Chain Management systems frequently.

Perceived usefulness
PU1 Using the e-Procurement/e-Supply Chain Management system in my job would enable me to accomplish tasks more quickly.
PU2 Using the e-Procurement/e-Supply Chain Management system would improve my job performance.
PU3 Using the e-Procurement/e-Supply Chain Management system in my job would increase my productivity.
PU4 Using the e-Procurement/e-Supply Chain Management system would enhance my effectiveness on the job.
PU5 Using the e-Procurement/e-Supply Chain Management system would make it easier to do my job.
PU6 I would find the e-Procurement/e-Supply Chain Management system useful in my job.

Perceived ease of use
EOU7 Learning to operate the e-Procurement/e-Supply Chain Management system would be easy for me.
EOU8 I find it easy to get the e-Procurement/e-Supply Chain Management system to do what I want it to do.
EOU9 My interaction with the e-Procurement/e-Supply Chain Management system would be clear and understandable.
EOU10 I would find the e-Procurement/e-Supply Chain Management system to be flexible to interact with.
EOU11 It would be easy for me to become skillful at using the e-Procurement/e-Supply Chain Management system.
EOU12 I would find the e-Procurement/e-Supply Chain Management system easy to use.
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*

Demographic questions – U.S. Automotive Industry Survey

Q. Employment History
How long have you worked for your current company?

o Less than one year
o From one to less than three years
o From three to less than five years
o From five years to less than ten years
o From ten years to fifteen years
o From fifteen years to twenty years
o Greater than twenty years

Q. Employment Area
Which of the following is your primary department that you have responsibility/authority for?

o Purchasing/Procurement
o Engineering/Design
o Sales/Marketing
o Manufacturing/Production
o Human Resources
o Accounting/Finance
o Quality/Inspection

Q. Education
What is the highest degree or level of school you have completed?

If currently enrolled, mark the previous grade or highest degree received.

o Attended high school, received no diploma
o High school graduate - high school diploma or the equivalent (for example: GED)
o Some college credit, no degree
o Associate degree (for example: AA, AS)
o Bachelor's degree (for example: BA, AB, BS)
o Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)
o Professional degree (for example: MD, DDS, DVM, LLB, JD)
o Doctorate degree (for example: PhD, EdD)

Q. What is your gender?

o Male
o Female

Q. Employer Type
Please describe your company's primary level within the U.S. Automotive Supply Chain

- o Tier 1 Supplier to the OEMs – Direct Supplier
- o Tier 2 Supplier
- o Tier 3 Supplier
- o Tier 4 or below
- o Non-Supplier, Do not currently have or support any automotive industry business

Q. Does your company currently use e-SCM procurement software?

- o Yes
- o No

Q. Corporation Income
Based on last year's earnings, what are your company's annual revenues?

- o Less than $500,000
- o From $500,000 to $1 Million
- o From $1 Million to $10 Million
- o From $10 Million to $50 Million
- o From $50 Million to $100 Million
- o From $100 Million to $1 Billion
- o From $1 Billion to $5 Billion
- o From $5 Billion to $10 Billion
- o Over $10 Billion
- o Unknown

Q. How many total employees are in your company (globally, all locations)?

- o Under 100
- o 100 to 500
- o 500 to 1,000
- o 1,000 to 5,000
- o 5,000 to 9,999
- o 10,000 to 15,000
- o 15,000 to 25,000
- o 25,000 or more

Thankyou again for your time and assistance in this academic study.

****

Appendix D

Research Overview and Consent Form for Prospective Survey Respondents for Use in Research and Corresponding Data Collection

Automotive Industry Technology Survey
Research Overview and Consent Form

GENERAL INSTRUCTIONS

This survey is part of a study to document the value of electronic technology (e-Business) in enhancing the sourcing function within the automotive industry. Such knowledge gained from such research can help professionals and researchers alike in focusing on the most important procurement processes/activities that can help an organization to improve its competitive position in the global economy of today.

Each question within this survey requires that you choose the alternative answer that best fits your view on that topic. Please note that there are no right or wrong answers, as I am only interested in your opinions. Participation in this study is entirely voluntary. This questionnaire should take no longer than 8-10 minutes to complete.

Also, please note that the information provided by you will be treated in the strictest confidence. Your responses will be entered into a coded format and in no instance will a person ever be identified as having given a particular response. By submitting this survey, you are giving your consent to participate in this research project.

Thank you very much for your help in this study. Please feel free to contact me if you have any questions, concerns or would like to know more about this research project. Please start the survey now by clicking on the **Survey Link** button below.

Sincerely,

Joseph J. Joyce
Ph.D Student
Eastern Michigan University
College of Technology – Doctoral Department
Phone: (810) 919-3857
Email: jjoyce@emich.edu

Appendix E

Research Survey Data

Survey - SurveyMonkey® Tabulation Results for Joseph J. Joyce, EMU

Response Summary Total Surveyed: 400 (303 minus bounces)

Total Completed Surveys: 144 (47.5%)

1. Please rate your satisfaction with the amount of purchasing currently transacted by your organization via means of electronic selections. This is based on a scale of 1 through 5, with 5 being extremely satisfied and 1 being absolutely no satisfaction at all.

	Response Percent	Response Count
1 - No satisfaction at all	4.2%	6 (6)
2 - Minimal/Partial Satisfaction	20.1%	29 (58)
3 - Neutral ("half-satisfied")	33.3%	48 (144)
4 - Mostly Satisfied	38.9%	56 (224)
5 - Extremely Satisfied	3.5%	5 (25) **Avg – 3.17**

2. Using e-Supply Chain Management (e-SCM) systems improve my department's effectiveness.

	Response Percent	Response Count
1 - Strongly Disagree	2.1%	3 (3)
2 - Disagree	9.7%	14 (28)
3 - Neither Agree Nor Disagree	37.5%	54 (162)
4 - Agree	40.3%	58 (232)
5 - Strongly Agree	10.4%	15 (75) **Avg – 3.47**

3. Using an e-Procurement/e-Supply Chain Management system allows my department to accomplish tasks critical to the organization.

	Response Percent	Response Count
1 – Strongly Disagree	4.2%	6 (6)
2 – Disagree	13.2%	19 (38)
3 – Neither Agree Nor Disagree	31.6%	46 (138)
4 – Agree	45.8%	66 (264)
5 – Strongly Agree	5.9%	7 (35) **Avg -3.34**

4. Using e-Supply Chain Management (e-SCM)/e-Procurement systems allow my department to reduce costs.

	Response Percent	Response Count
1 – Strongly Disagree	3.5%	5 (5)
2 – Disagree	9.7%	14 (28)
3 – Neither Agree Nor Disagree	36.1%	52 (156)
4 – Agree	43.8%	63 (252)
5 – Strongly Agree	6.9%	10 (50) **Avg–3.41**

5. Using e-Supply Chain Management (e-SCM)/e-Procurement systems help my department meet staffing goals.

	Response Percent	Response Count
1 – Strongly Disagree	3.5%	5 (5)
2 – Disagree	9.0%	13 (26)
3 – Neither Agree Nor Disagree	54.2%	78 (234)
4 – Agree	29.9%	43 (172)
5 – Strongly Agree	3.5%	5 (25) **Avg-3.21**

6. Using e-Supply Chain Management (e-SCM)/e-Procurement systems makes it easier to perform my departmental functions.

	Response Percent	Response Count
1 – Strongly Disagree	4.9%	7 (7)
2 – Disagree	9.0%	13 (26)
3 – Neither Agree Nor Disagree	35.4%	51 (153)
4 – Agree	43.1%	62 (248)
5 – Strongly Agree	7.6%	11 (55) **Avg-3.40**

Page: 2

1. In general using e-Supply Chain Management (e-SCM)/e-Procurement systems are useful.

	Response Percent	Response Count
1 – Strongly Disagree	1.4%	2 (2)
2 – Disagree	6.3%	9 (18)
3 – Neither Agree Nor Disagree	25.7%	37 (111)
4 – Agree	57.6%	83 (332)
5 – Strongly Agree	9.0%	13 (65) **Avg-3.67**

2. I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.

	Response Percent	Response Count
1 – Strongly Disagree	4.2%	6 (6)
2 – Disagree	6.9%	10 (20)
3 – Neither Agree Nor Disagree	39.6%	57 (171)
4 – Agree	43.1%	62 (248)
5 – Strongly Agree	6.3%	9 (45) **Avg-3.40**

3. Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.		
	Response Percent	Response Count
1 – Strongly Disagree	2.1%	3 (3)
2 – Disagree	4.2%	6 (12)
3 – Neither Agree Nor Disagree	20.1%	29 (87)
4 – Agree	62.5%	90 (360)
5 – Strongly Agree	11.1%	16 (80) **Avg-3.76**

4. I use e-Supply Chain Management (e-SCM)/e-Procurement systems as often as needed.		
	Response Percent	Response Count
1 – Strongly Disagree	6.9%	10 (10)
2 – Disagree	11.8%	17 (34)
[illegible]	37.5%	54 (162)

Nor Disagree		
4 – Agree	37.5%	54 (216)
5 – Strongly Agree	6.3%	9 (45) **Avg-3.24**

5. In order to better interact with my OEM/Tier 1 customers, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.

	Response Percent	Response Count
1 – Strongly Disagree	13.9%	20 (20)
2 – Disagree	17.4%	25 (50)
3 – Neither Agree Nor Disagree	36.8%	53 (159)
4 – Agree	26.4%	38 (152)
5 – Strongly Agree	5.6%	8 (40) **Avg-2.92**

6. To the extent possible, I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.

	Response Percent	Response Count
1 – Strongly Disagree	10.4%	15 (15)
2 – Disagree	19.4%	28 (56)
3 – Neither Agree Nor Disagree	38.9%	56 (168)
4 – Agree	27.8%	40 (160)
5 – Strongly Agree	3.5%	5 (25) **Avg-2.94**

7. It is due to the request of my OEM/Tier 1 customers that I use e-Supply Chain Management (e-SCM)/e-Procurement systems frequently.

	Response Percent	Response Count
1 – Strongly Disagree	7.6%	11 (22)
2 – Disagree	16.7%	24 (48)
3 – Neither Agree Nor Disagree	39.6%	57 (171)
4 – Agree	29.2%	42 (168)
5 – Strongly Agree	6.9%	10 (50)

	Avg-3.19

Page: 3

1. Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job enables me to accomplish tasks more quickly.		
	Response Percent	Response Count
1 – Strongly Disagree	6.9%	10 (10)
2 – Disagree	14.6%	21 (42)
3 – Neither Agree Nor Disagree	28.5%	41 (123)
4 – Agree	45.1%	64 (256)
5 – Strongly Agree	5.6%	8 (40) **Avg-3.27**

2. Using the e-Supply Chain Management (e-SCM)/e-Procurement system improves my job performance.		
	Response Percent	Response Count
1 – Strongly	5.6%	8 (8)

Disagree		
2 – Disagree	13.2%	19 (38)
3 – Neither Agree Nor Disagree	36.0%	52 (156)
4 – Agree	39.6%	57 (228)
5 – Strongly Agree	5.6%	8 (40) **Avg-3.26**

3. Using the e-Supply Chain Management (e-SCM)/e-Procurement system in my job increases my productivity.

	Response Percent	Response Count
1 – Strongly Disagree	6.9%	10 (10)
2 – Disagree	13.9%	20 (40)
3 – Neither Agree Nor Disagree	31.3%	45 (135)
4 – Agree	41.7%	60 (240)
[illegible]	[illegible]	[illegible]

		Avg-3.25
4. Using the e-Supply Chain Management (e-SCM)/e-Procurement system enhances my effectiveness on the job.		
	Response Percent	Response Count
1 – Strongly Disagree	6.9%	10 (10)
2 – Disagree	13.2%	19 (38)
3 – Neither Agree Nor Disagree	34.7%	50 (150)
4 – Agree	40.3%	58 (232)
5 – Strongly Agree	4.9%	7 (35) **Avg-3.23**
5. Using e-Supply Chain Management (e-SCM)/e-Procurement systems make it easier to do my job.		

	Response Percent	Response Count
1 – Strongly Disagree	8.3%	12 (12)
2 – Disagree	13.9%	20 (40)
3 – Neither Agree Nor Disagree	25.0%	36 (108)
4 – Agree	46.5%	67 (268)
5 – Strongly Agree	6.3%	9 (45) **Avg-3.28**

6. I find the e-Supply Chain Management (e-SCM)/e-Procurement system useful in my job.

	Response Percent	Response Count
1 – Strongly Disagree	6.9%	10 (10)
2 – Disagree	10.4%	15 (30)
3 – Neither Agree Nor Disagree	26.4%	38 (114)
4 – Agree	50.7%	73 (292)
5 – Strongly Agree	5.6%	8 (40)

	Avg-3.38

Page: 4

1. Learning to operate the e-Supply Chain Management (e-SCM)/e-Procurement system was easy for me.

	Response Percent	Response Count
1 – Strongly Disagree	3.5%	5 (5)
2 – Disagree	9.7%	14 (28)
3 – Neither Agree Nor Disagree	52.8%	76 (228)
4 – Agree	25.7%	37 (148)
5 – Strongly Agree	9.0%	13 (65) **Avg-3.29**

2. I find it easy to get the e-Supply Chain Management (e-SCM)/e-Procurement system to do what I want it to do.

	Response Percent	Response Count
1 – Strongly	1.4%	2 (2)

Disagree		
2 – Disagree	25.4%	36 (72)
3 – Neither Agree Nor Disagree	45.6%	65 (195)
4 – Agree	24.3%	35 (140)
5 – Strongly Agree	4.2%	6 (30) **Avg-3.05**

3. My interaction with the e-Supply Chain Management (e-SCM)/e-Procurement system is clear and understandable.

	Response Percent	Response Count
1 – Strongly Disagree	4.9%	7 (7)
2 – Disagree	8.3%	12 (24)
3 – Neither Agree Nor Disagree	45.8%	66 (198)
4 – Agree	37.5%	54 (216)
5 – Strongly Agree	3.5%	5 (25) **Avg-3.26**

4. I find the e-Supply Chain Management (e-SCM)/e-Procurement system to be flexible in operation.

	Response Percent	Response Count
1 – Strongly Disagree	5.6%	8 (8)
2 – Disagree	23.7%	34 (68)
3 – Neither Agree Nor Disagree	51.4%	74 (222)
4 – Agree	15.3%	22 (88)
5 – Strongly Agree	4.2%	6 (30) **Avg-2.89**

5. It was easy for me to become skillful at using the e-Supply Chain Management (e-SCM)/e-Procurement system.

	Response Percent	Response Count
1 – Strongly Disagree	2.1%	3 (3)
2 – Disagree	7.9%	11 (22)

3 – Neither Agree Nor Disagree	54.2%	78 (234)
4 – Agree	29.9%	43 (172)
5 – Strongly Agree	6.3%	9 (40) **Avg-3.27**

6. I find the e-Supply Chain Management (e-SCM)/e-Procurement system easy to use.

	Response Percent	Response Count
1 – Strongly Disagree	2.1%	3 (3)
2 – Disagree	6.3%	9 (18)
3 – Neither Agree Nor Disagree	44.4%	64 (192)
4 – Agree	40.3%	58 (232)
5 – Strongly Agree	7.0%	10 (50) **Avg-3.43**

1. Employment History: How long have you worked for your current company?			
		Response Percent	Response Count
Less than one year (1)		8.3%	12 (12)
From one to less than three years (2)		8.3%	12 (24)
From three to less than five years (3)		8.3%	12 (36)
From five years to less than ten years (4)		25.7%	37 (148)
From ten years to fifteen years (5)		18.1%	26 (130)
From fifteen years to twenty years (6)		12.5%	18 (108)
Greater than twenty years (7)		18.8%	27 (189) **Avg-4.5 (Bet. 10-15 yrs)**
2. Employment Area Which of the following is your primary department that you have responsibility/authority for?			

	Response Percent	Response Count
Purchasing/Procurement (1)	25.7%	37
Engineering/Design (2)	32.6%	47
Sales/Marketing (3)	16.7%	24
Manufacturing/Production (4)	6.1%	9
Human Resources (5)	1.4%	2
Accounting/Finance (6)	2.1%	3
Information Technology (7)	1.4%	2
Quality/Inspection (8)	6.3%	9
Other (9)	7.9%	11

3. Education What is the highest degree or level of school you have completed? If currently enrolled, mark the previous grade or highest degree received.

	Response Percent	Response Count
Attended high school, received no diploma (1)	0.0%	0 (0)
High school graduate - high school diploma (or equiv., GED) (2)	3.5%	5 (10)
Some college credit, no degree (3)	3.5%	5 (15)
Associate degree (for example: AA, AS) (4)	7.0%	10 (40)
Bachelor's degree (for example: BA, AB, BS) (5)	50.0%	72 (360)
Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA) (6)	25.4%	37 (222)
Professional degree (for example: MD, DDS, DVM, LLB, JD) (7)	1.8%	3 (21)

Doctorate degree (for example: PhD, EdD) (8)	8.8%	12 (96) **Avg-5.31 (Bachelor)**

4. What is your gender?

	Response Percent	Response Count
Male (1)	86.1%	124
Female (0)	13.9%	20

5. Employer Type: Please describe your company's primary level within the U.S. Automotive Supply Chain

	Response Percent	Response Count
Tier 1 Supplier to the OEMs – Direct Supplier (1)	54.9%	79 (79)
Tier 2 Supplier (2)	26.3%	38 (76)
Tier 3 Supplier (3)	8.8%	13 (39)
Tier 4 or below (4)	5.2%	7 (28)
Non-Supplier:Do not have/support any direct auto industry business (5)	5.2%	7 (35) **Avg-1.78 (Bet 1-2)**

6. Does your company currently use e-SCM procurement software?

	Response Percent	Response Count
Yes (1)	77.8%	112
No (0)	22.2%	32

7. Corporation Income: Based on last year's earnings, what are your company's annual revenues?

	Response Percent	Response Count

Less than $500,000 (1)	3.5%	5
From $500,000 to $1 Million (2)	0.0%	0
From $1 Million to $10 Million (3)	7.0%	10
From $10 Million to $50 Million (4)	14.9%	22
From $50 Million to $100 Million (5)	7.0%	10
From $100 Million to $1 Billion (6)	27.2%	39
From $1 Billion to $5 Billion (7)	18.4%	27
From $5 Billion to $10 Billion (8)	7.9%	11
Over $10 Billion (9)	7.9%	11
Unknown	6.1%	9 **Avg. - 6.06**

8. How many total employees are in your company (globally, all locations)?

	Response	Response

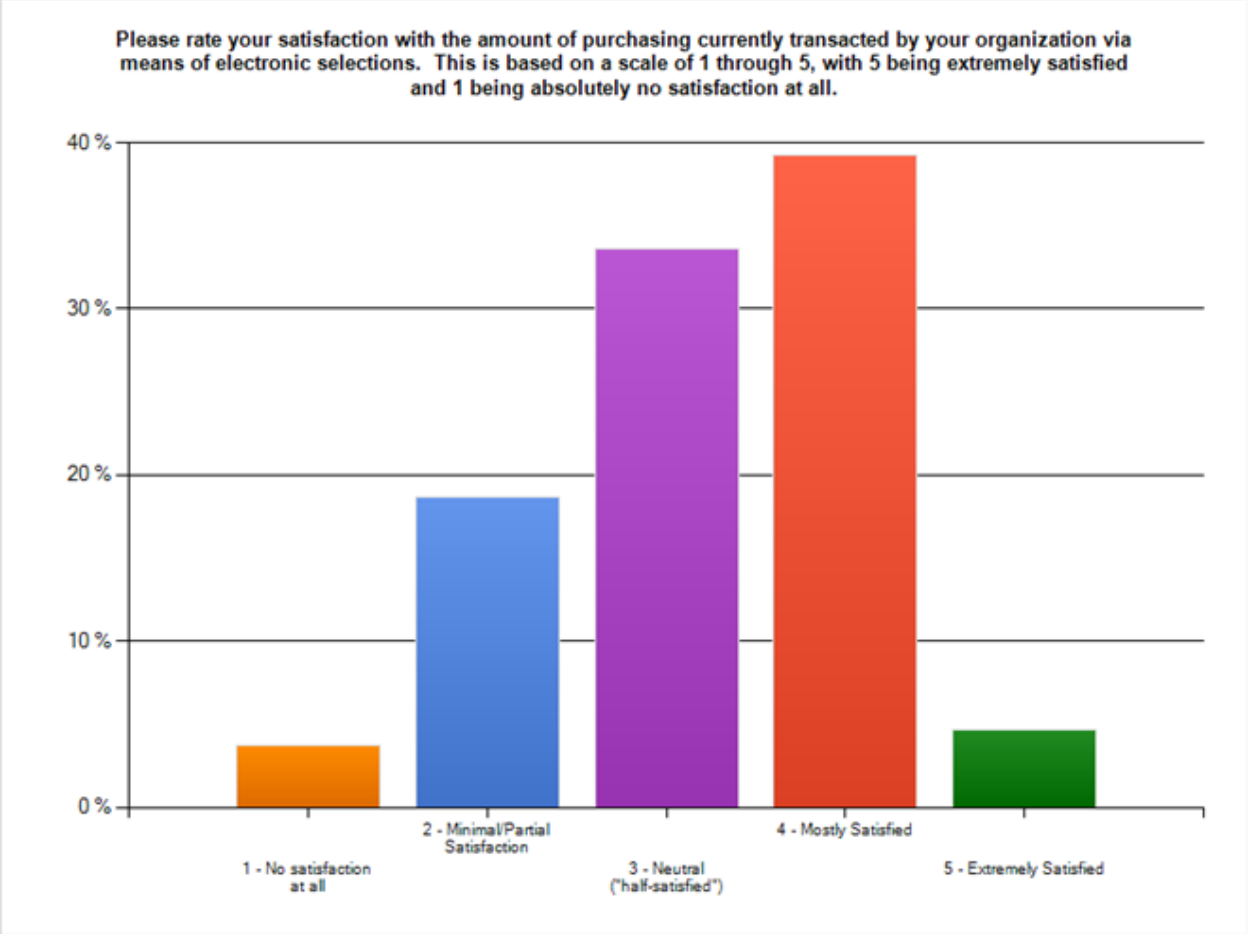
	Percent	Count
Under 100 (1)	13.9%	20
100 to 500 (2)	9.7%	14
500 to 1,000 (3)	9.0%	13
1,000 to 5,000 (4)	16.0%	23
5,000 to 9,999 (5)	6.3%	9
10,000 to 15,000 (6)	9.0%	13
15,000 to 25,000 (7)	17.4%	25
25,000 or more (8)	18.8%	27 **Avg.- 4.81**

Appendix F

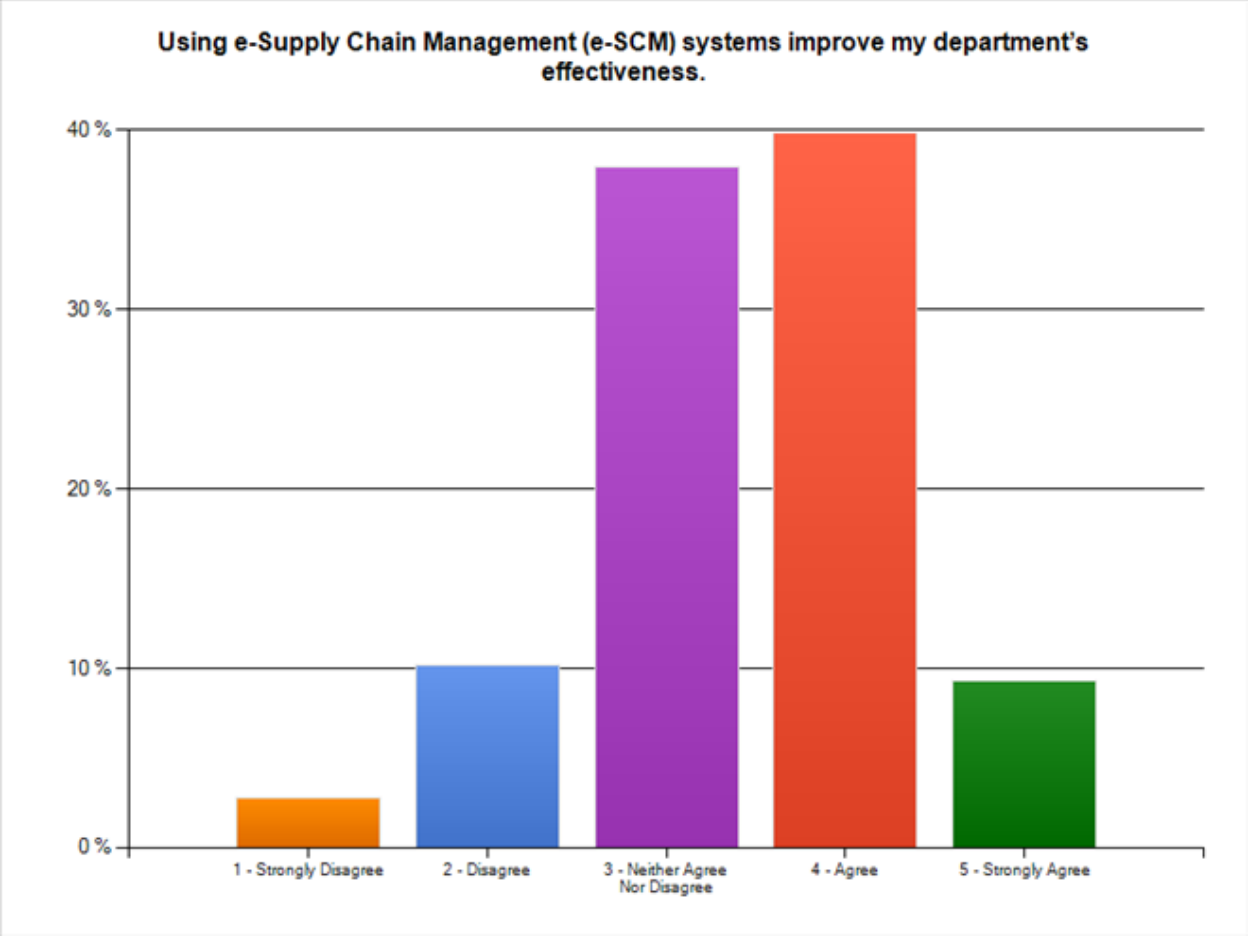
Research Survey Data - Graphical

Joseph Joyce – Ph.D. Study Regarding e-SCM in the U.S. Automotive Industry
Eastern Michigan University

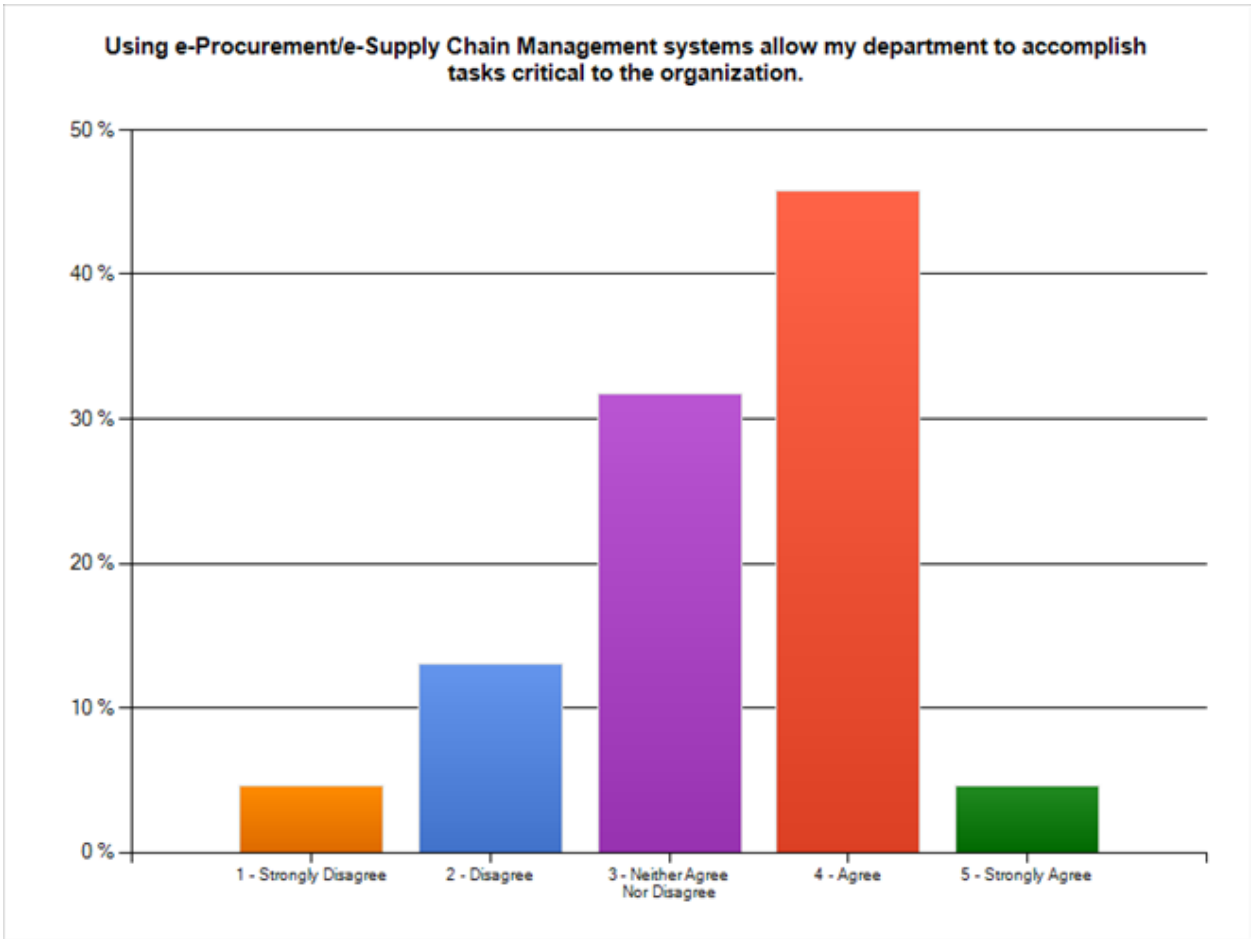
Q1 – Page 1 (PU1)



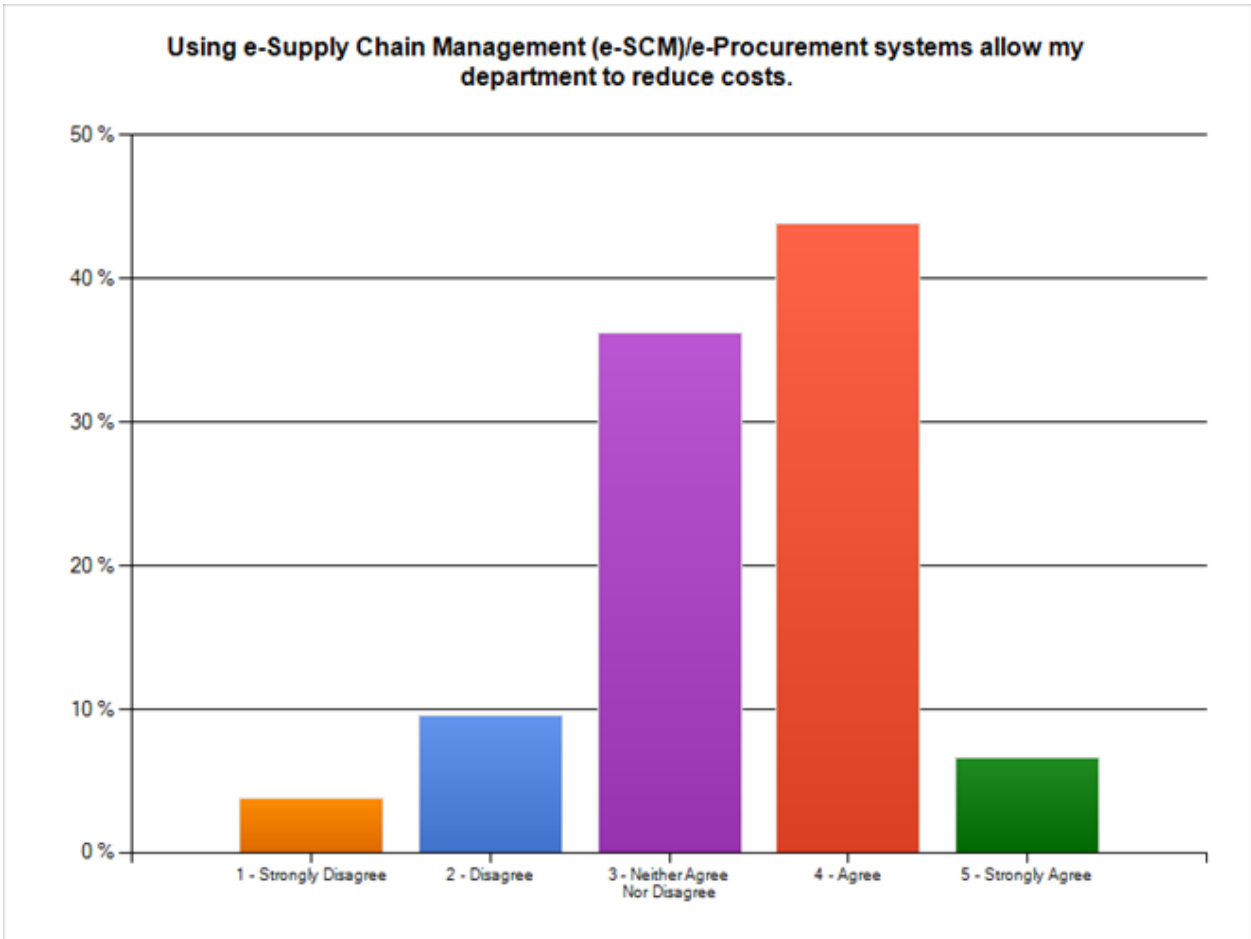
Q2 – Page 1 (PU2)


Using e-Supply Chain Management (e-SCM) systems improve my department's effectiveness.
40 %
30 %
20 %
10 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

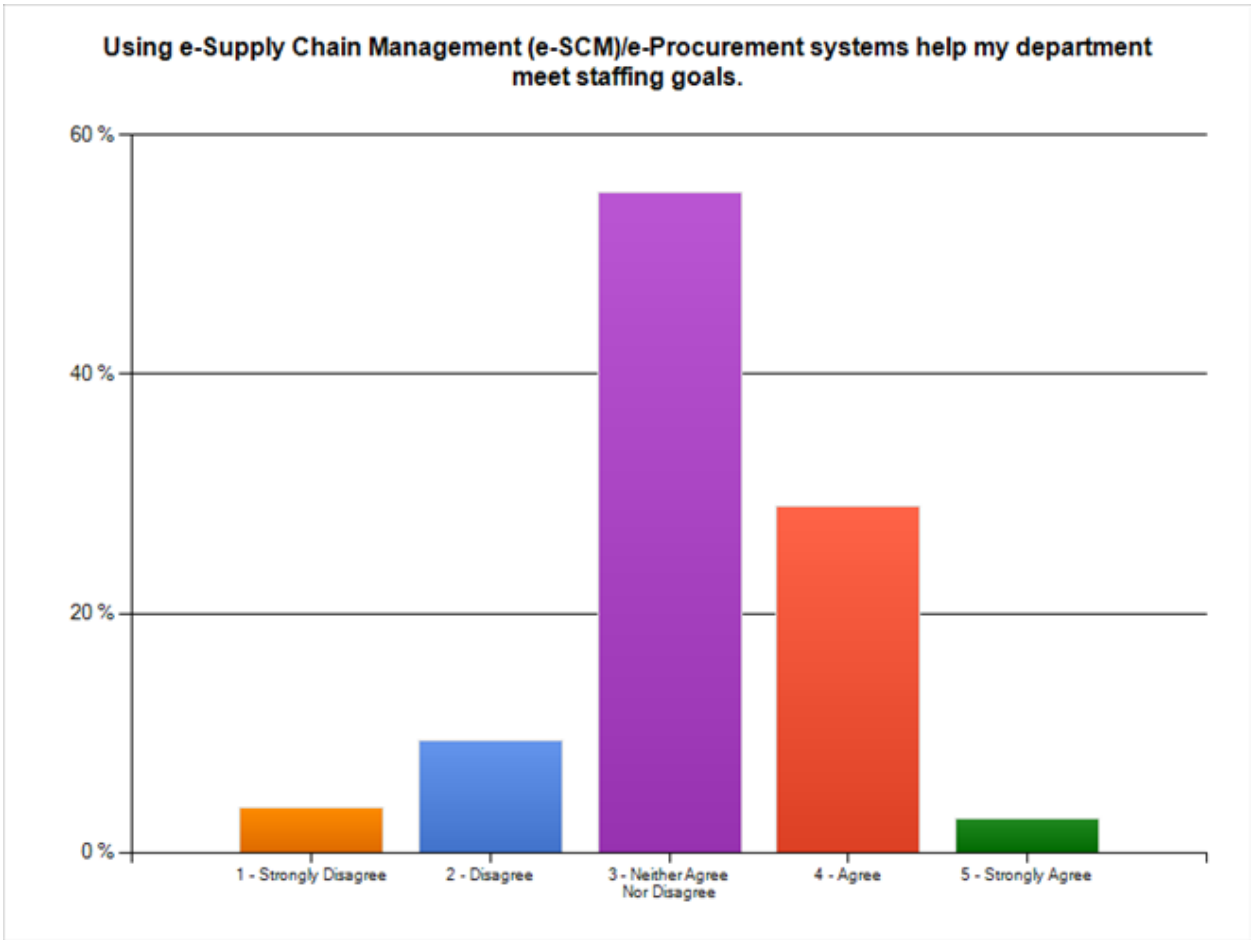
Q3 – Page 1 (PU3)


Using e-Procurement/e-Supply Chain Management systems allow my department to accomplish tasks critical to the organization.
50 %
40 %
30 %
20 %
10 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

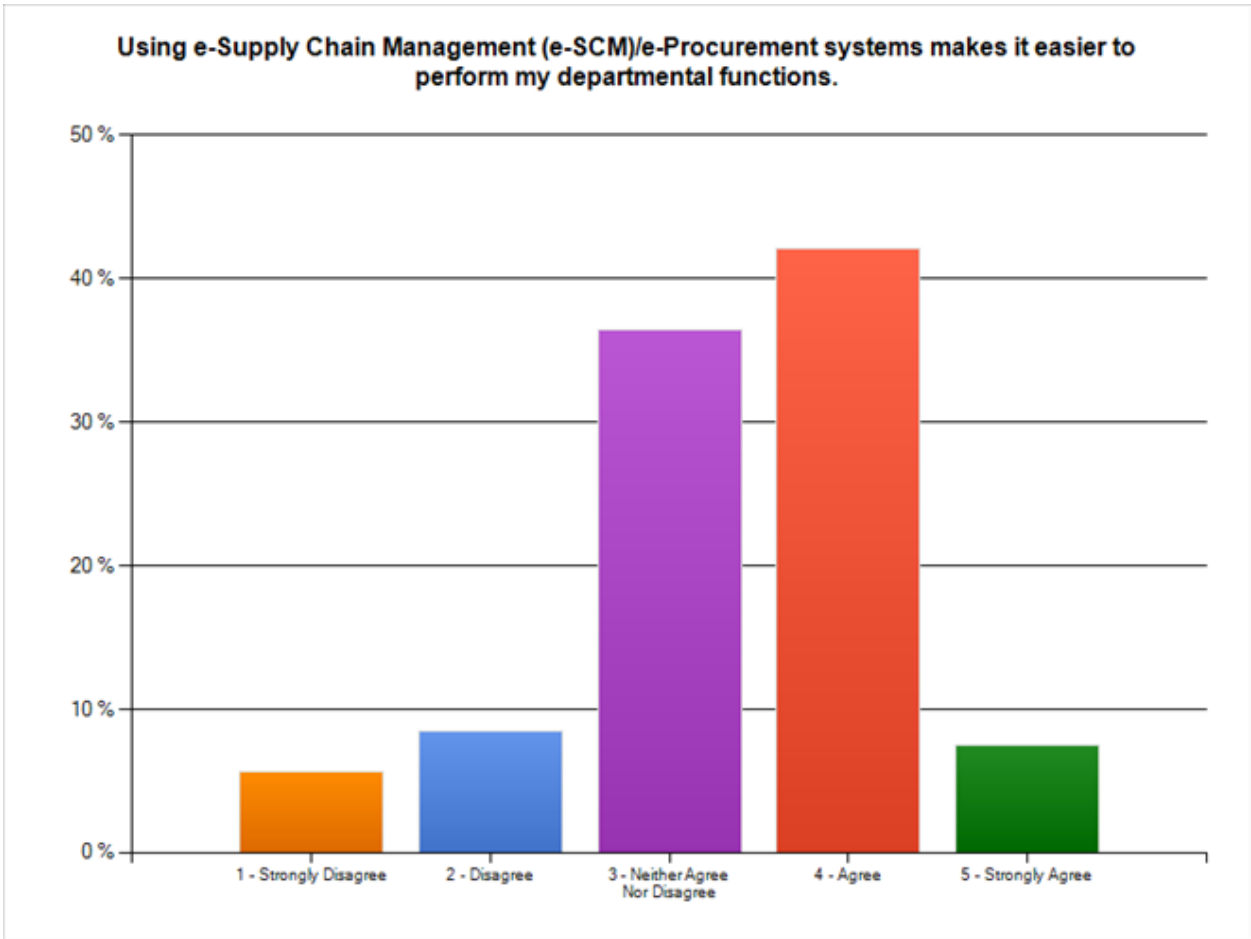
Q4 – Page 1 (PU4)


Using e-Supply Chain Management (e-SCM)/e-Procurement systems allow my department to reduce costs.
50 %
40 %
30 %
20 %
10 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

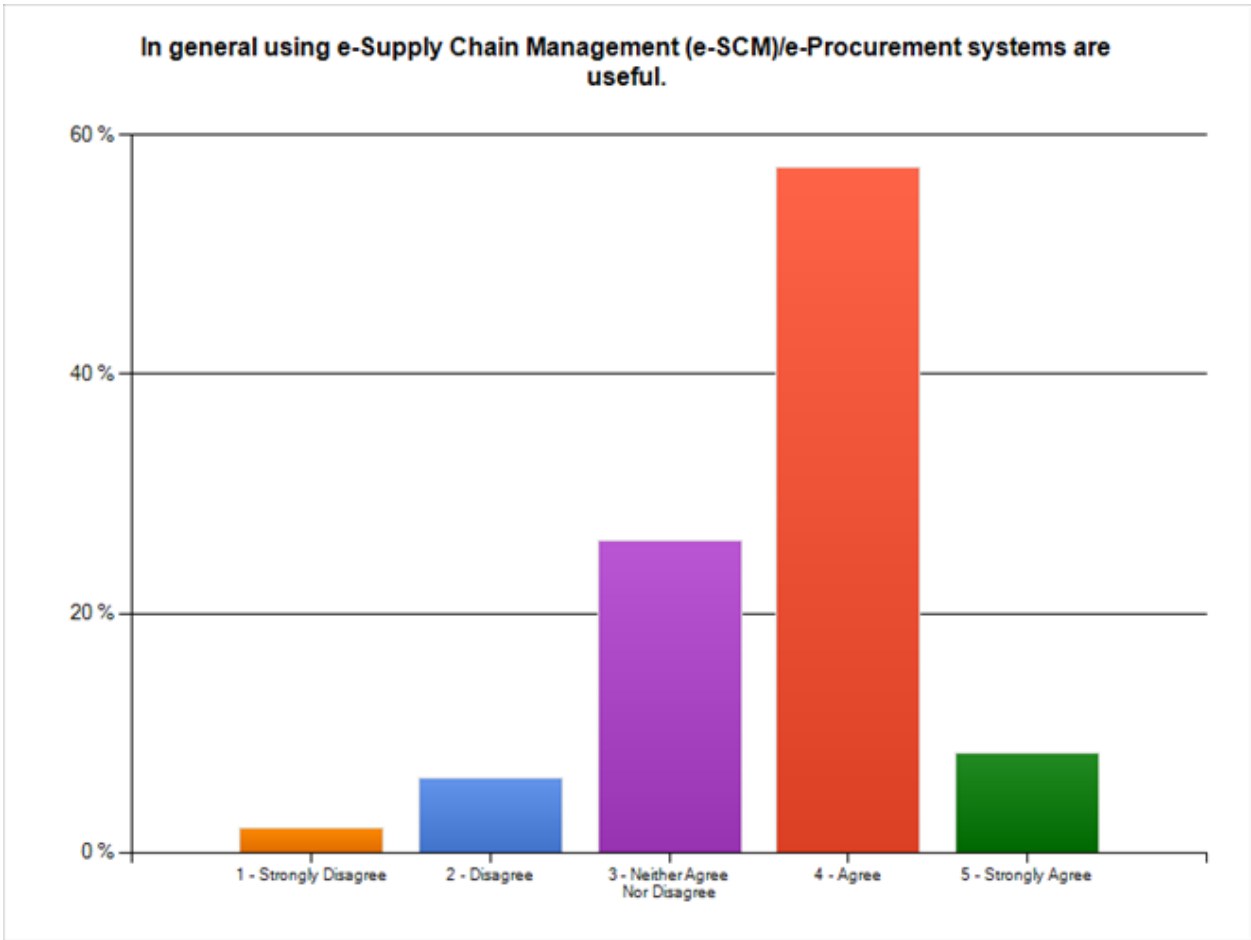
Q5 – Page 1 (PU5)


Using e-Supply Chain Management (e-SCM)/e-Procurement systems help my department meet staffing goals.
60 %
40 %
20 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

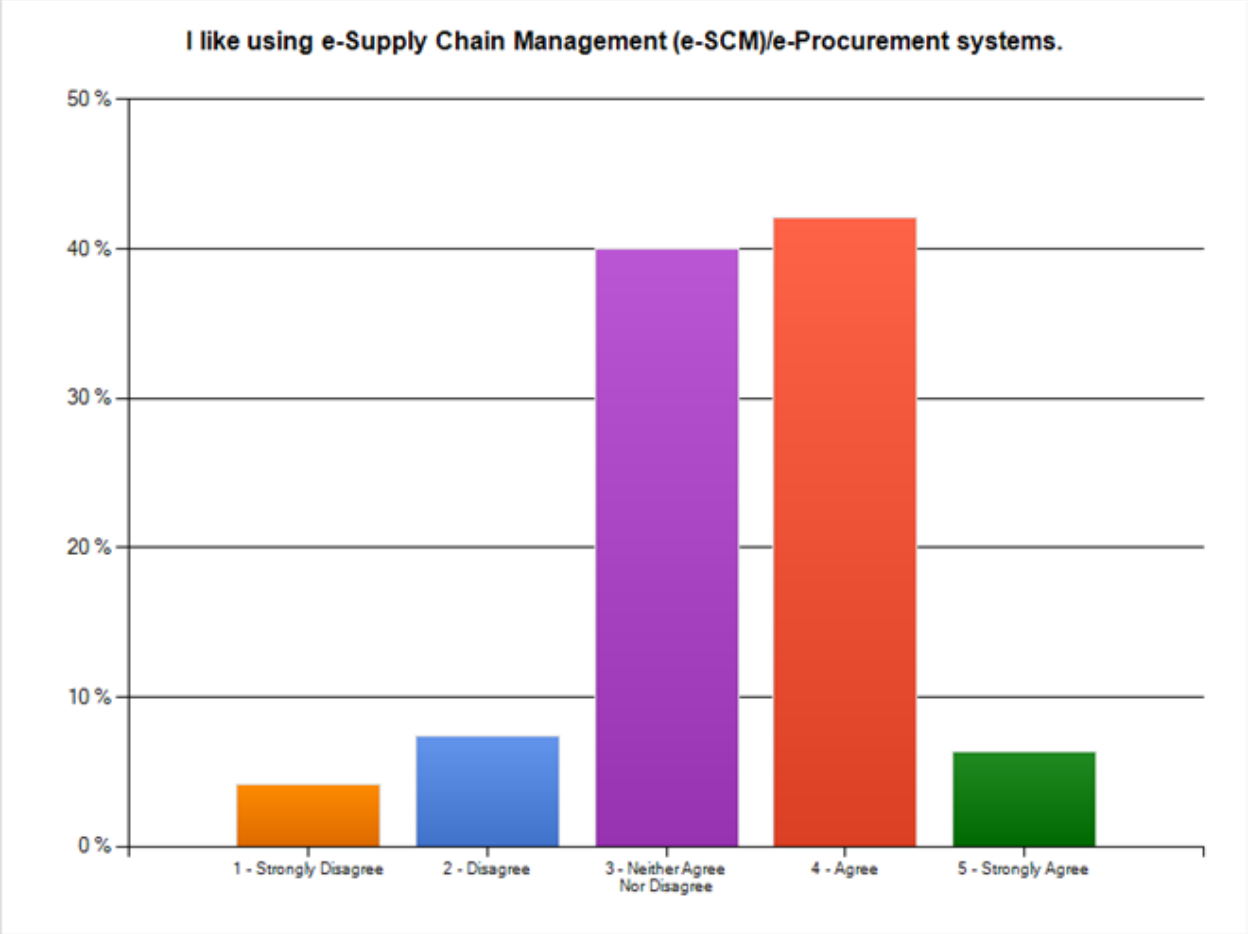
Q6 – Page 1 (PU6)


Using e-Supply Chain Management (e-SCM)/e-Procurement systems makes it easier to perform my departmental functions.
50 %
40 %
30 %
20 %
10 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

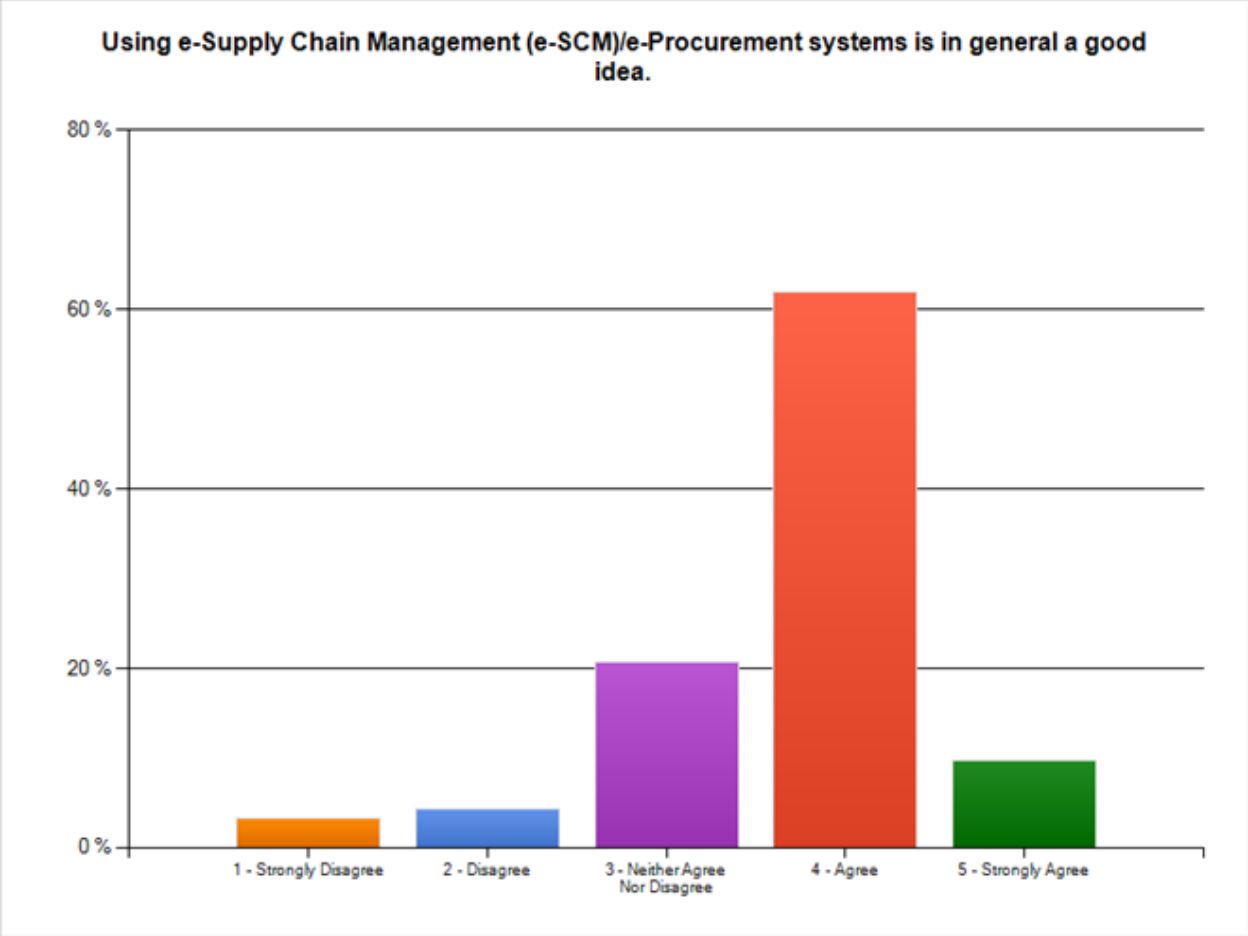
Q7 – Page 2 (PU7)


In general using e-Supply Chain Management (e-SCM)/e-Procurement systems are useful.
60 %
40 %
20 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

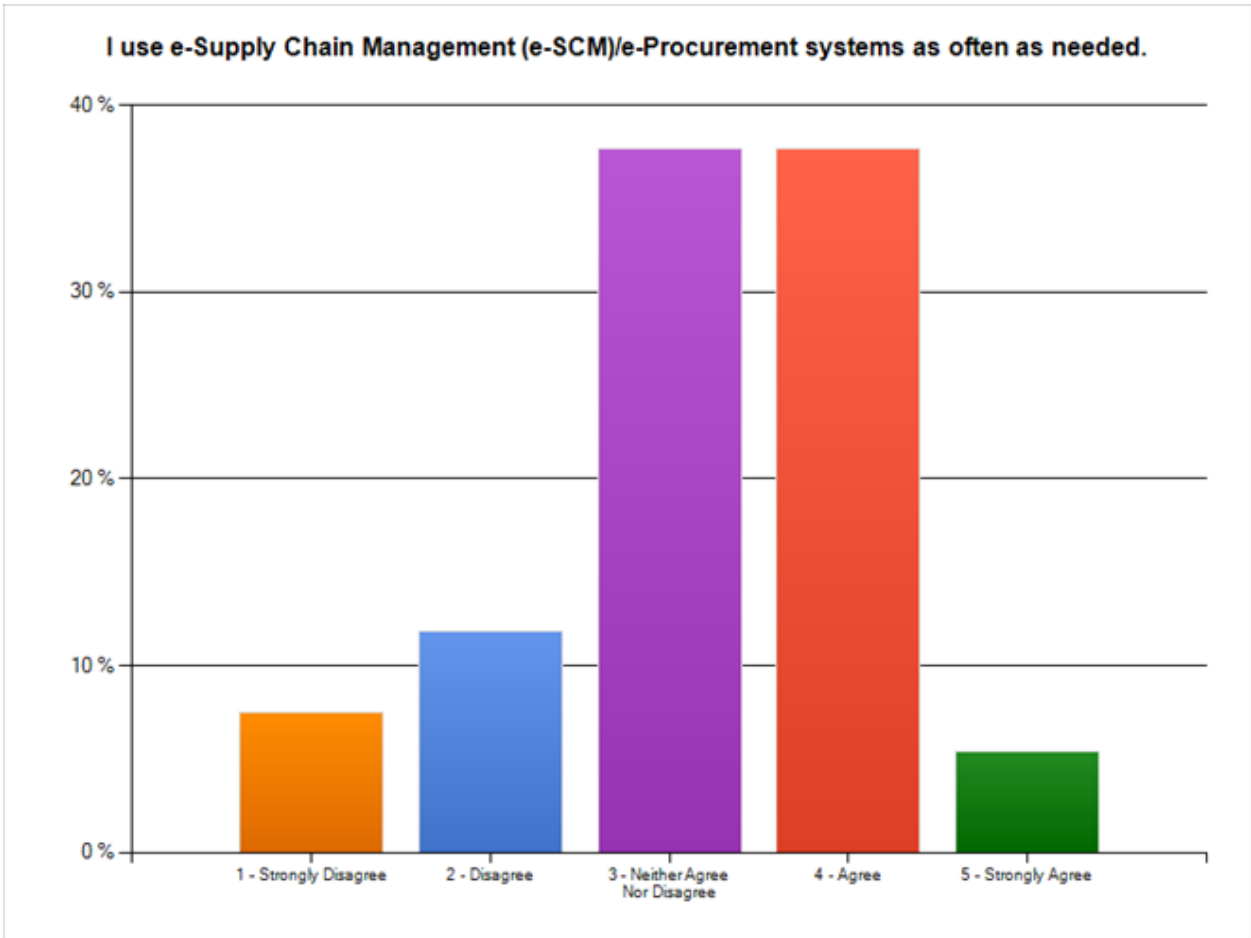
Q8 – Page 2 (PU8)


I like using e-Supply Chain Management (e-SCM)/e-Procurement systems.
50 %
40 %
30 %
20 %
10 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

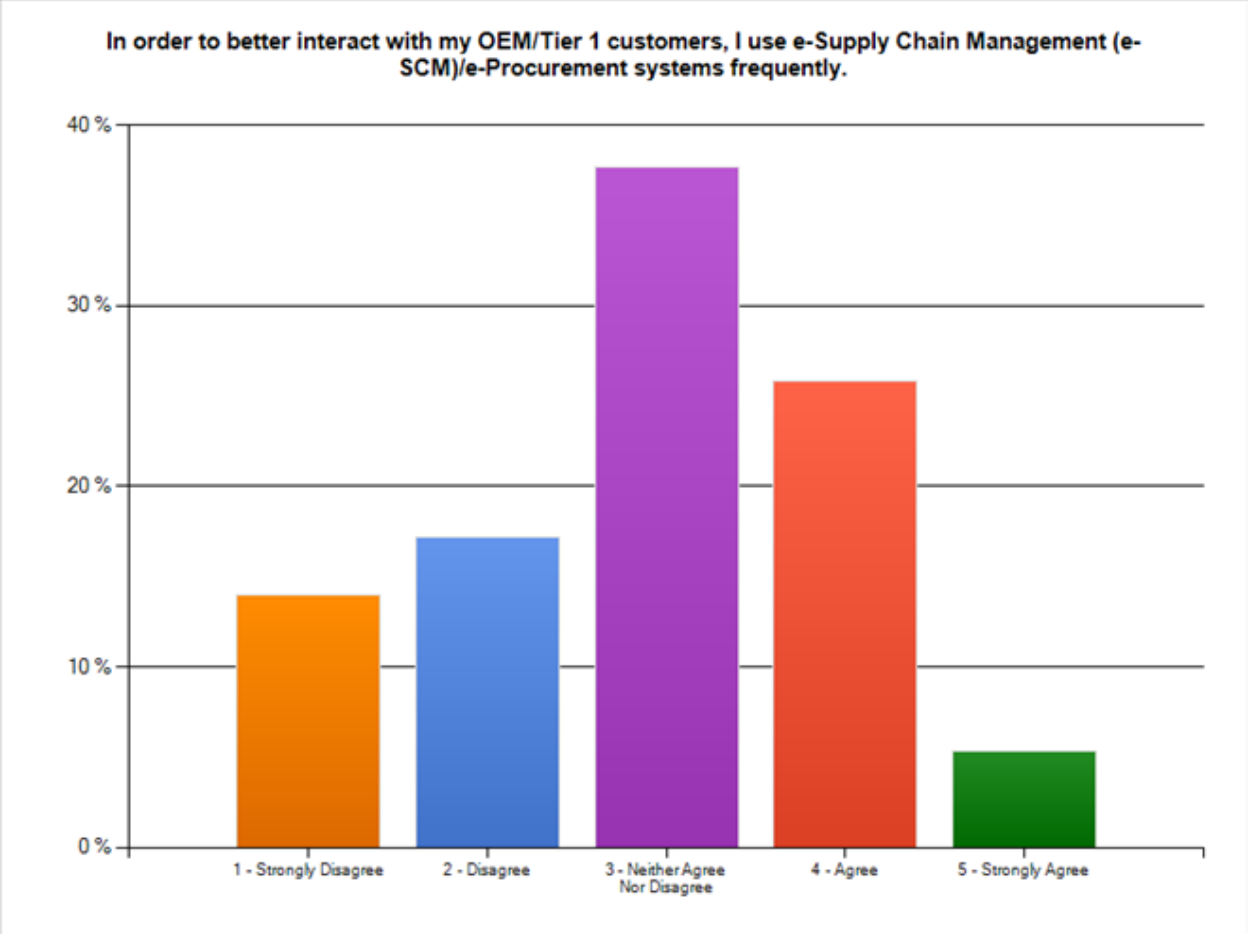
Q9 – Page 2 (PU9)


Using e-Supply Chain Management (e-SCM)/e-Procurement systems is in general a good idea.
80 %
60 %
40 %
20 %
0 %
1 - Strongly Disagree
2 - Disagree
3 - Neither Agree Nor Disagree
4 - Agree
5 - Strongly Agree

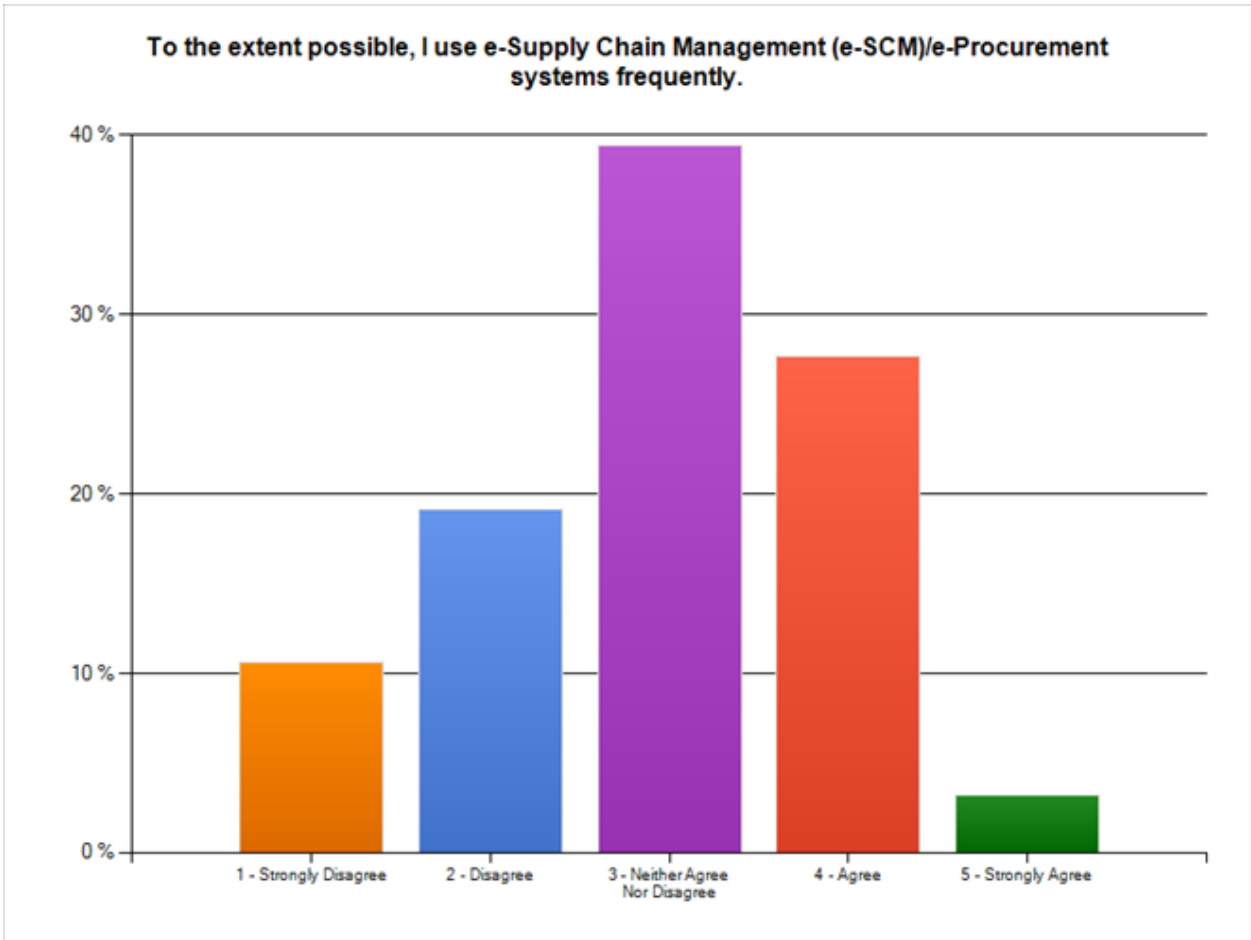
Q10 – Page 2 (PU10)



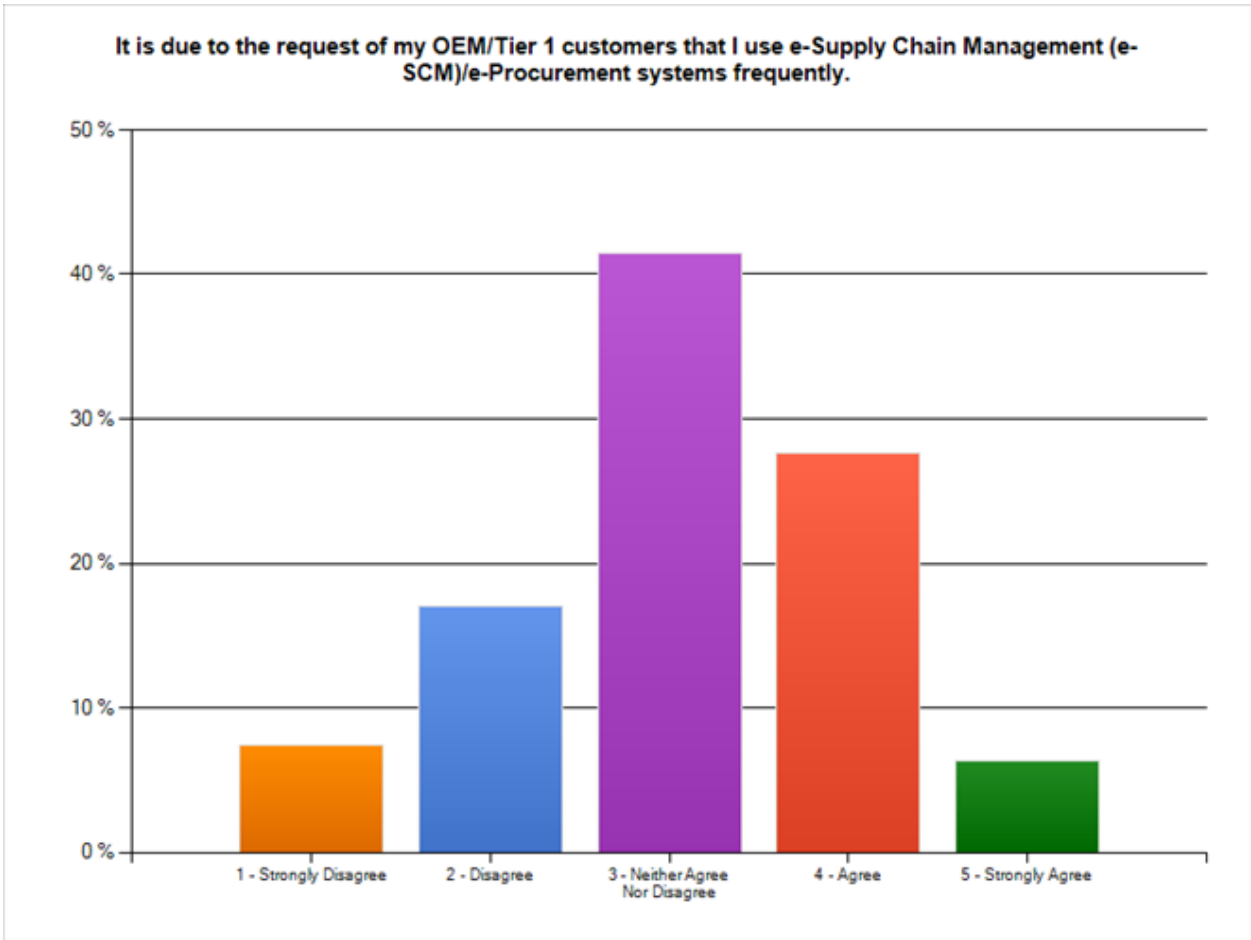
Q11 – Page 2 (PU11)



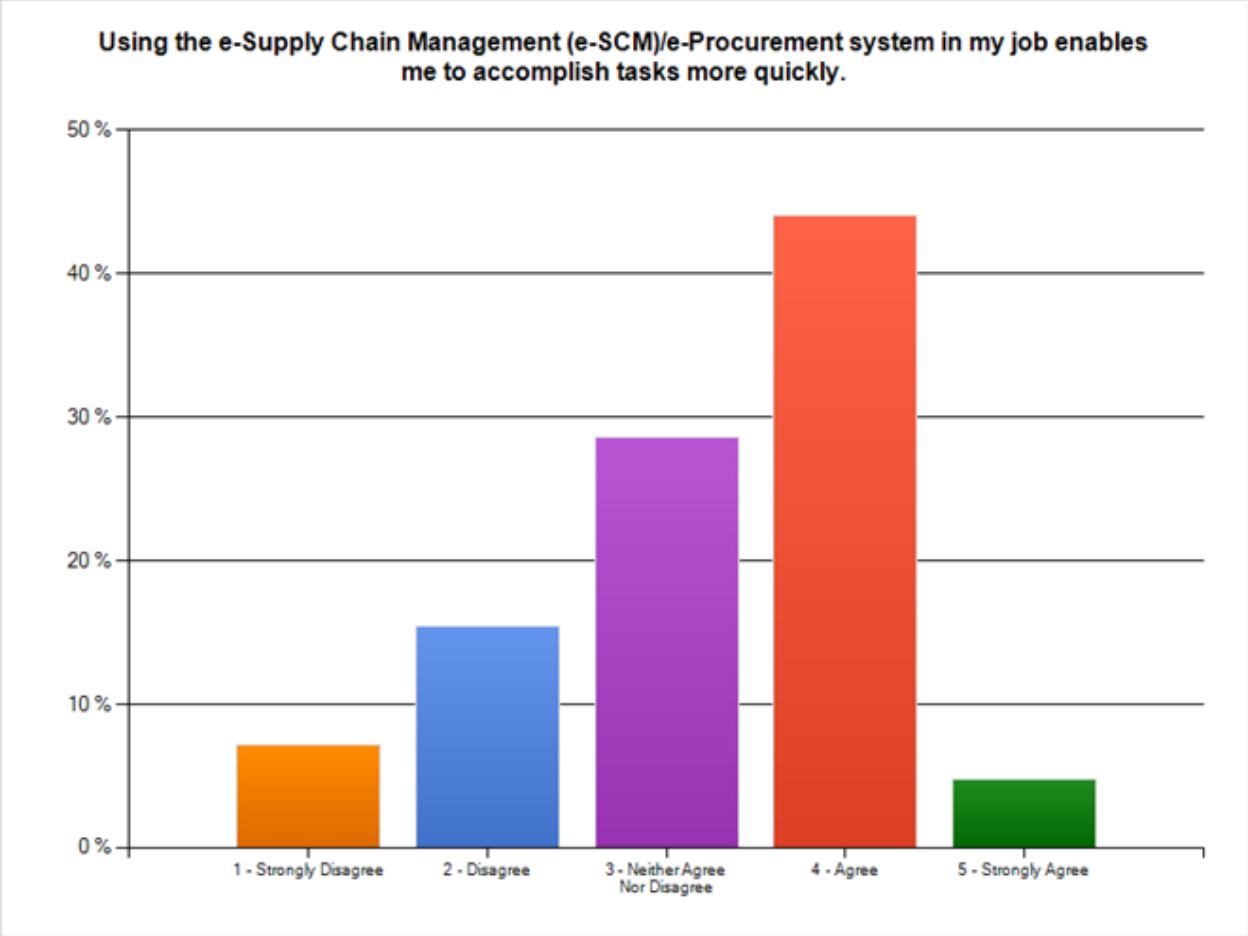
Q12 – Page 2 (PU12)



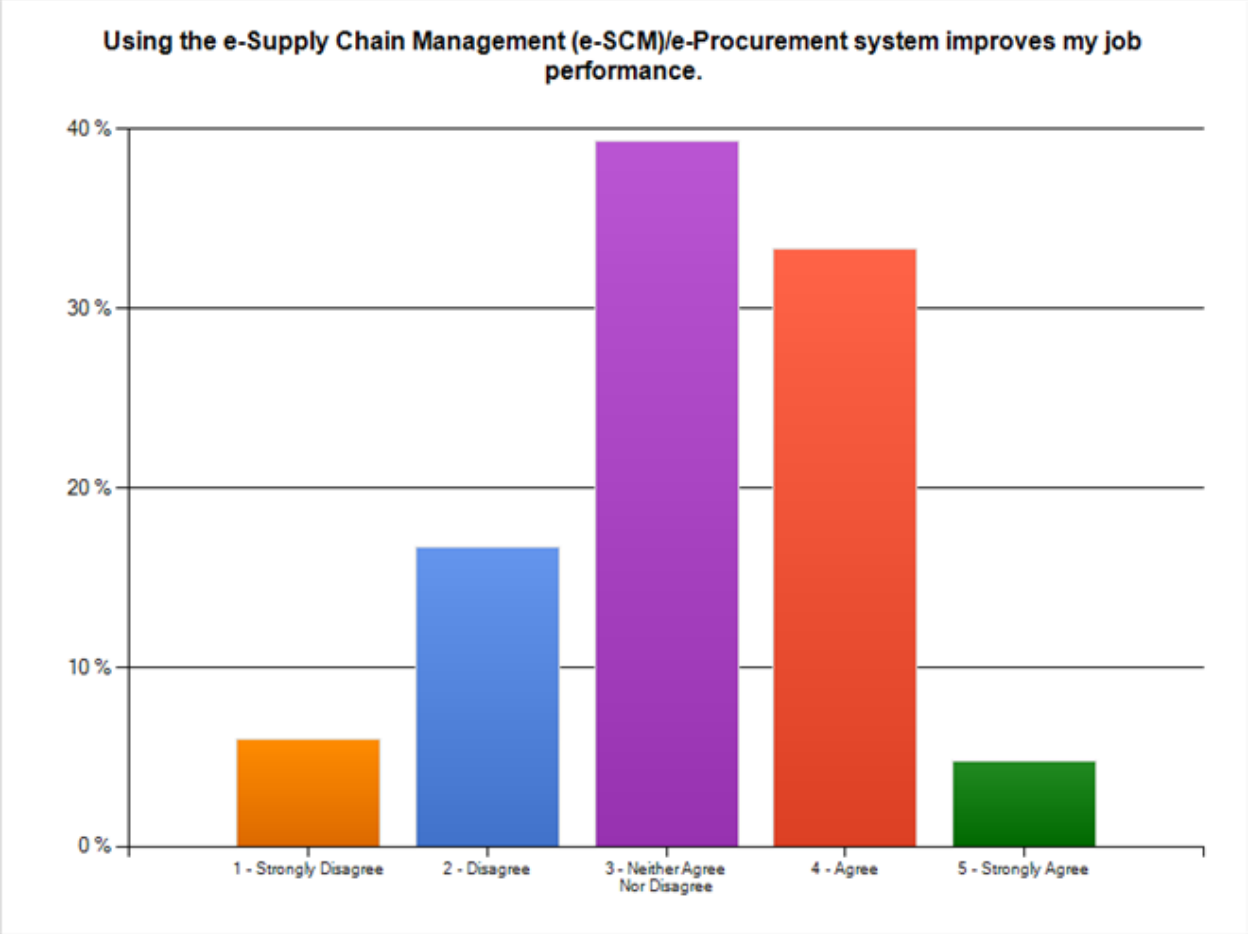
Q13 – Page 2 (PU13)



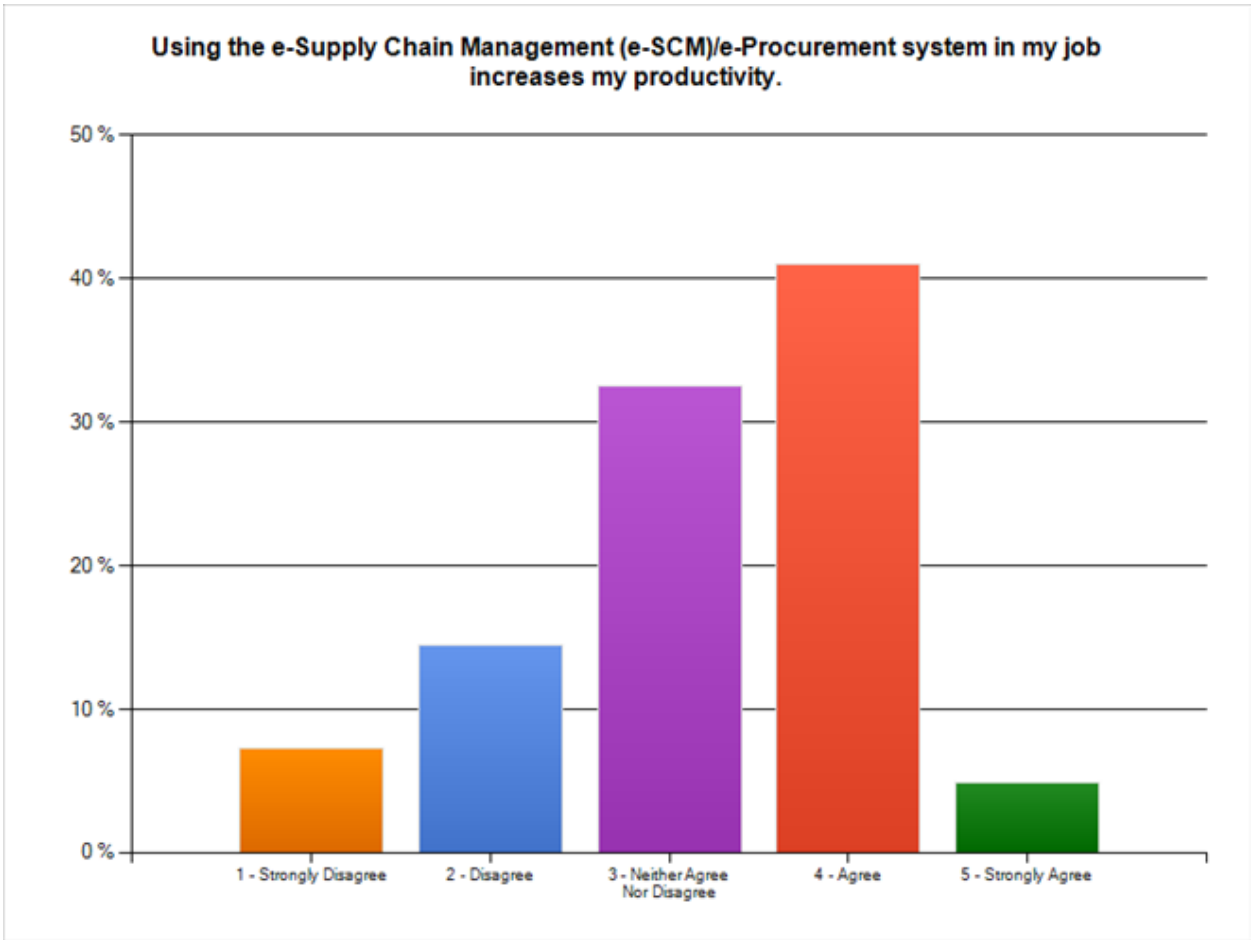
Q14 – Page 3 (EOU1)



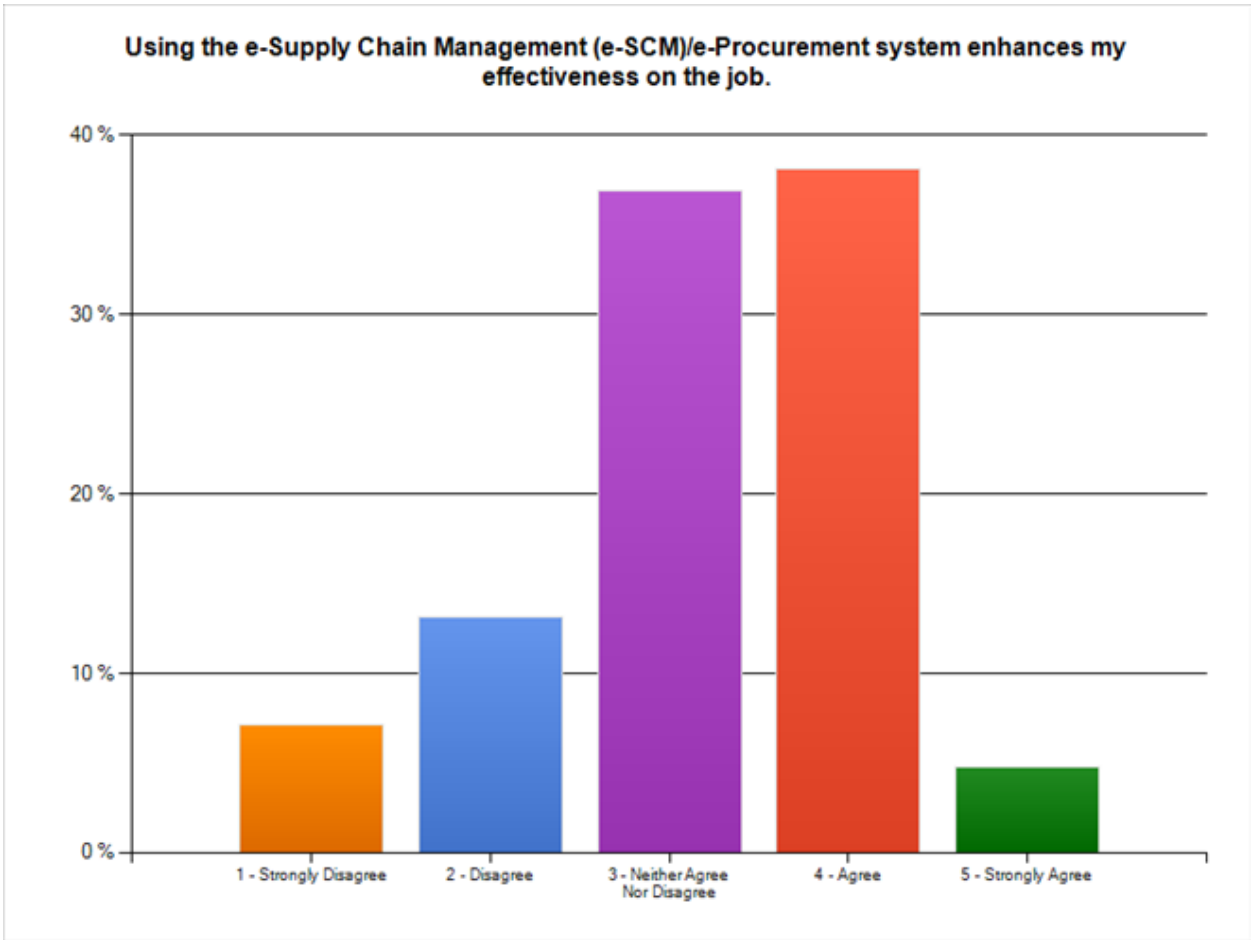
Q15 – Page 3 (EOU2)



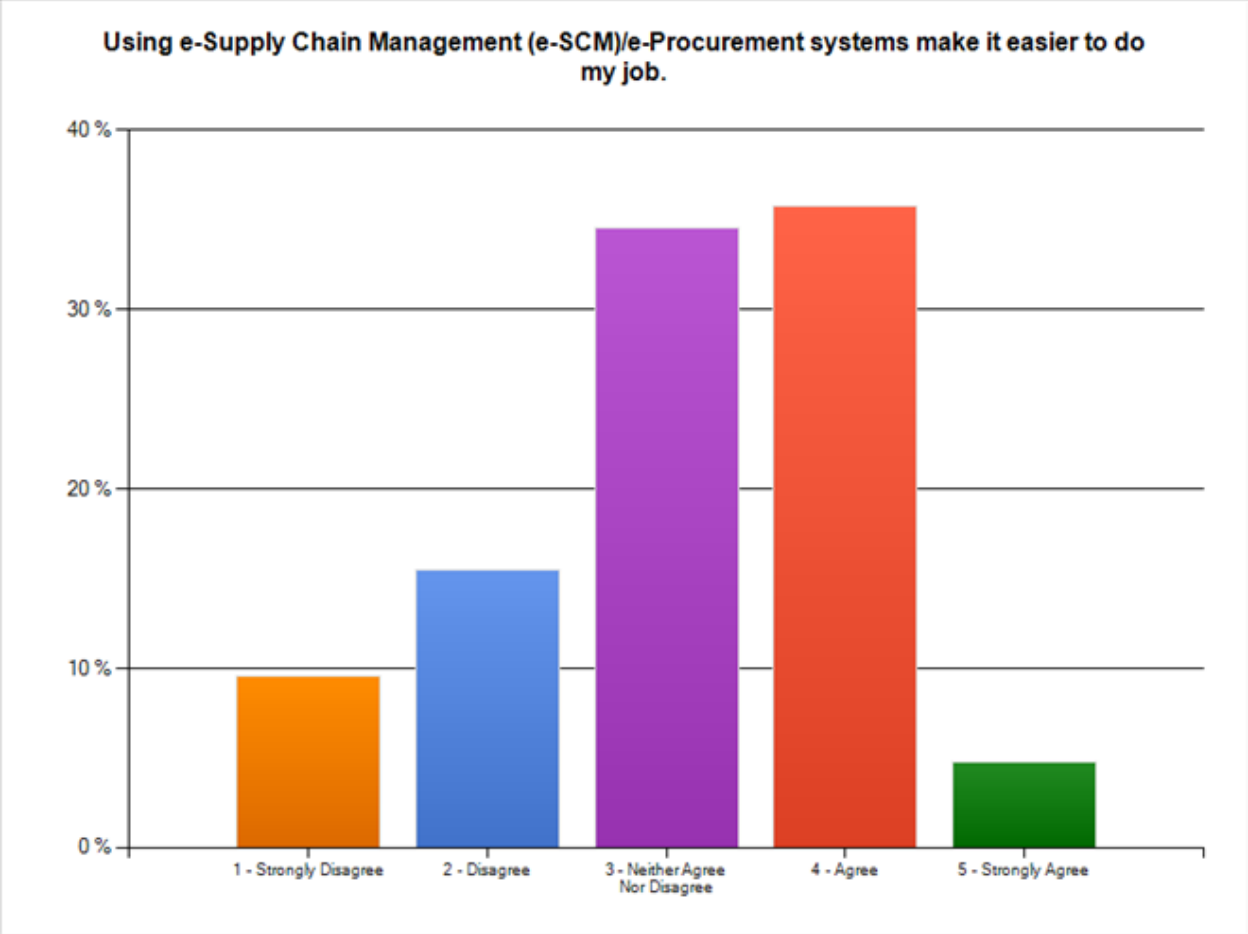
Q16 – Page 3 (EOU3)



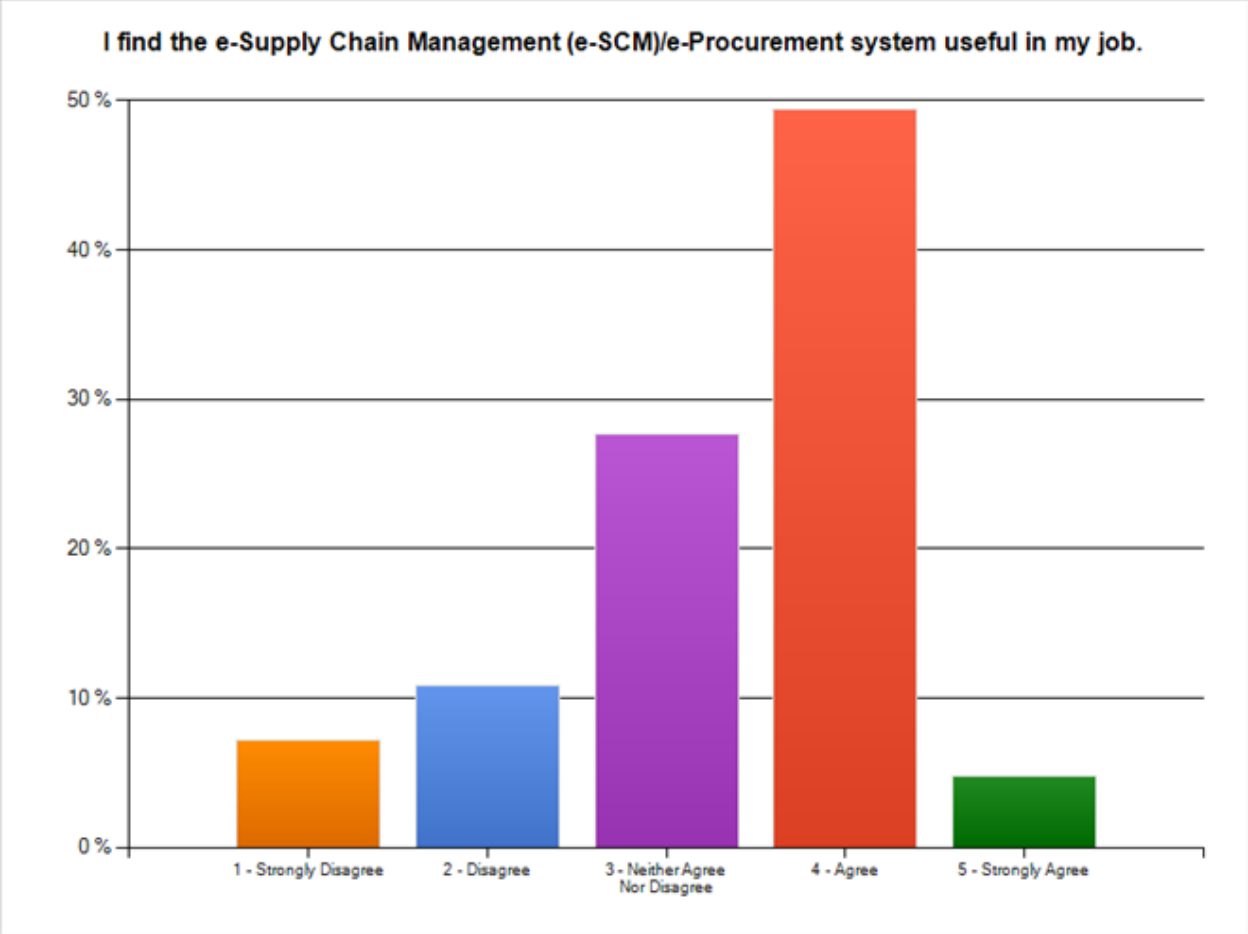
Q 17 – Page 3 (EOU4)



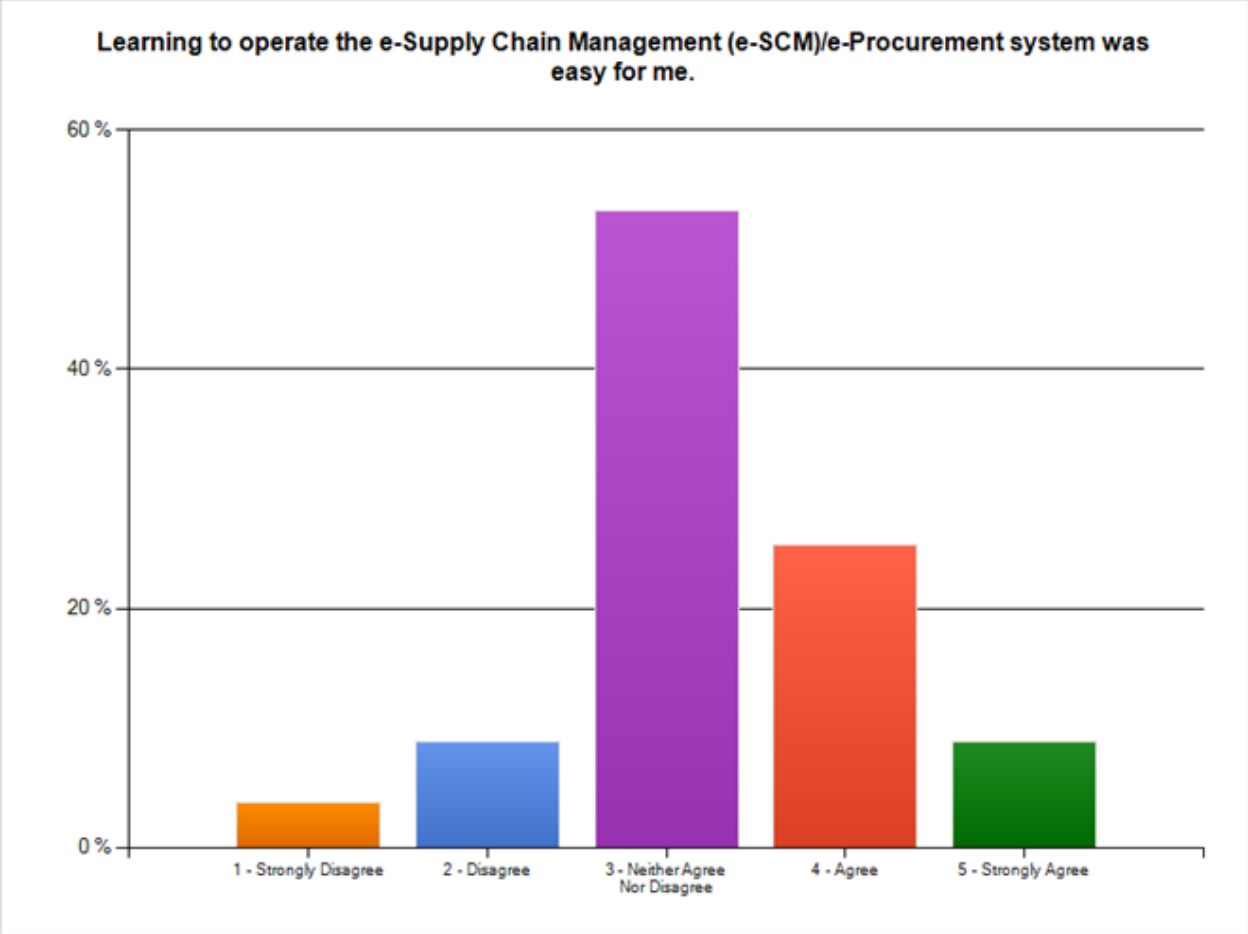
Q18 – Page 3 (EOU5)



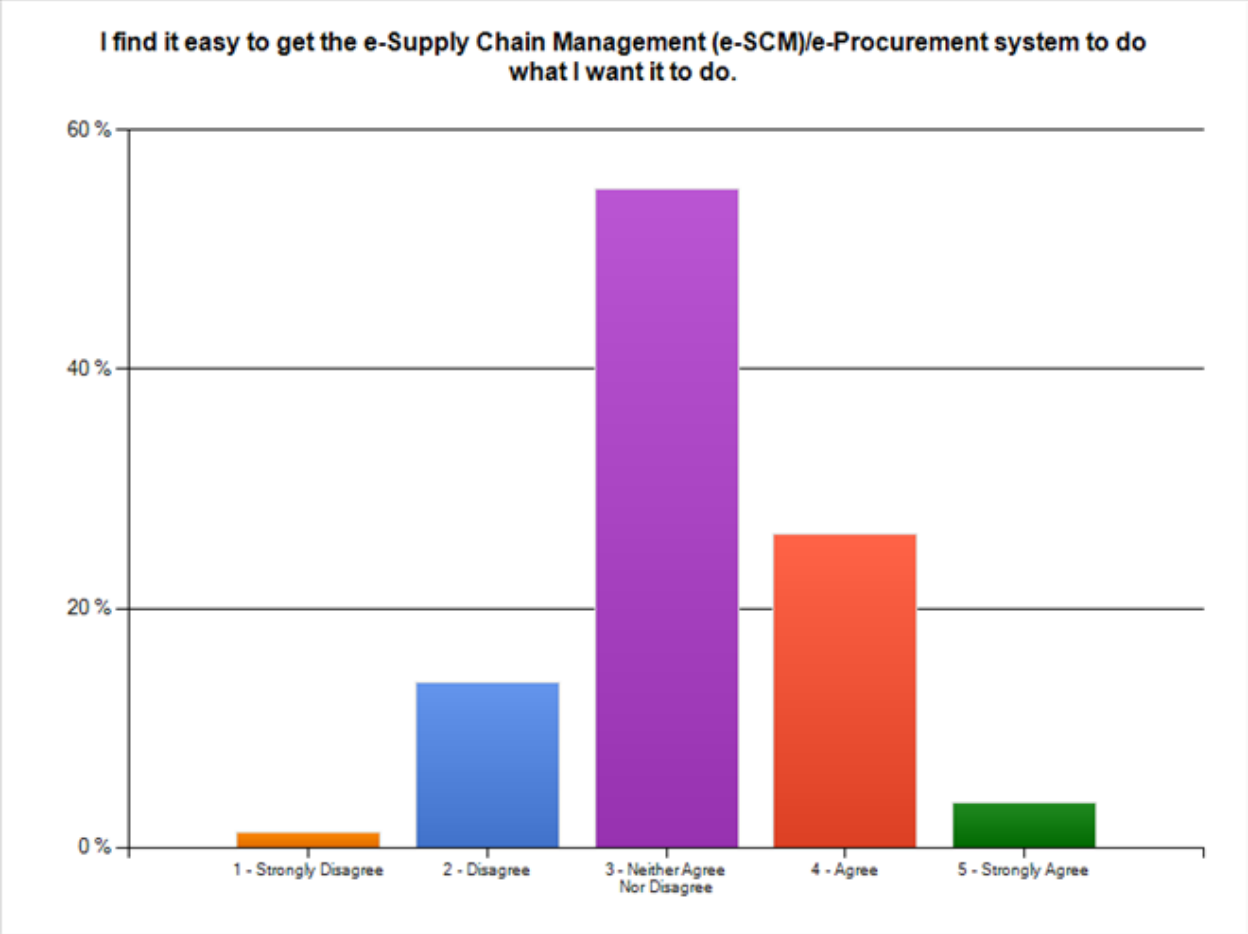
Q19 – Page 3 (EOU6)



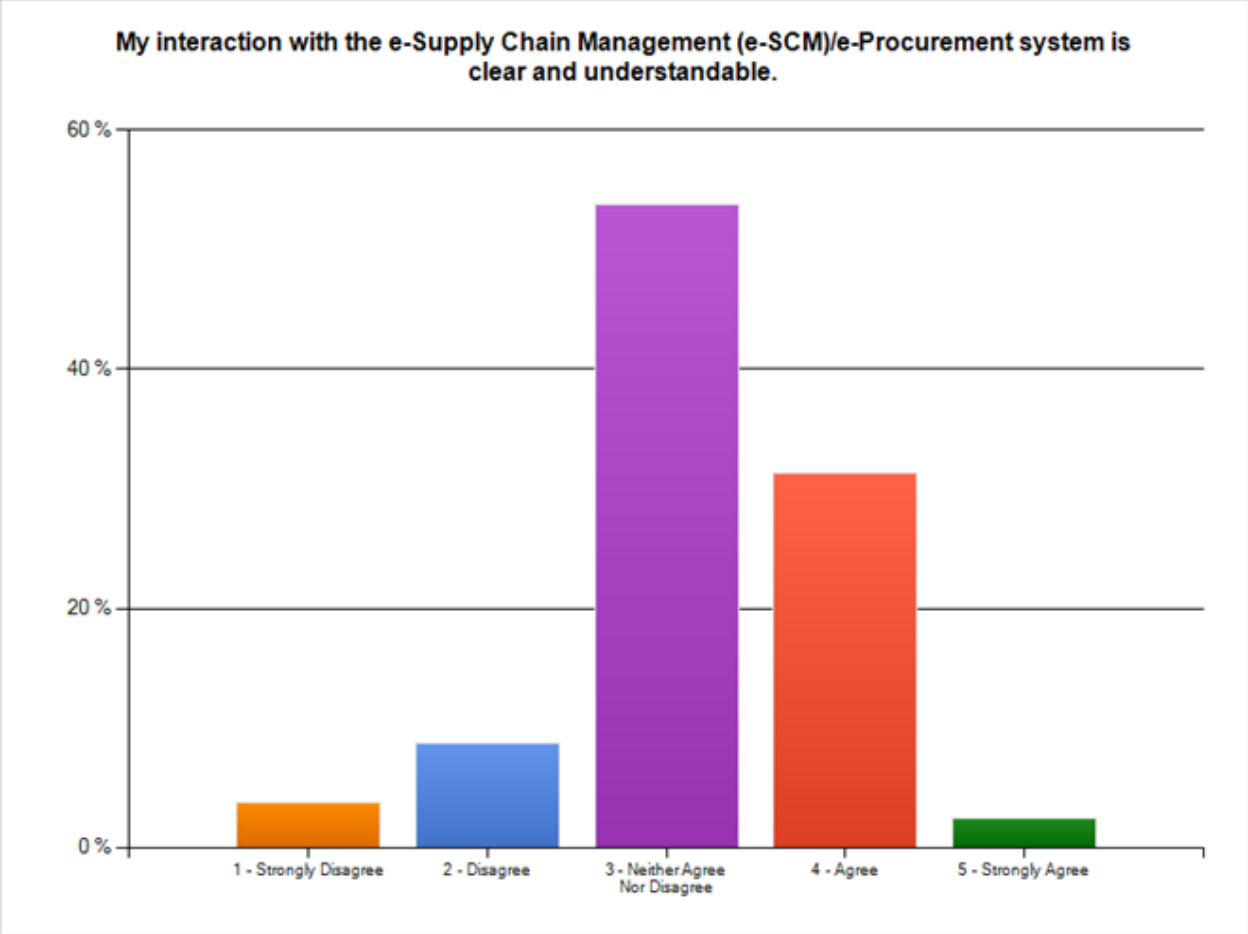
Q20 – Page 4 (EOU7)



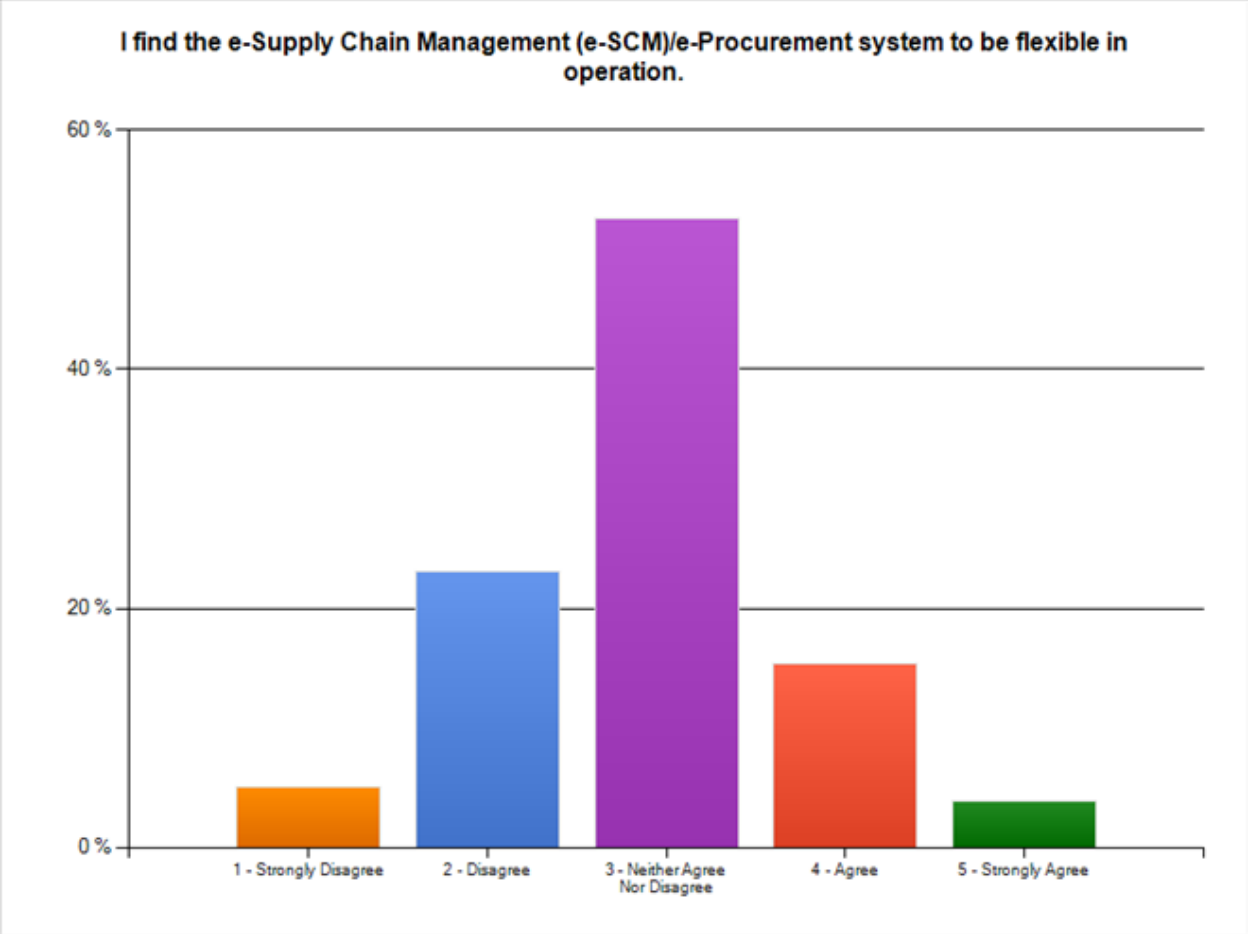
Q21 – Page 4 (EOU8)



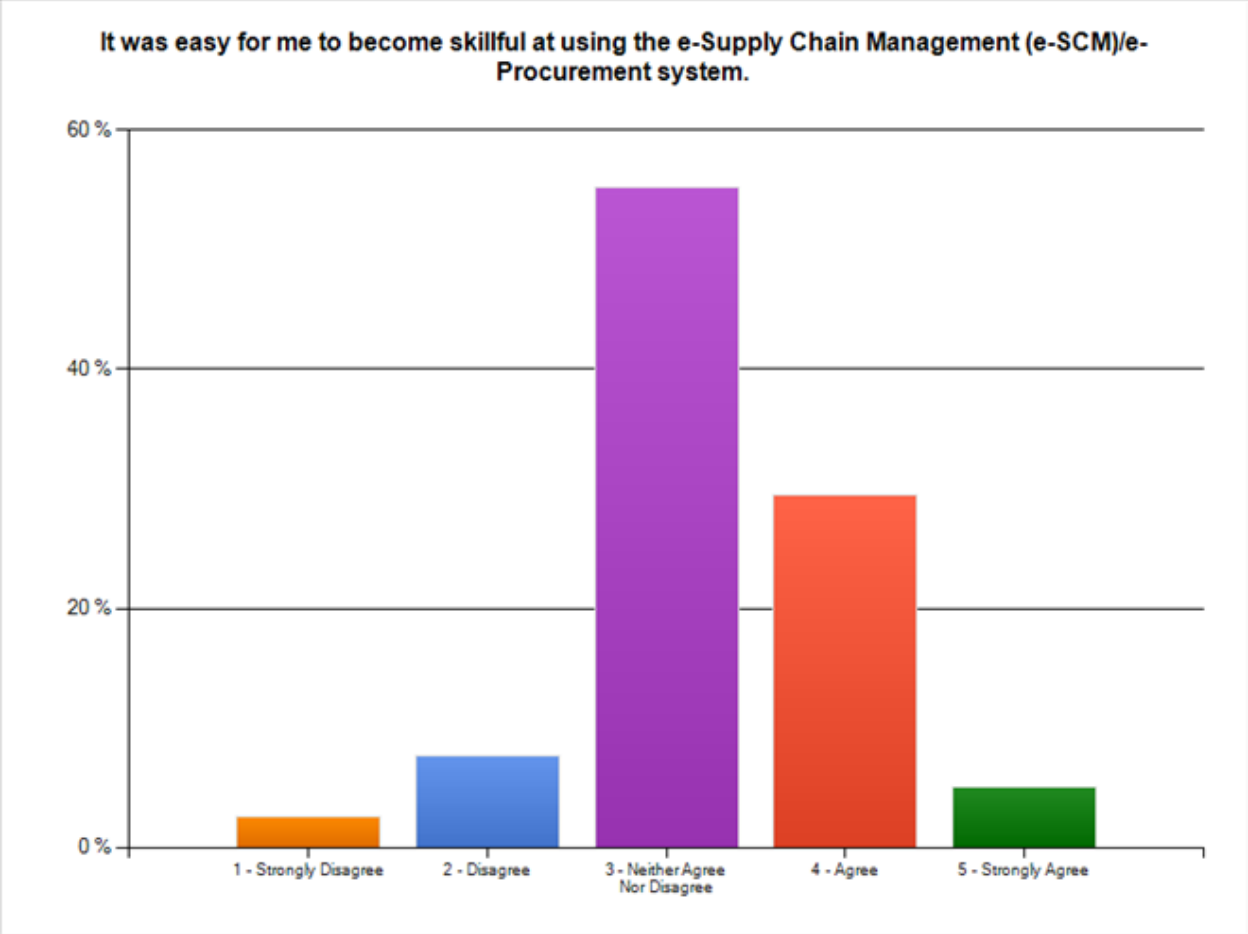
Q22 – Page 4 (EOU9)



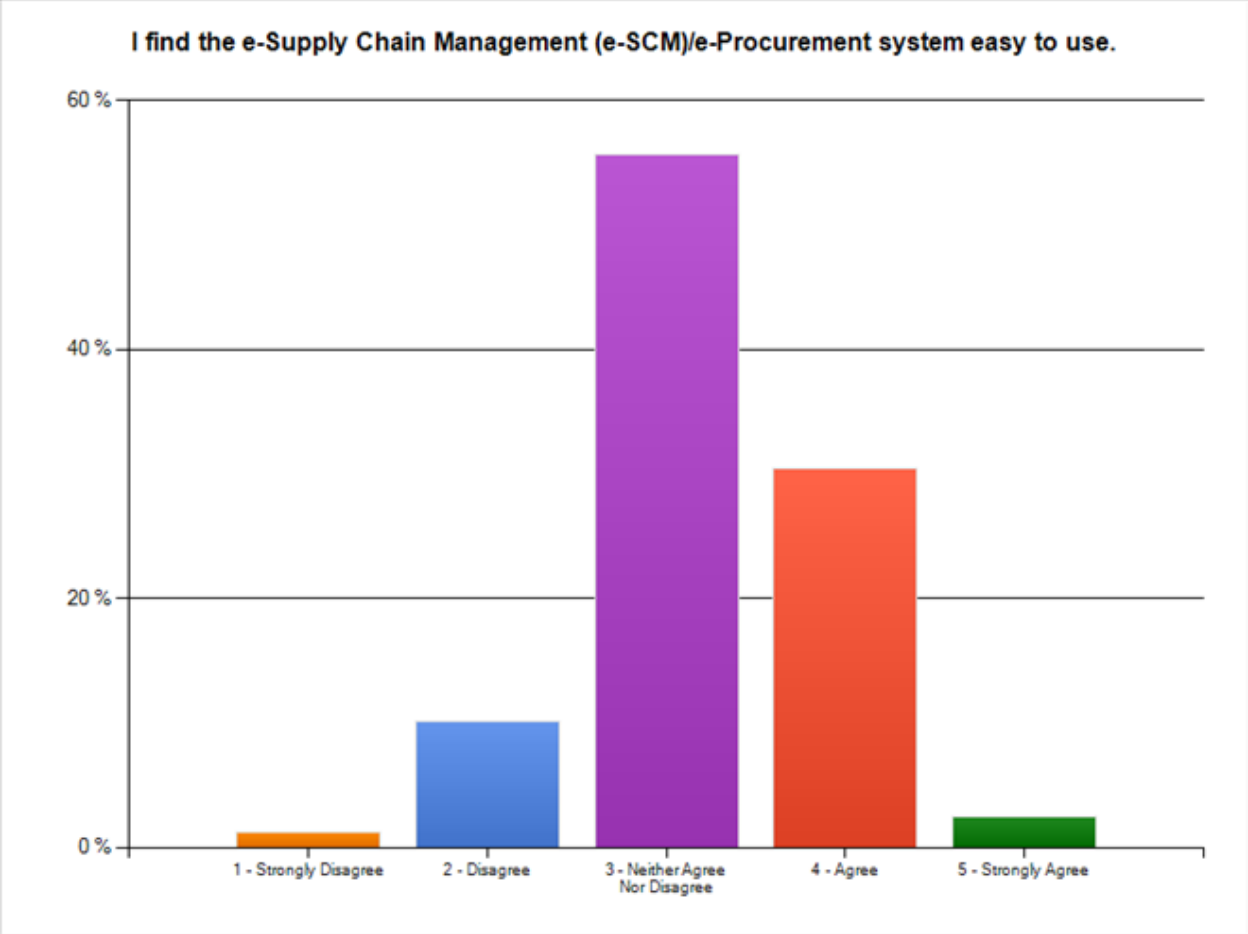
Q23 – Page 4 (EOU10)



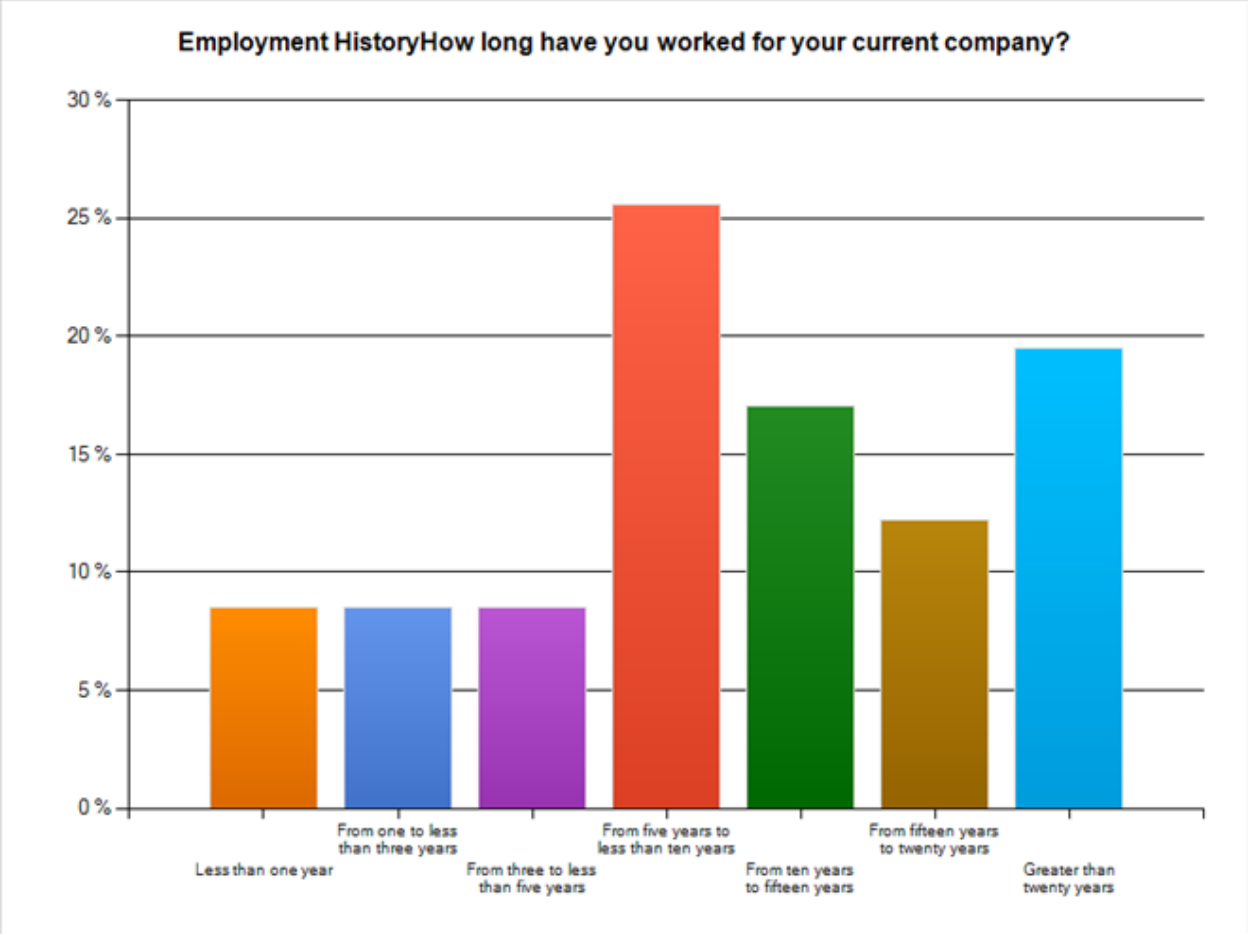
Q24 – Page 4 (EOU11)



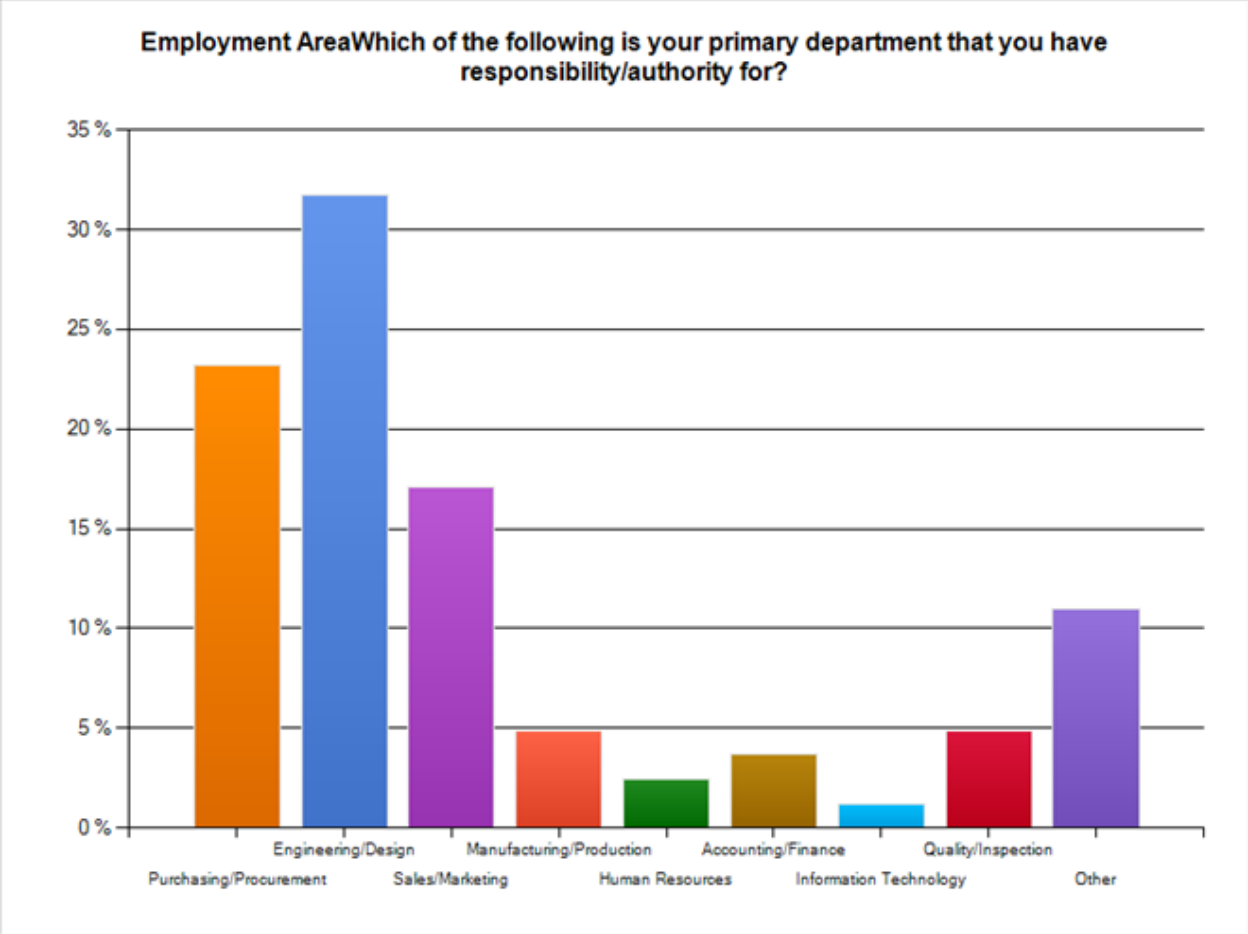
Q25 – Page 4 (EOU12)



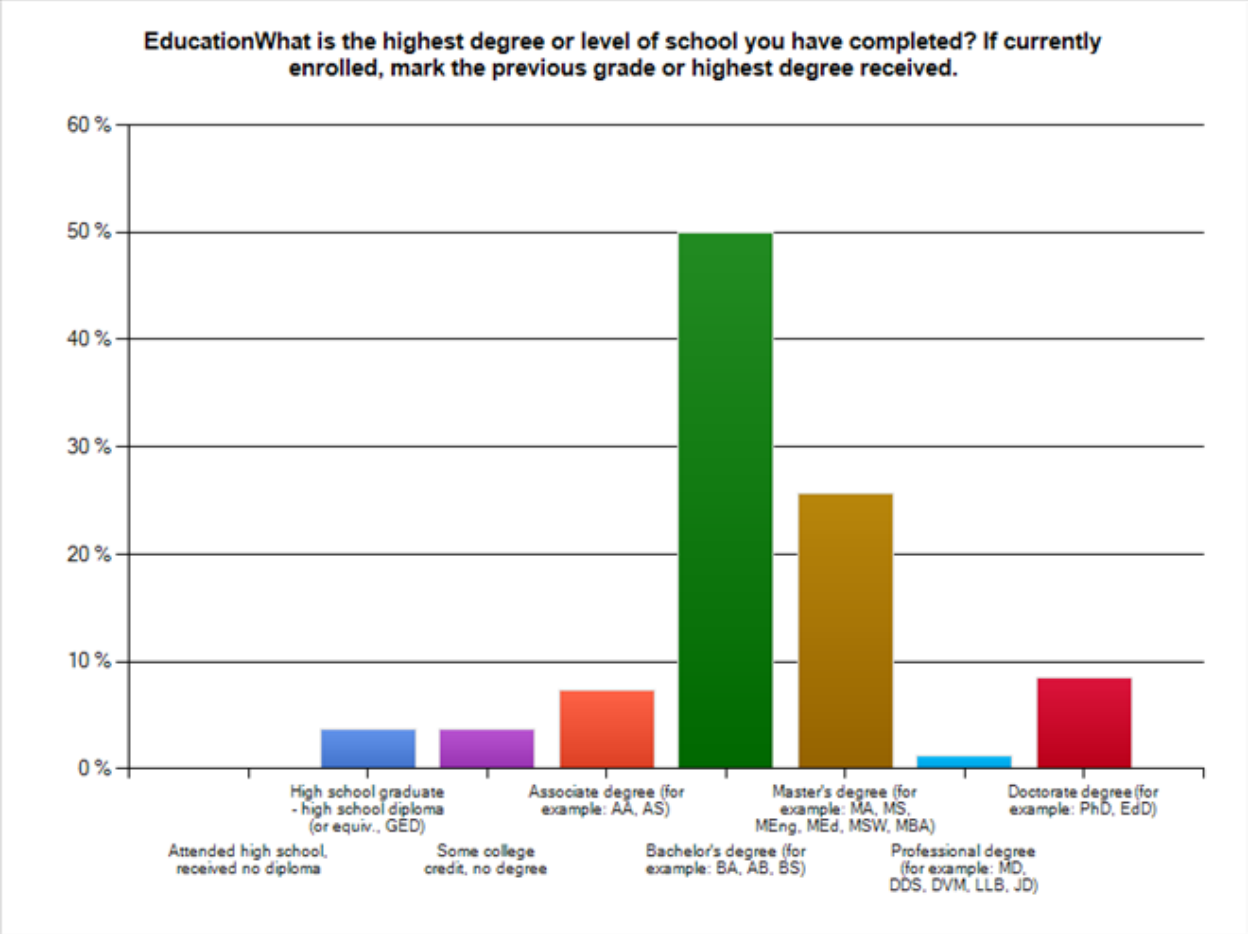
Q26 – Page 5 (DEMO1)



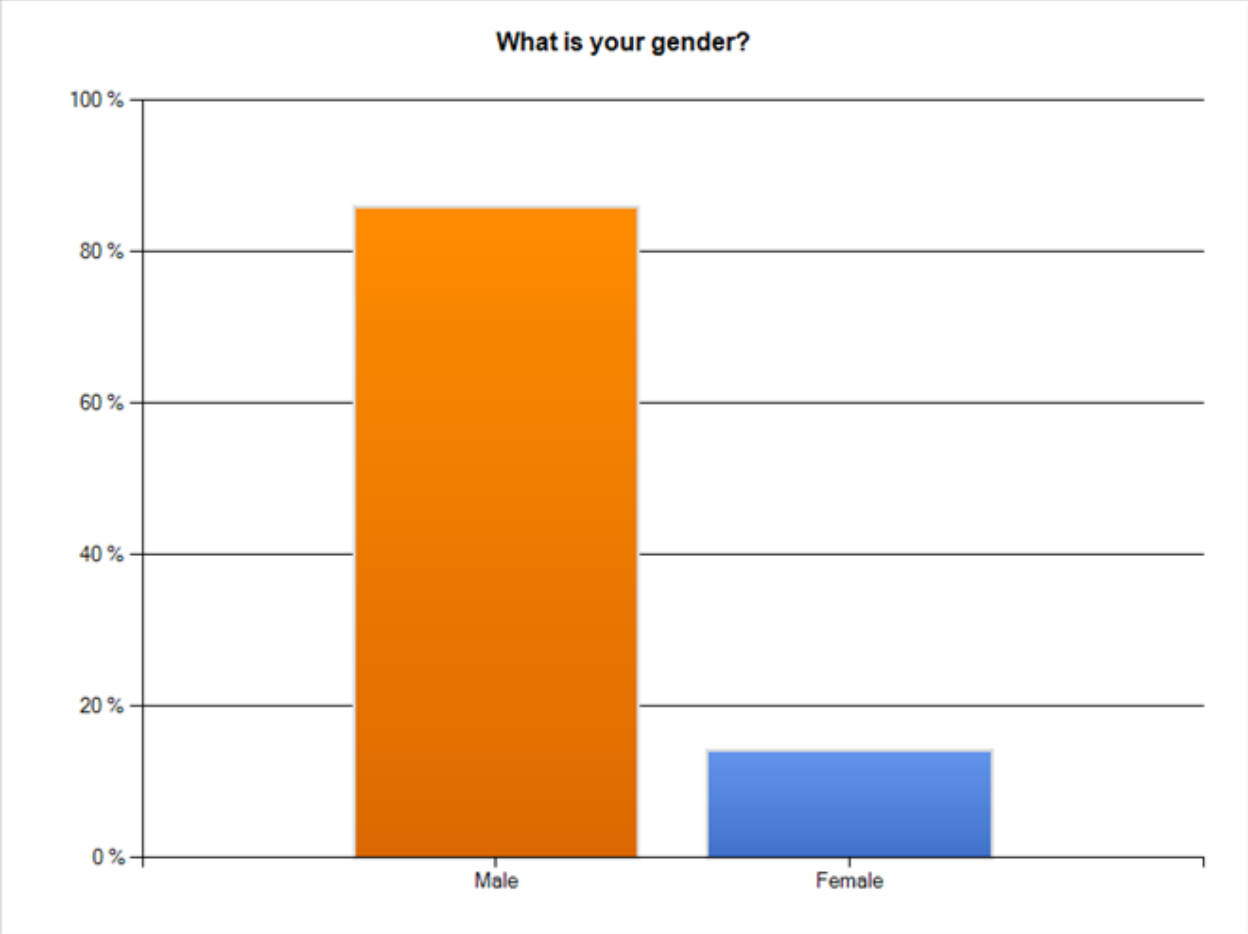
Q27 – Page 5 (Demo2)



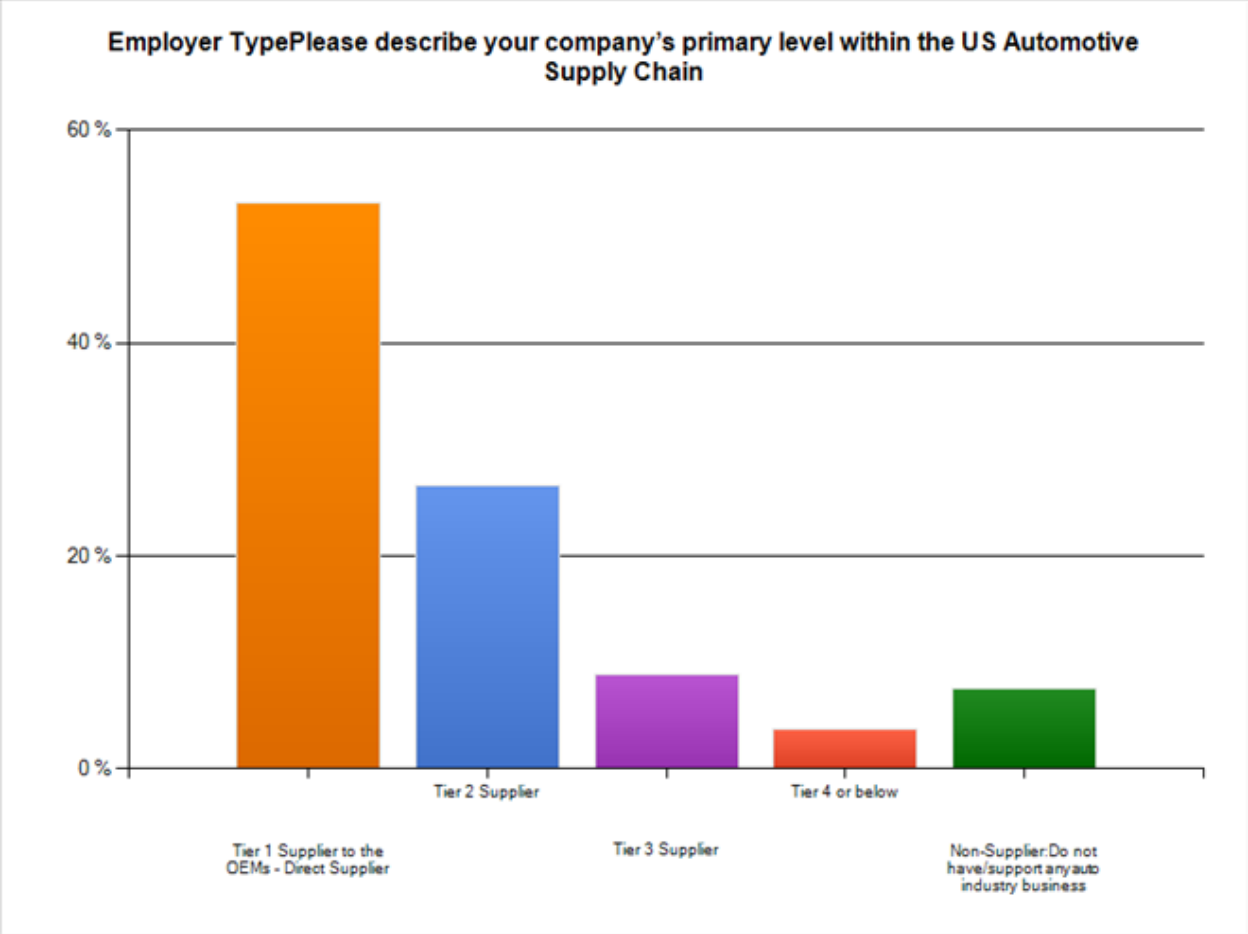
Q28 – Page 5 (Demo3)



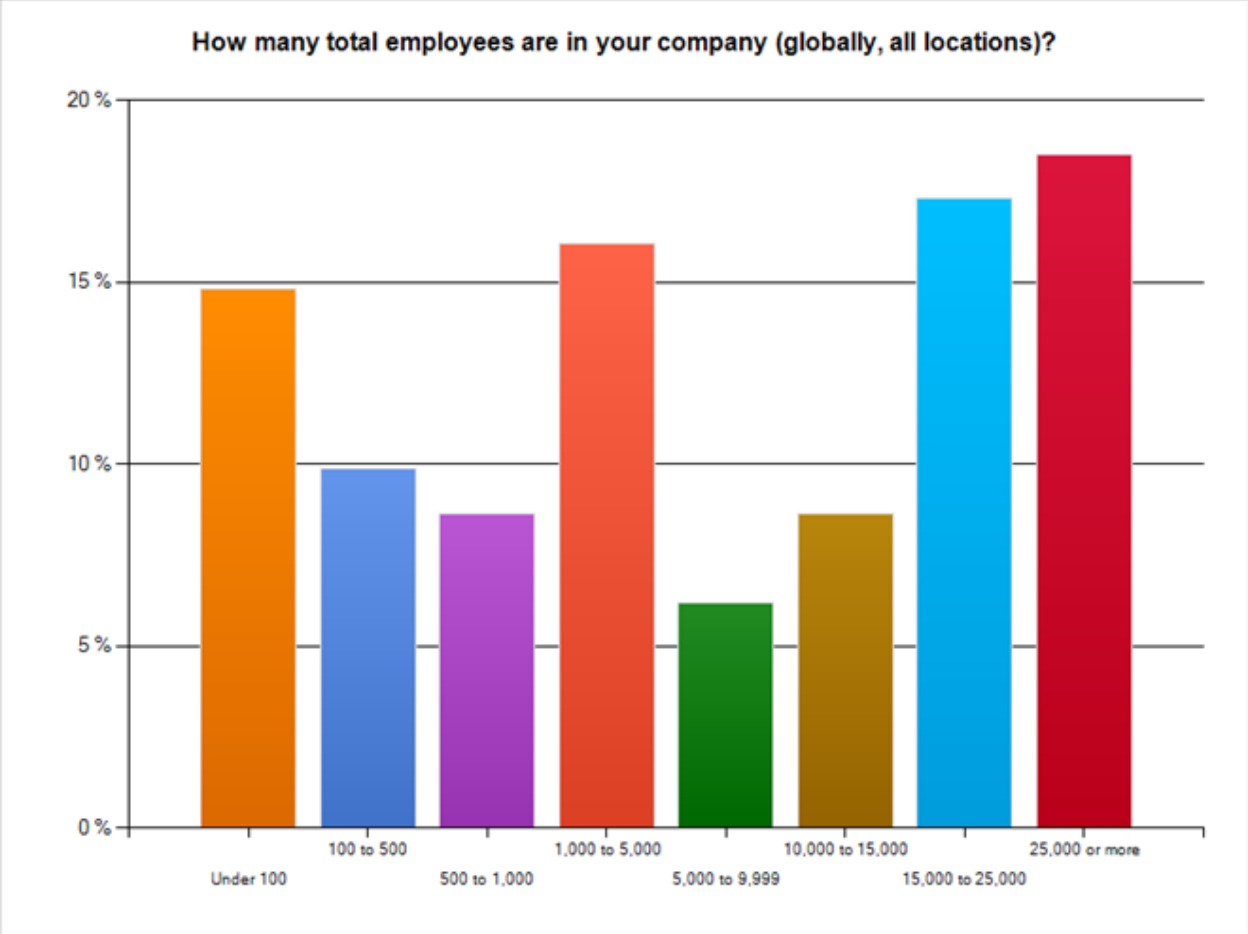
Q29 – Page 5 (Demo4)



Q30 – Page 5 (Demo5)



Q33 – Page 5 (Demo8)



Appendix G

Respondent Group Profile Characteristics (Summary)

Group Characteristics	Frequencies
Organizational Departments	Purchasing/Procurement (37), Engineering/Design (47), Sales/Marketing (24), Manufacturing/Production (9), Human Resources (2), Accounting/Finance (3), Information Technology (2), Quality/Inspection (9), All Other, Including Executives (11)
Years with Current Organization	Less than 1 year (12), 1 to 3 years (12), 3 to 5 years (12), 5 to 10 years (37), 10 to 15 years (26), 15 to 20 years (18), 20 or more years (27)
Education	High School (5), Some College (5), Associates Degree (10), Bachelors Degree (72), Master's Degree (37), Doctorate (12), Professional Degree (MD, JD, etc.) (3)
Gender	Male (124), Female (20)
Number of Employees*	Under 100 employees (20), 100 to 500 (14), 501 to 1000 (13), 1001 to 5000 (23), 5001 to 9999 (9), 10000 to 15000 (13), 15,001 to 25,000 (25), 25,001 or more (27)
Employer Type	Tier 1 Direct Supplier to OEM (79), Tier 2 (38), Tier 3 (13), Tier 4 or Below (7), Non-Supplier to Auto OEM Industry (7)
Does Organization Currently Use e-SCM software ?	Yes (112), No (32)
Corporation Income (Annual Revenues)	Less than $500k (5),From $500k to $1MM (0), From $1MM to $10MM (10), From $10 MM to $50MM (22), From $50 to $100 MM (10), From $100 MM to $1B (39), From $1B to $5B (27), From $5B to $10 B (11), Over $10B (11)

Note: *This refers to the number of employees at the respondent's respective company.

Appendix G shows the overall breakdown in terms of each captured demographic. These demographic questions help to better define each respondent's respective organization/company along with classifying the individual respondent in terms of various professional categories.

Appendix H

Biography of Dr. Fred D. Davis

Dr. Davis provided the seminal work and research on the TAM model, both in theory development as well as in practical applications. Dr. Davis serves as Associate Editor for the scholarly journal *Management Science*, and has published extensive research on user acceptance of technology in the workplace and computer-assisted planning and decision making. In addition to prior research at institutions such as the Massachusetts Institute of Technology, the University of Michigan and the University of Maryland, he is currently the Distinguished Professor and David D. Glass Chair in Information Systems at the Sam M. Walton College of Business at the University of Arkansas (Faculty Profile, University of Arkansas, 2014).

Appendix I

Biography of Everett M. Rogers, Ph.D.

Dr. Rogers (March 6, 1931 - October 21, 2004) provided the seminal work and research on the Innovation Diffusion model, both in theory development as well as in practical applications, originating from his seminal text, *The Diffusion of Innovations* (1963). From this work and further studies, Dr. Rogers coined the gradual terms "Innovators, Early Adopter, Early Majority, Late Majority and finally, Laggards". From his origins on his family farm in Carrol, Iowa, Dr. Rogers observed the importance of innovation at an early age. As his father initially declined and then eventually accepted, the innovation of hybrid grain and eventual resulting higher output. His value of his own education was likewise started in a one-room schoolhouse and completed with his doctorate from Iowa State University. Rogers' 30 books–translated into 15 languages–and more than 500 articles were testament to his extensive research on user and organizational acceptance of innovations in the workplace.

Almost 47 years of his life was dedicated to the fulfillment of his role as teacher and mentor, including faculty positions at Ohio State University, Universidad Nacional de Colombia, Michigan State University, University of Michigan, Stanford University, Universite de Paris, University of Southern California, and finally the University of New Mexico, where as department chair he was instrumental in initiating a doctoral program in 1995. As a scholar, his impressive body of work has provoked social and industrial/organizational change, inspired new ideas and insights, and influenced the lives of countless others. His most significant contribution, however, is the living legacy of his students. (University of New Mexico, 2013).