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Requirements of Commercial-Off-The-Shelf Software – A Comparison between Manufacturing and Service Sectors

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ABSTRACT

The objective of this study is to project long-term trends in the relative share of different categories of application software in the manufacturing and service sectors of the United States.

The findings suggest that the respondents perceive that there is approximately an equal usage of commercial-off-the-shelf (COTS) and proprietary packages in each of manufacturing and service sectors. Furthermore, high cost and risk prone tendency of the needed software will be positively related to the growth in the requirement of COTS/ERP software in the case of manufacturing and service sectors the quantum improvement is positively associated with growth/no-growth in COTS/ERP software.

KEYWORDS: Commercial-off-the-shelf software, Application software

INTRODUCTION

The average information technology (IT) investment reported by organizations participating in the Society for Information Management's 36th Anniversary IT Trends Study was 5.3% of their gross revenue (Kappelman, et al., 2016) and IT contributes up to 50% of total capital costs (Applegate et. al. 2009). IT is essential for most businesses. In the United States (US), former President Obama requested a decrease of 2.9 percent in spending for IT projects for fiscal year 2015 bringing total requested IT spending for the United States Government to $79 billion (Information Week, 2014). This savings of $2.4 billion (2.9 percent) attributed to consolidation of commodity IT products and services, reduction of duplication, and cutting waste. Between 2011 and 2014 the Federal Government IT spending increased from $79.4 billion to $81.4 billion. Global spending on IT is expected to have a compound annual growth rate of 3.3 percent per year from 2015-2020, translating to almost $2.4 trillion in 2015 to over $2.7 trillion in 2020 spent on IT production and services (IDC, 2016). This increase is likely to be driven by demand for new technologies such as cloud computing, software as a service (SaaS) and Enterprise Resource Planning (ERP) packages among others Luftman et al. (2015).
In the early 1950s, each service sector employee produced about $39,000 in output (in 2000 dollars), while in manufacturing, the output was $48,000. Now, 50 years later, service productivity has increased to $54,000, whereas manufacturing productivity is at $207,000 (Altman, 2004). Organizations (both manufacturing as well as service sector) are becoming increasingly reliant upon information technology, especially service sector, and are likely to continue to be so into the future to improve productivity in both manufacturing and service sectors. Organizations are using more software solutions to meet customer demands and create a more efficient business model. This increased usage is fueling a growth in demand for

IT applications and proprietary and commercial-off-the-shelf (COTS) software in both ERP and non-ERP use cases. For example, customers increasingly expect to be able to utilize smart phones and other mobile devices to accomplish a growing array of tasks that were not previously possible without access to a full computer. This increased demand for more useful and powerful applications permeates an industry to the point that it becomes a basic expectation. Organizations not keeping current in their technological offerings are at a competitive disadvantage. Cloud computing, IT resource price decline, decreased costs of storage, and the increased processing power available at an affordable price point allows many small and medium size companies to afford IT applications for their organizations when they previously would not have been able to do so (Srinivasan, 2013). These factors, among others, are leading to annual increases in IT investments worldwide. Increased maturity in business intelligence, mobile computing, web-enabled transactions, and other areas are seen as applications that are beneficial to more and more organizations. In spite of this, limited monetary and human resources will lead to an increased reliance on cloud computing and outsourcing/offshoring services. Organizations using cloud computing and/or offshoring/outsourcing will need fewer employees with higher IT skills (Himmel and Grossman, 2014). These trends are expected to lead to growth in end user computing (EUC) and the development and use of information systems by people outside the organization's IS department (Agrawal et al., 2011; McLean, 1979).

The Information Technology (IT) market is experiencing global growth in IT investment. However, factors such as high risk and increased costs to develop application packages, plus the reduced life cycles for both products and systems, (Turban et al., 2015) make it challenging for organizations to keep up with demand for application packages. This paradox has led to alternate outlets to overcome the significant backlog caused by the demand increase. These outlets include, but are not limited to, end-user computing, outsourcing, cloud computing, COTS packages, and ERP solutions. The exponential growth in capability per dollar in the technology sector for resources such as network capacity, processing power, storage, and other basic factors have led to a continuous growth in the usage of off-the-shelf/ERP solutions in business organizations (Agrawal, 2005a). In the current study, the application packages are categorized as proprietary (non-ERP), proprietary (ERP), COTS (non-ERP), and COTS (ERP) packages. ERP packages are kept as a separate category because of their size and scope.

The theme of this research is to gain an understanding of the changing trends in the utilization of different categories of the application software. The objective of this study is to identify the current and future trends in the demand for different categories of software separately in manufacturing as well as service sectors, and the contributing factors influencing the future trends. The identification of both current and future trends in the demand for different categories of software will help organizations in formulating their IT strategies and their human resources planning. Further, the trends in usage of different categories of software will help academic institutions amend the curriculum offered to meet the changing needs of the business organizations. The specific research questions addressed are:

- What will be the trends in usage of various categories of application software in manufacturing and service sectors?
- Will there be usage of COTS/ERP packages in higher proportion compared to proprietary packages in either manufacturing or service sector?
- What contributing factors are driving the above trend of COTS solutions in manufacturing and service sectors?

The present work conducts an analysis on the manufacturing sector and service sector. For the purpose of this study the manufacturing sector includes the automobile, computer hardware, pharmaceutical, telecommunication (hardware), and "other" industries. The service sector is comprised of the banking, retail, hotels, computer software, construction, government, healthcare, insurance, technology, transportation, utilities, and "other" industries. The quantitative and qualitative data were collected through a survey of Executives, Directors, First Line Managers, and Middle Managers from large, medium, and small-scale organizations in the United States. This study offers projections of trends in usage of packages and the possible motivations of these trends. The study will help in identifying opportunities for both practitioners and researchers.

This paper begins with the literature review and development of the research model. It continues with a presentation of the research hypotheses. The measurement section is followed by the methodology section and the implementation of research methodology. Finally, data processing and results follows the limitations of the study, implications for practice, suggestions for future work, and concluding remarks.

LITERATURE REVIEW & DEVELOPMENT OF HYPOTHESES/RESEARCH MODEL

A review of the literature in information systems, operations, supply chain management, and related fields was conducted with the most relevant information summarized below. The study focused on the United States and is not represented as being generalizable to non-US companies. This design choice was made to increase the power of the statistical tests and as a matter of convenience and practicality.

The requirements trends for COTS, proprietary and ERP packages have been researched extensively as an area of considerable interest for IS researchers for decades. The history of ERP systems dates back to the early 1950's when Lyons Teashops used computers to plan material needs, take orders, plan for goods distribution and other functions (Rahman & Kurien, 2007). In the 1960's J.I. Case and IBM collaborated to develop Materials Requirement Planning software that was the forerunner to modern ERP systems, (although it would be the early 1990's before the actual ERP term was used by the Gartner Group (Sturdy, 2012). One of the first studies to quantify the trends was Agrawal (2005a). Figure 1 illustrates a model presented in Agrawal's paper and the parameters (Table 1) thought to influence application software trends in usage across multiple categories. This study uses the model for the design of a survey to test the model and potentially offer suggestions for how to improve the model's predictive validity. In Agrawal's study, the variables were shrinkage in systems life cycle, the high cost and risk prone tendency of the needed software, desired characteristics of the software solution, administrative motivations, and quantum improvements. The first four independent variables were hypothesized to lead to an increase in the dependent variable, usage of off-the-shelf/ERP solutions while the last variable, quantum improvements, was hypothesized to lead to a decrease in the dependent variable. Each of the constructs, along with the expected relationships and hypotheses are discussed in six parts: proprietary software (including automation in application software development), and commercial-off-the-shelf software (including systems life cycle is shrinking, high cost and risk-prone tendency of the needed software, desired characteristics of software, administrative motivation, continuous improvements/quantum improvements).

Organizations are increasingly moving to the cloud to decrease their investments in IT infrastructure while also engaging in initiatives to reduce costs via productivity improvements, moving away from proprietary ERP usage to COTS ERP solutions, using COTS customer relationship management (CRM) solutions, and developing initiatives to generate additional revenue via CRM, analytics, and other IT enabled methods Luftman et al. (2015). Luftman et al. (2015) forecasts that over the next 3 – 5 years as organizations shift IT spending in a desire for flexibility and need for security cloud technologies will be one of the top investments in technology.

Proprietary Software

As information technology has matured, it has become more strategically vital in some areas while also being reduced to a role similar to a commodity in other areas. In 2003 Nicholas Carr's article "IT Doesn't Matter" (Carr, 2003) was published in the Harvard Business Review and almost instantly sparked passionate debate in academic circles. While the authors of this article do not want to rekindle a debate on the now distant article we believe that Carr's point was that IT no longer mattered in the way that it once did. At one time IT was valuable, rare, imperfectly imitable, and non-substitutable. In other words, it fits the criteria to be a resource that can be used to establish a sustainable competitive advantage according to the resource based view of the firm. According to the resource based view of the organization, in order for an organization to develop a sustainable competitive advantage the organization needs to have a resource, or resources, that is/are heterogeneous and immobile. Four attributes needed to achieve this are: the resources have to be valuable, rare, imperfectly imitable, and not substitutable by a resource that does not meet the previous three criteria (Barney, 1991). But by 2003 IT had become much more ubiquitous. By that time, high quality software packages were available to address many of the problems organizations had once had to develop solutions to independently. Therefore, many IT solutions were no longer a strategic resource. Instead they were an expense that needed to be minimized (while still meeting the organizations' expectations). On the other hand, in areas where IT could be a strategic resource, IT mattered greatly. One of Carr's main points was that the level of corporate investment in IT needed to be considered strategically and according to whether each particular IT solution was more properly considered a secondary activity or if it added value as a strategic resource that could provide a strategic advantage.

Since it is difficult in a free market to obtain and keep a sustainable competitive advantage (Porter, 1980) when an organization can obtain a strategic resource through the usage of IT they should usually invest in proprietary IT to increase their strategic flexibility by maintaining control of the software development (Agrawal, 2005a; Agrawal et al., 2016) if doing so will assist the organization in preserving rarity and imperfect imitability to the maximum extent possible. When an organization can't use IT as a strategic resource, rivals can act as fast followers to develop and implement similar IT solutions quickly. Wailgum (2007) uses Walmart, Dell, and Jet Blue as examples of organizations that have used proprietary software for competitive advantage. However, that advantage has faded or disappeared for these and many other companies. As the quality of COTS products has increased across most domains the comparative differences between COTS and proprietary applications has been greatly reduced - in many cases to the point that COTS can not only serve as an effective substitute to even very good proprietary systems but the COTS product can usually do so at a fraction of the cost. Companies such as Walmart were innovators in building IT applications to support business processes that were best practices. But given the current IT business environment, they are split on IT applications. Walmart will continue to build custom applications where it makes sense from a strategic perspective, but they will increasingly use commercial applications for business intelligence and other infrastructural needs (Wailgum, 2007)

Figure 1: Conceptual Model – Strategic Issues in Development of Software: Source Agrawal (2005a), Agrawal et al. (2016)

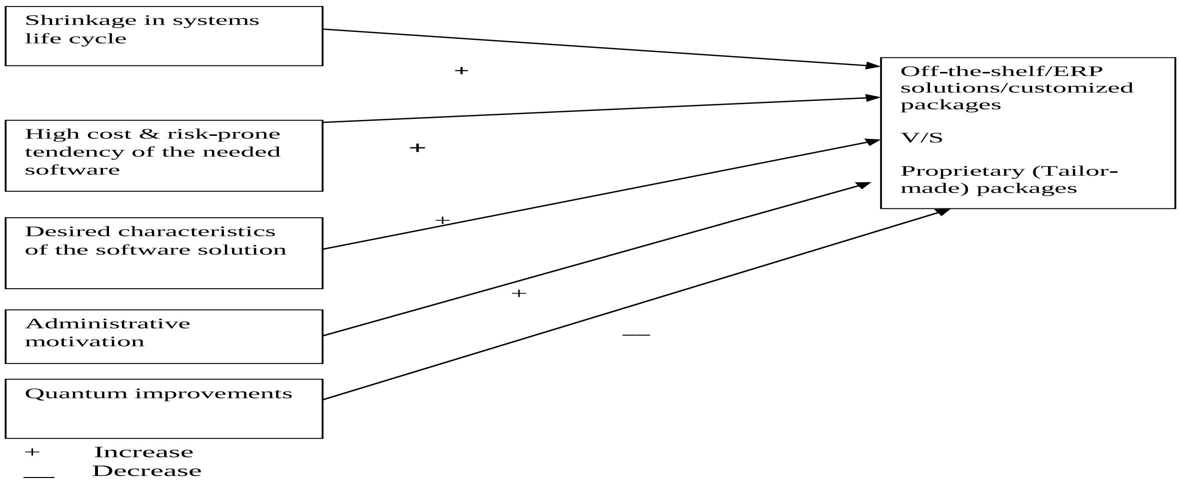


Table 1: Measuring Parameters with Identified Variables (Agrawal, 2005a, Agrawal et al. 2016))

Item	Variable	Questions for Measurement
B3a.	Shrinkage in Systems Life Cycle	Time compression
B3b.		Shorter obsolescence cycle of packages.
B3i.		Higher rate of upgrades in hardware/software.
B3c.	High Cost and High Risk Prone Tendency of the needed Software	High failure rate of packages.
B3d.		Cost of development of packages.
B3e.		Complexity of required application packages.
B3g.	Desired Characteristics of the Software Solution	The packages have in-built best practices followed in the industry
B3h		Ease of training
B3k.		The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering.
B3l.		The packages are proven for reliability.
B3n.		Little maintenance problem in the packages.
B3f.	Administrative Motivation	Non-availability of manpower in information technology
B3j.		Organizations prefer to change their processes due to advantages in using the packages.
B3m.		Availability of skilled End Users to operate the packages.
B3o.		Availability of reliable software maintenance support.
B3q.		Packages are critical to the operation of the organization.
B3p.	Quantum Improvement	Flexibility available in the software packages.
B3r.		Control of the entire life cycle of the package.
B3s.		Packages enable automation of firm specific processes

Four major trends leading to decreased usage of proprietary software are faster development time (shrinkage in systems life cycle), more complex projects (high cost and risk-prone tendency of the needed software), ease of use and predictability (desired characteristics of the software solution), and the desire of senior management to avoid risks and to focus on core competencies (administrative motivation) (Agrawal, 2005a; Agrawal et al., 2016).
These factors serve to make proprietary software development riskier and of decreased incremental value than was traditionally the case in comparison to COTS. This is hypothesized to lead to an overall decrease in usage of proprietary software as organizations shift usage to

COTS application. One exception is when a new solution, or a radical change to existing IT application, is introduced and greatly improves existing business practices in such a way as to provide a sustainable competitive advantage (quantum improvements). Organizations seeking to use quantum improvements to achieve a strategic advantage are hypothesized to be more likely to attempt to do so through the usage of proprietary software because using a COTS product might be valuable but using a COTS application would all but prohibit any possibility of a resource being rare and imperfectly imitable (even if the COTS resource was valuable and non-substitutable). The impact of each of the trends above will be considered in relation to how it affects the percentage of applications moving to COTS (and conversely, away from proprietary software).

Commercial-Off-The-Shelf Software

The systems life cycle is shrinking***:*** The number of organizations competing and the number of workers employed by those organizations has been growing. The growth is characterized by an increased level of international business and a systems life cycle that continues to shrink as formal software development methodologies and other improvements occur. The environment is rapidly changing, turbulent, and unpredictable (Applegate et al., 2009; Scott-Morton, 1991; Turban & Volonino, 2011). Time-compression, short product life cycles, discontinuity of strategies, an increased need for in depth knowledge, and an approach that focuses on the customer are common in the current IT environment. (El Sawy, Malhotra, Gosain, & Young, 1999). In addition to, and at least partially because of these factors, COTS packages will also be costlier because of faster obsolescence. Many organization now compete on the basis of time (Li and Ye, 1999) which increasingly adds to the pressure on IT systems. More frequent changes in strategy will occur because of the pace of business (enabled largely by IT) will drive an organization’s supporting software to respond quickly to the needed timeframe. Naukam (2014) asserted that the business users are not satisfied with the backlog of projects and the performance of IT departments. Commercial Off the Shelf ERP systems are expected to experience increased adoption because of the resulting higher rate of obsolescence (Agrawal, 2005b). Mainly because of the IT environment described above, most organizations will strive to reduce the amount of time and money invested in IT software development by utilizing COTS, cloud computing, software as a service, COTS/ERP, and other solutions, in an effort to decrease the expense and risk associated with developing proprietary software (Agrawal et al., 2011).

Hypothesis 1a: In manufacturing as well as service sector, the mean “Systems life cycle shrinkage” score for managers who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean “Systems life cycle shrinkage” score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis 1b: The “Systems life cycle shrinkage” will lead to increased usage of COTS/ERP in the next 5 years, both in the case of manufacturing as well as service sector.

High cost and risk-prone tendency of the needed software***:*** IT outsourcing has grown because of three primary reasons 1.) companies increasingly want to concentrate on their core competencies so they outsource areas such as technologies and IT components when those are not core competencies; 2.) officer dissatisfaction with the information systems department’s performance; 3.) outsourcing is more cost effective (Lucas, 2000; Turban, McLean, & Whetherbe, 2001; Turner & Kambil, 1994; Venkatraman & Short, 1992).
Purely technical IT tasks, such as change management and implementation, were projected to not be good candidates for outsources but the rest of the organization’s IT functions, such as coding, are good candidates to outsource in order to reduce IT expenses (Markus &

Benjamin,1996). Palvia and Wang (1995) found that outsourcing and downsizing was being considered by many IS executives to improve their IT department's performance. Software development is expensive and risky due to the complexity of modern systems and high project failure rates. A report by Standish Group 2015 Chaos Report on the success of software projects revealed that in the United States in 2015, 29% of all projects succeeded (delivered on time, on budget, with required features and functions), 52% were challenged (late, over budget, and/or with less than the required features and functions), and 19% failed (cancelled prior to completion or delivered and never used). Furthermore, estimated success of large-scale (large and grand) software development (projects with more than $10 million in labor content) stated that 10.5% of all projects succeeded, 57% were challenged, and 32.5% failed (Hastie & Wojewoda, 2015).
Complex systems are more likely to fail as are integrated systems since development of integrated systems tends to be both complex and large (Jeong & Klein, 1999). Software development productivity has increased because of improvements in code reusability and customizability resulting from the object-oriented approach and this has led to increased flexibility, increased predictability, and fewer errors (Nidumolu & Knotts, 1998). However, a fast obsolescence rate combined with high cost and risk factors will continue to make in-house development less desirable for complex projects (if the functionality required is available in a COTS alternative.) As information technology shifts toward a strategic necessity approach (Carr, 2003; 2013), reduced investments on IT applications will be preferred if requirements can be met by a COTS product at a significantly lower cost.

Hypothesis H2a: In manufacturing as well as service sector, the mean "Higher development cost and risks associated with the development of proprietary software" score for managers who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean "Higher development cost and risks associated with the development of proprietary software" score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis H2b: In manufacturing as well as service sector, the "Higher development cost and risks associated with the development of proprietary software" will lead to increased usage of COTS/ERP in the next 5 years.

<u>Desired characteristics of software</u>: Ease of use and predictability of cost and outcome are desired characteristics of software that favor COTS/ERP. Davis (1986) found that ease of use and usefulness predict user intention to use a technology. Many COTS products now offer a standardized user interface that helps end users learn how to use similar products quicker than in the past. In order to reduce training costs and improve user satisfaction, firms want software that is user friendly. A simpler user interface and improved artificial intelligence are factors that are leading many COTS systems to be operational with little or no training. Reliable predictions of costs of acquisition, implementation, and use of off-the-shelf/ERP solutions can be determined with some precision (Heikkilä, Saarinen, & Sääksjärvi, 1991; Laudon & Laudon, 2015) but as mentioned in the preceding section, the development of proprietary systems is subject to cost overruns, budget delays, and an uncertain ability to meet the expectations of the users (Hastie & Wojewoda, 2015). Many organizations desire the predictability and the speed associated with COTS packages. The costs savings (up to 50% less expensive vs. developing proprietary packages) make COTS packages advantageous. In addition, organizations can reduce maintenance costs by implementing COTS/ERP packages. As much as 80% of an organization's IT budget can be dedicated to maintenance costs of in-house developed proprietary packages (Turban et al., 2011). Installing a new COTS/ERP application allows

organizations to upgrade their processes using best practices built into the packages (Turban et al., 2001).

Hypothesis H3a: In manufacturing as well as service sector, the managers with a higher mean score on the “desired characteristics of software” construct who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean ““desired characteristics of software” construct” score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis H3b: In manufacturing as well as service sector, the “desired characteristics of software” construct will lead into increased usage of COTS/ERP in the next 5 years.

Administrative motivation***:*** Many of the IT functions previously addressed by an organization’s information systems department have shifted to end users. Corresponding human resources and funding to accomplish those functions have also gone to the end user, resulting in lower resources dedicated to the information systems departments (Edberg & Bowman, 1996; He, Kusy, & Zhao, 1998; Lucas, 2000). This shift is largely driven by an increased availability of user-friendly software, knowledgeable end-users, and extensive company support to EUC (Turban et al., 2001). End-users are assuming greater responsibilities for information systems applications, and end-user involvement is positively correlated with the success of information systems (Doll & Torkzaddah, 1988; McLean, Kappelman, & Thompson, 1993; Winter, Chudoba, & Gutek, 1997). Turban et al. (2001) claimed that many of the user requirements are smaller in size and can be developed by end-users themselves. The percentage of knowledge and information work constitutes 60% of America’s GNP and 55% of America’s labor force (Laudon & Laudon, 1999). More knowledge workers are available and the have tools (simple user interfaces for daily work and application development tools/utility programs) to develop most small one-time software application with no or minimal assistance from IT professionals (Agrawal et al., 2011). Many of the previously mentioned factors also serve as administrative motivation for moving to COTS. Motivation for administrators to migrate to COTS include the continuing proliferation of software and the outsourcing market (responsible for the shifting role of IT as a commodity due to the reliability of services provided by these sources) (Carr, 2003; 2013). Because management is not satisfied with the performance of IT departments they are replacing in-house development with COTS (Naukam, 2014). In order for organizations to survive in an increasingly competitive environment, they have to consider the usage of COTS or outsourcing where appropriate.

Hypothesis H4a: In manufacturing as well as service sector, managers with a higher mean score on the “administrative motivation, system performance” construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean “administrative motivation, system performance” construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis H4b: In manufacturing as well as service sector, the “administrative motivation, system performance” construct will lead into increased usage of COTS/ERP in the next 5 years.

Continuous improvements/quantum improvements: Intense competition leads to uncertainty and stimulates higher innovation and adoption rates that will, in turn, increase competition (Ettlie, 1983; Lewin, Lewin, & Meisel, 1987). Supernormal profits are not sustainable in a competitive market with free entry (Porter, 1980).

Short-term profits are possible, over time, if the profit earned will equal the cost of capital plus compensation to the owner for unique inputs to production. When secrecy is maintained, IT can provide a short-term competitive advantage. However, duplication time for applications is only months in many cases and rapidly developed new innovations will make the old ones outdated

(Porter, 1996; Turban et al., 2015). In light of this, IT is unlikely to be a basis for gaining a competitive advantage in most situations. Researchers have identified IT as mainly a commodity or a strategic necessity for the organization and cannot be a source of sustainable competitive advantage (Brynjolfsson, 1996; Carr, 2003; 2013; Clemons, 1990; 1991; Clemons & Kimbrough, 1986; Emery, 1990; Kermer & Sosa, 1991; McNurlin, 1991). In the industrial world most businesses could not function without computers and software (Jones, 1994). As IT's role shifts away from a strategic necessity to gain a competitive advantage, resources dedicated to IT will decrease in most organizations (Carr, 2003; 2013). Organizations will cut their application packages expenses by using COTS/ERP solutions with a policy of continuous improvements. Alternatively, when organizations have the chance to establish a sustainable strategic advantage, they will develop proprietary application packages that will garner control over the software development and be tailored to their needs (even though it will require more of the organization's resources).

Hypothesis H5a: In manufacturing as well as service sector, managers with a higher mean score on the "importance of quantum improvement" construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean "the importance of quantum improvement" construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis H5b: In manufacturing as well as service sector, the "importance of quantum improvement" construct will lead into increased usage of proprietary packages in the next 5 years.

MEASURES

After a thorough review of the literature (Table 1), measures were validated and adapted to the context of this study. Multiple-item measures were used for assessing the various research constructs. Items were measured using a seven-point Likert-type scale. More details on this process can be found in section 5, "Implementation of Research Methodology."

METHODS

This study is exploratory and descriptive in nature. Participants from manufacturing and service sectors of United States based organizations were surveyed. This approach was selected to achieve more generalized results and depth. The study's three phases include:

Phase 1 – Exploratory Study: In this phase, a literature search was conducted and the findings were analyzed. The analysis yielded the problem list and a revised version of Agrawal's questionnaire (Agrawal, 2005a) was developed.

Phase 2 – Survey and Construct Validity: A questionnaire survey was developed to answer the research questions in this phase. To test the construct validity of the questionnaire, a principal component factor analysis, combined with Varimax rotation, was performed.

Phase 3 – Data Analyses*:* The quantitative data was used to test the hypotheses using t-test, and correlation.

IMPLEMENTATION OF RESEARCH METHODOLOGY

This section is divided into six sub-sections: questionnaire design, questionnaire validation, reliability using Cronbach's Alpha, questionnaire testing, administering the instrument, and profile of responding firms and respondents.

Questionnaire Design*:* The questionnaire uses the Likert-type scale with seven intervals, from low to high, with equal weights. Open-ended questions were avoided due to the difficulties in measurement.

Questionnaire Validation: The questionnaire validation exercise was divided into four parts: face validity, criterion-related validity, content validity, and construct validity*.*

Face validity: The variables and items developed by Agrawal (2005a) were used for initial development of the questionnaire. This study's authors discussed and agreed upon a revised set of variable attributes with agreed upon wording to describe each attribute. The wording of each attribute's description was used as an item to describe the over-all constructs being studied. The construct each item on the questionnaire was hypothesized to represent was validated and refined using the following process. Three professors served as judges and independently specified which construct, if any, each item represented. The perceptions were then compared. If all judges agreed on which construct the item represented, then the item was considered to have acceptable face validity. When there was disagreement among the judges, the meaning of the question was discussed to make sure each judge had the same understanding of the meaning. If the disagreement of the judges was not with the wording of the question, but instead with the meaning the question, the question was considered not be a good item to measure the underlying construct the item was meant to measure and the question was discarded. Where the meaning of the question was perceived differently, the question was reworded to clarify the meaning and the judges independently evaluated each item again. This process continued until all three judges agreed on which underlying construct the item would measure or the meaning of the question was clearly understood but there was still disagreement on the suitability of that question to serve as an item to measure a particular construct. In the latter case, that item was discarded. The idea was to bring out the mental image for the variables in acceptable language. This exercise helped in evolving operational definitions of variables and in modifying the language of the questions. Once the items had face validity they were operationalized through the questionnaire.

Criterion-related validity: This helped in understanding the questionnaire, its objective, purpose, language, context, and feasibility of answering from the respondent's point of view. Four IS executives from different organization were involved in this exercise, which helped in making the questions more specific. Based on their experience, the executives commented on the wording, size and time required to respond to each question. They suggested several major changes. Items changed as a result of this process were then reexamined for face validity.

Content validity: A document containing the objective of the study and operational definitions of the variables, plus the questionnaire was supplied to four professors and three IS executives. The judges were to indicate which questions measured which variables. The questions scoring less than 70 percent agreement were modified. After correcting the questionnaire, the judges helped in resequencing the questions so they represented the logical relationship of variables and natural flow of thoughts.

Construct validity: Prior to the extraction of the factors, several tests were used to assess the suitability of the respondent data for factor analysis. These tests included Kaiser-Meyer-Olkin (KMO) Measure of Sampling Accuracy (Kaiser, 970; Kaiser, 1974), Correlation Analysis (Kim & Mueller, 1978), and Bartlett's Test of Sphericity (Bartlett, 1950). SPSS version 23.0 was used for all data analysis conducted in this study. The KMO index, in particular, is recommended when the cases to variable ratio are less than 1:5. The KMO index ranges from 0 to 1, with 0.5 considered suitable for factor analysis (Hair, Anderson, Tatham, & Black, 1995; Tabachnick &

Fidell, 2007). When analyzing the correlations of the items only items with a correlation of .4 and above should be retained for factor analysis (Kim & Mueller, 1978). All items were correlated with all other items at greater than the .4 level with .437 being the lowest correlation between any two items. The Bartlett's Test of Sphericity should be significant ($p<0.05$) for factor analysis to be suitable (Hair et al., 1995; Tabachnick & Fidell, 2007). For the data used in this study, the KMO index is 0.934 and Bartlett's Test of Sphericity has a significance level p = 0.000 (Table 2), therefore the respondents' data are suitable for factor analysis.

Table 2: Measurement of Sampling Adequacy Using KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.934
Bartlett's Test of Sphericity	Approx. Chi-Square	2530.010
	df	190
	Sig.	.000

In order to determine the number of factors for each construct an eigenvalue greater than one rule is recommended for established instruments (Churchill, 1979). For exploratory analysis the selection of the number of factors is determined using both the underlying theory used to develop the instrument and on empirical results (Hinkin, Tracey, & Enz, 1997). Six factors were used for factor analysis to test the theory-based proposed 5 factor model. Factor analysis was also conducted with 4, 5, and 7 factors to test for the possibility that the items might better conform to a different factor structure. Of the models tested, the 6-factor model fit the best. Loadings greater than 0.40 in absolute value are suggested as the criterion for significant factor loadings (Ford, MacCallum, & Tait , 1986) and all items loaded in excess of 0.4 (Table 5). The items employed in this study to assess factors influencing the trend in requirements of categories of application software was a 20-item evaluation of all samples in manufacturing and service sectors of the United States. A principal component factor analysis of the evaluation scale was conducted using the 148 valid responses collected. Factor analysis can obtain an accurate solution with a sample size of 150 observations or more if intercorrelations are reasonably strong (Guadagnoli & Velicer, 1988) so the sample size is considered adequate. The questionnaire items generally loaded under the variables they sought to measure (Table 3). In some cases, items loaded on a different construct from the one hypothesized by this paper's research review.

If the item had more than a 0.2 difference it was used to measure the construct it loaded on the highest. Some items loaded on more than one factor but every item loaded on at least one factor at a significant level. Some possible reasons for the cross loadings are discussed in the "limitations" section of this paper.

Six distinct factors were used. The Eigenvalues and variance explained by each factor are presented in Table 4. The 7-item factor of desired characteristics of the software solution explained the majority of the scale variance, followed by 4-item factor administrative motivation, system performance, 3-item factor shrinkage in systems life cycle, and 3-factor administrative motivation, HR. The high-cost and risk prone tendency of needed software explained by the 2-item factor and the sixth factor quantum improvement by one-item. The factors emerged as anticipated, given a subjective knowledge of the participants' responses. The summary of constructs and factor loadings are narrated in Table 4 and Table 5, respectively.

Table 3: The Modified Constructs with Measuring Data Items

Item	Variable	Questions for Measurement
13	Desired Characteristics of the Software Solution (Factor 1)	Availability of skilled End Users to operate the packages.
14		Reduced maintenance problems in the packages
15		Availability of reliable software maintenance support.
16		Flexibility available in the software packages
17		Packages are critical to the operation of the organization.
19		Packages enable automation of firm specific processes
21		The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering.
1	Shrinkage in Systems Life Cycle (Factor 2)	Rapid changes in the business cycle.
2		Applications are becoming obsolete quickly
3		High failure rate of packages during development
9	Administrative Motivation, Systems Performance (Factor 3)	Faster upgrades in hardware/software
10		Organizations prefer to change processes to gain advantages using packages
12		The packages are proven for better reliability
20		Availability of a user community
6	Administrative Motivation, HR (Factor 4)	Shortage of information technology professionals
7		The packages have in-built best practices followed in the industry
8		Ease of training
4	High Cost and High Risk Prone Tendency of the needed Software (Factor 5)	Cost of development of packages
5		Complexity of required application packages.
18	Quantum Improvement (Factor 6)	Control of the entire life cycle of the package

“Desired characteristics of the software solution” was the label given to the first factor. This 7-item dimension explained the most variance of the five emergent factors (59.702%). Example items include: “availability of skilled End Users to operate the packages,” and “reduced maintenance problems in the packages.” The second factor “shrinkage in systems life cycle” contains items such as “rapid changes in the business cycle,” “applications are becoming obsolete quickly,” and “high failure rate of packages during development.” The high failure rate of packages during development,” which was proposed under “High cost and high risk prone tendency of the needed software,” loaded strongly on “shrinkage in systems life cycle.” This is possibly because the shrinkage in the system life cycle is associated with a higher failure rate for ERP and is thus an important consideration when considering the acquisition of a new software application. The proposed factor “administrative motivation” is split into two factors: administrative motivation, system performance and administrative motivation, HR, which contain items such as “the packages have in-built best practices followed in the industry,” “ease of training,” and “faster upgrades in hardware/software.” The faster upgrades of hardware/software classified under administrative motivation may be because of this feature. With the shift to COTS solutions, customers have come to expect each organization to provide all of the latest features. For example, if one organization in an industry offers the ability to track packages, then customers expect that all organization in that industry will be able to track packages. Organizations not using IT for a competitive advantage can more easily introduce capabilities made possible with newer versions of software quickly using COTS/ERP packages. This would likely not apply to companies such as Facebook, Netflix, Amazon, and others that use their information systems as a core part of their business strategy. Furthermore, the fourth factor “high cost and risk prone tendency of the needed software” contains the items “cost of development of packages” and “complexity of required application packages.” These questions were also identified with the same variables by Agrawal (2005a) and Agrawal et al. (2016). A sixth factor “quantum improvement” is associated with only one item “control of the entire life cycle of the package.”

Table 4. Factor Analysis – Loading and Variances in the Identified Factors

Factor	Items	Eigenvalue	% of Variance
Desired Characteristics of the software solution (Factor 1)	7	11.940	59.702
Shrinkage in systems life cycle (Factor 2)	3	1.064	5.319
Administrative motivation, Systems Performance (Factor 3)	4	0.972	4.858
Administrative motivation, HR (Factor 4)	3	0.870	4.349
High cost and risk prone tendency of the needed software (Factor 5)	2	0.645	3.225
Quantum Improvement (Factor 6)	1	0.601	3.007

Based on the results of the exploratory factor analysis, an additional hypothesis for the new construct was developed and is reflected in a revised model (Figure 2).

Hypothesis H6a: In the manufacturing as well as service sector, managers with a higher mean score on the “administrative motivation (HR)” construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean “administrative motivation (HR)” construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Hypothesis H6b: In the manufacturing as well as service sector, the “administrative motivation (HR)” construct will lead into increased usage of COTS/ERP in the next 5 years.

Based on the constructs identified, the model is revised and shown in Figure 2 which is considered uniformly to facilitate the needed analysis of responses from organizations in the United States. In spite of apparent limitations, this provides confidence that the questionnaire administered had enough construct validity.

Table 5: Loading of Data Items on the Factors

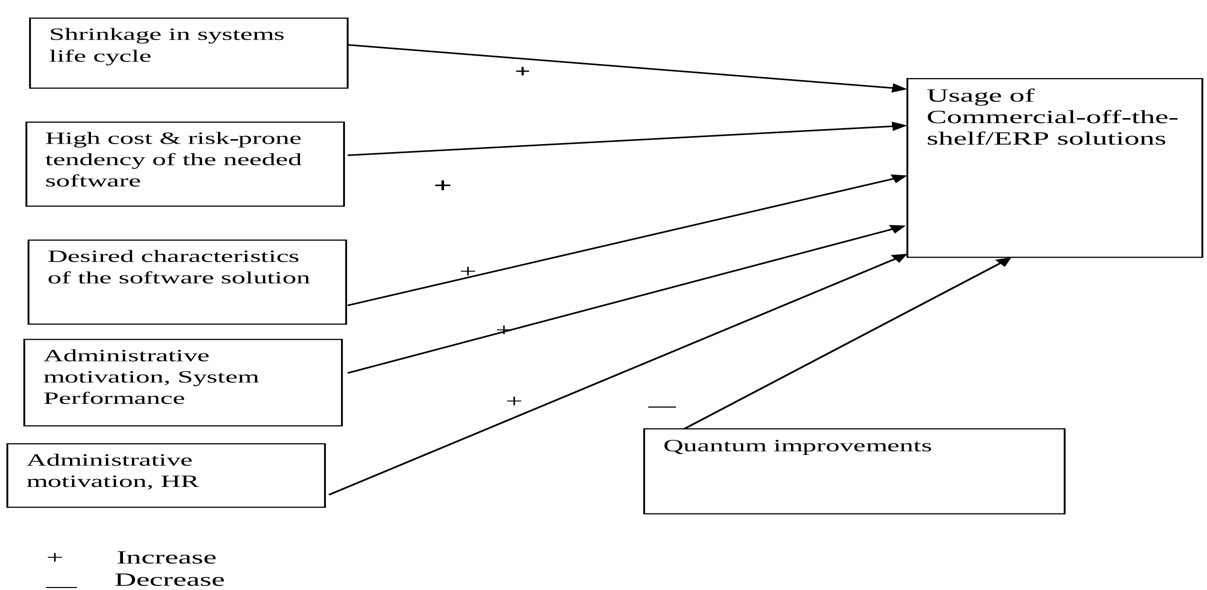
Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
B3_1	.249	.800	.235	.226	.083	.124
B3_2	.420	.659	.218	-.043	.279	.145
B3_3	.315	.586	.146	.353	.295	.113
B3_4	.254	.272	.068	.100	.830	.159
B3_5	.213	.151	.297	.389	.705	.095
B3_6	.304	.288	.061	.784	.254	-.008
B3_7	.297	.189	.493	.596	.188	.241
B3_8	.285	.166	.484	.563	.068	.407
B3_9	.115	.393	.675	.035	.295	.391
B3_10	.490	.264	.671	.249	.103	.001
B3_12	.579	.292	.614	.183	.126	-.049
B3_13	.757	.260	.207	.155	.311	-.123
B3_14	.741	.227	.104	.204	.197	.212
B3_15	.755	.250	.203	.277	.176	.198
B3_16	.639	.252	.359	.310	.143	.294
B3_17	.714	.261	.223	.165	.100	.345
B3_18	.364	.395	.140	.142	.305	.626
B3_19	.470	.463	.255	.312	.195	.345
B3_20	.173	.596	.433	.363	.212	.134
B3_21	.410	.575	.189	.308	.255	.301

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 12 iterations.
Factor 1 = Desired Characteristics of the Software Solution; Factor 2 = Shrinkage in Systems Life Cycle; Factor 3 = Administrative Motivation, Systems Performance; Factor 4 = Administrative Motivation, HR; Factor 5 = High Cost and High Risk Prone Tendency of the needed Software; Factor 6 = Quantum Improvement

Figure 2: Modified Conceptual Model – Strategic Issues in Development of Software



Reliability using Cronbach's Alpha: Cronbach's Alpha Was used to estimate the reliability of a scale. An increase in the correlation between items will result in an increase in the value of Cronbach's Alpha. Table 6 shows the results of a reliability analysis conducted using Cronbach's Alpha.

Five of the six factors, both for manufacturing and service sectors, had alpha reliabilities that were within the traditionally acceptable range of above 0.70 (Nunnally, 1970). The factor quantum improvement is explained by one-item and therefore its alpha reliability could not be calculated.

Table 6. Reliability Analysis

		Cronbach's Alpha		Cronbach's Alpha
Factor	Items	COTS Software-Manufacturing Sector	Items	COTS Software-Service Sector
Desired Characteristics of the software solution (Factor 1)	7	0.942	7	0.931
Shrinkage in systems life cycle (Factor 2)	3	0.779	3	0.872
Administrative motivation, system performance (Factor 3)	4	0.876	4	0.873
Administrative motivation, HR (Factor 4)	3	0.849	3	0.852
High cost and risk prone tendency of the needed software (Factor 5)	2	0.700	2	0.833
Quantum Improvement (Factor 6)	1	Single Item	1	Single Item

Questionnaire Testing: The questionnaire was tested with the help of four professors and three IS executives. The respondents were encouraged to identify difficulties in completing the questionnaire. Issues regarding the format, length, language, and context of some of the statements were noted and the questionnaire was redesigned.

Administering the Instrument: The questionnaire survey was administered following the guidelines suggested by Dillman (1978; 2000). The targeted sample was of IT professionals with some responsibility for making IT software acquisition decisions for organizations based in the United States. The survey instrument was operationalized electronically using the fees-based non-probability internet panel service from Qualtrics. Blankenship, Breen, & Dutka (1998) indicated that online panels were lower cost, faster response, and had the ability to obtain a targeted sample of people who are limited in the general population.

The questionnaire survey was sent to a panel of senior managerial IT professionals (directors, chief information officers, middle managers, etc.) of firms in the United States. All recipients of the invitation were selected from among those who have registered to participate in Qualtrics online surveys and polls. The data have not been weighted to reflect demographic composition of IT professionals and no demographic analysis is conducted. In order to participate, subjects were required to read and accept the institutional review board (IRB) statement and to select a qualifying description of the management position they served in. If anyone opted out of the survey after reading the IRB statement (or if they indicated they were not in an appropriate job function to participate) the survey terminated before advancing to the research questions. To establish adequate representation for analysis in each industry type, target quotas of 80 service sector responses and 70 manufacturing sector responses were established. The service sector industry type had a further target quota of 40 respondents in the Computer Software industry sector and 40 respondents for other service industry sectors. Once a quota was reached, Qualtrics deactivated the links given in the invitation to participate for that sector. The deactivated links were based upon the industry each person's panel profile indicated they were employed in. Because respondents were paid only if they completed the survey, the quota results were not exact. Respondents who had changed industry or who began a survey before the link was deactivated were allowed to finish the survey.

Out of the 153 questionnaires started, the total usable responses were 148. According to Callegaro & DiSogra (2008) calculating a response rate for non-probability samples is not meaningful because determining the denominator is not possible. This resulted in a break-off rate of 96.73 percent, indicating that subjects who started the survey were very likely to fully or partially complete the survey. Because the sample is based on those who initially self-selected for participation, rather than a probability sample, no estimates of sampling error can be calculated. All sample surveys and polls may be subject to multiple sources of error, including but not limited to sampling error, coverage error, and measurement error. (Baker et al., 2010)

Profile of Responding Firms and Respondents
This section is divided into three parts: industry type, organization size, and respondent profile.

Table 7: Distribution of Types of Industries in the Sample

What is the primary industry of your host organization	Responses	Percentage
Manufacturing Sector		
Automobile Manufacturing	1	1.4
Computer Hardware	17	23.9
Manufacturing	48	67.6
Pharmaceutical Manufacturing	2	2.8
Telecommunications Hardware	1	1.4
Other Manufacturing		
--Aerospace	1	1.4
--PI	1	1.4
Total Manufacturing Sector	**71**	**100%**
Service Sector		
Computer Software	38	49.4
Technology	19	24.7
Construction	3	3.9
Government	3	3.9
Healthcare	1	1.3
Insurance	2	2.6
Banking	3	3.9
Retail	1	1.3
Transportation	3	3.9
Utilities	1	1.3
Other		
-- Consumer	1	1.3
-- Engineering	1	1.3
-- Healthcare Analytics	1	1.3
Total Service Sector	**77**	**100%**

Industry type: In the manufacturing sector (Table 7), the majority of the respondents were from manufacturing (67.6%) and computer hardware (23.9%), while in the service sector (Table 7) respondents from computer software/technology were relatively higher (49.4% + 24.7% = 74.1%) compared to other industries.

Organization size: Respondents in manufacturing sector (Table 8) were distributed fairly in good proportion among the organizations had sales revenue between $5 million and $1 billion while in service sector the fair distribution was between sales revenue of $5 million to $2 billion

Table 8: Size of the Organizations in the Sample

	Manufacturing Sector		Service Sector	
What is the annual sales of your host organization	Number of Responses	Percentage	Number of Responses	Percentage
Up to 5 million	1	1.4	5	6.5
5 million to 20 million	10	14.1	19	24.7
20 million to 50 million	9	12.7	13	16.9
50 million to 250 million	19	26.8	11	14.3
250 million to 500 million	7	9.9	7	9.1
500 million to 1 billion	13	18.3	11	14.3
1 billion to 2 billion	5	7.0	8	10.4
More than 2 billion	7	9.9	3	3.9
Total	71	100%	77	100%

Table 9: Level of Respondents in the Organizations and their Functional Departments

Manufacturing Sector					
What is your level in the organization	Responses	%	Functional department	Responses	%
Executive	29	40.8	Accounting	1	1.4
Directors	18	25.4	Administration	6	8.5
First Line Management	13	18.3	Engineering	5	7.0
Middle Management	11	15.5	Information Systems	54	76.1
			Production	1	1.4
			Sales/Marketing	3	4.2
			Other		
			--Purchasing	1	1.4
	71	100%		71	100%
Service Sector					
What is your level in the organization	Responses	%	Functional department	Responses	%
Executive	25	32.5	Accounting	3	3.9
Directors	15	19.5	Administration	3	3.9
First Line Management	15	19.5	Engineering	7	9.1
Middle Management	22	28.6	Information Systems	62	80.5
			Sales/Marketing	1	1.3
			Other		
			--Development/Support	1	1.3
	77	100%		77	100%

Respondent profile: The perception about issues related to IT (Tables 9 and 10) seems to have a fair representation based on the respondent's profile in the organization. The largest proportion of respondents, both in manufacturing as well as service sectors, were from senior level management. More than 70% of the respondents in manufacturing, as well as the service sector, were from top management, i.e. first line management and above (directors and executives). Furthermore, more than75% of the respondents (either in manufacturing or service) are from information systems departments, as intended for this survey research. The remaining respondents were directly associated with the information systems department. In most of the respondents' organizations the full-time information systems' employees were 100 or higher having IT department's budget more than $10 million.

Table 10: Number of Full-time IT Employees and IT Budget					
Manufacturing Sector					
Full-time information systems' employee in your organization	No. of responses	%	Budget of organization's IT Department	No. of responses	%
1 to 25	10	14.1	Up to 10 million	26	36.6
26 to 100	10	14.1	10 million to 25 million	14	19.7
101 to 500	21	29.6	25 million to 50 million	23	32.4
501 to 1,000	12	16.9	More than 50 million	8	11.3
1,000 to 2,000	13	18.3			
More than 2,000	5	7.0			
Total – Manufacturing Sector	71	100%		71	100%
Service Sector					
Full-time information systems' employee in your organization	No. of responses	%	Budget of organization's IT Department	No. of responses	%
1 to 25	6	7.8	Up to 10 million	30	39.0
26 to 100	7	9.1	10 million to 25 million	21	27.3
101 to 500	18	23.4	25 million to 50 million	18	23.4
501 to 1,000	23	29.9	More than 50 million	8	10.4
1,000 to 2,000	13	16.9			
More than 2,000	10	13.0			
Total – Service Sector	77	100%		77	100%

RESULTS AND DISCUSSION

The results of statistical analysis are presented to demonstrate the degree of association among the variables and to examine the statistical significance of the model presented. The significance levels of 0.01 and 0.05 are very common in research. In this study we considered 0.05 to 0.1 to be appropriate since the research is exploratory in nature. The software package used for all of the statistical analysis was SPSS version 23.00.
This part is divided into five sub-parts: descriptive statistics, ranking of variables and data items, trends in usage of category of software packages, analysis and validation of major hypothesis, contributing factors to support the trends in usage of various categories of application software.

Table 11: Descriptive Statistics of Variables
Descriptive Statistics – Manufacturing Sector (Sample Size 71)

	Range	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
C.Usage of Off-the-shelf, Non-ERP Software	100	28.21	23.592	556.598	1.542	.285	2.409	.563
C.Usage of Proprietary, Non-ERP Software	100	22.49	19.033	362.254	1.868	.285	6.180	.563
C.Usage of Off-the-shelf, ERP Software	100	28.87	25.273	638.712	1.438	.285	1.974	.563
C. Usage of Proprietary, ERP Software	70	20.42	17.943	321.962	.950	.285	.890	.563
F.Usage of Off-the-shelf, Non-ERP Software	100	26.07	22.755	517.809	1.629	.285	3.283	.563
F.Usage of Proprietary, Non-ERP Software	100	24.70	22.696	515.126	1.962	.285	4.890	.563
F.Usage of Off-the-shelf, ERP Software	100	28.77	26.149	683.748	1.479	.285	1.940	.563
F. Usage of Proprietary, ERP Software	90	20.45	18.842	355.023	1.240	.285	2.421	.563
Change in Usage of COTS over 5 Years	170.0	-2.239	21.5761	465.528	-2.166	.285	12.240	.563
Change in Usage of Proprietary Software over 5 Years	170.0	2.239	21.5761	465.528	2.166	.285	12.240	.563
Desired Characteristics of the software solution (Factor 1)	6.0	4.891	1.332	1.775	-1.399	.285	2.081	.563
Shrinkage in systems life cycle (Factor 2)	5.67	4.737	1.3140	1.727	-1.098	.285	1.067	.563
Administrative motivation, system performance (Factor 3)	6.00	4.9225	1.30561	1.705	-1.218	.285	1.502	.563
Administrative motivation, HR (Factor 4)	6.00	4.8779	1.3723	1.883	-1.141	.285	1.391	.563
High cost and risk prone tendency of the needed software (Factor 5)	6.0	4.979	1.2376	1.532	-.968	.285	1.546	.563
Quantum Improvement (Factor 6)	6	4.94	1.319	1.740	-1.085	.285	1.791	.563

Descriptive Statistics-Service Sector (Sample Size 77)

	Range	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
C.Usage of Off-the-shelf, Non-ERP Software	100	22.64	20.493	419.971	2.079	.274	6.161	.541
C.Usage of Proprietary, Non-ERP Software	100	25.70	20.405	416.370	1.560	.274	3.653	.541
C.Usage of Off-the-shelf, ERP Software	100	21.35	17.274	298.389	1.313	.274	4.508	.541
C. Usage of Proprietary, ERP Software	100	30.31	23.954	573.796	1.082	.274	1.513	.541
F.Usage of Off-the-shelf, Non-ERP Software	100	22.81	16.136	260.369	1.251	.274	5.658	.541
F.Usage of Proprietary, Non-ERP Software	100	26.69	19.993	399.717	1.414	.274	3.649	.541
F.Usage of Off-the-shelf, ERP Software	100	21.08	17.090	292.073	1.254	.274	4.602	.541
F. Usage of Proprietary, ERP Software	100	29.43	26.926	725.011	1.277	.274	1.070	.541
Change in Usage of COTS over 5 Years	140.0	-.104	19.3034	372.621	-1.733	.274	7.443	.541
Change in Usage of Proprietary Software over 5 Years	140.0	.104	19.3034	372.621	1.733	.274	7.443	.541
Desired Characteristics of the software solution (Factor 1)	6.0	5.17	1.214	1.475	-1.219	.274	1.500	.541
Shrinkage in systems life cycle (Factor 2)	6.0	4.905	1.394	1.944	-.676	.274	.059	.541

Administrative motivation, system performance (Factor 3)	6.0	5.1039	1.26916	1.611	-.928	.274	.901	.541
Administrative motivation, HR (Factor 4)	6.0	4.853	1.365	1.864	-.731	.274	.217	.541
High cost and risk prone tendency of the needed software (Factor 5)	6.0	5.058	1.3352	1.783	-.716	.274	.792	.541
Quantum Improvement (Factor 6)	6	5.00	1.423	2.026	-1.012	.274	.991	.541
Prefix C = Current (2016), Prefix F – Future (% years from 2015) Prefix Prop. = Proprietary, COTS = Commercial-off-the-shelf								

The Descriptive Statistics: The descriptive statistics for factors hypothesized to influence the trends in usage of various categories of application software are tabulated in the Table 11. In the case of usage of COTS/ERP software, the respondents ranked in manufacturing sector the influencing variables, High Cost and Risk Prone Tendency of the Needed Software; Quantum improvements; and Administrative motivation, system performance, with mean values above 4.9 (slightly high) on a seven-point scale. However, in service sector the respondents ranked influencing variables, Desired characteristics of software solution, Administrative motivation, system performance; High cost and risk prone tendency of the needed software; and Quantum Improvement with a mean value little higher than 5.0. The other variables ranked in the range lower than 4.9 in either manufacturing or service sectors. The standard deviations ranges between 1.2 and 1.4 in both manufacturing as well as service sectors, which seems very normal for a seven-point scale. Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. Kurtosis is a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution. The skewness for a normal distribution is zero, and any symmetric data should have a skewness near zero. Negative values for the skewness indicate data that are skewed left and positive values for the skewness indicate data that are skewed right. By skewed left, we mean that the left tail is long relative to the right tail. Similarly, skewed right means that the right tail is long relative to the left tail. All variables for COTS software were skewed negatively in the range of 0.96 to 1.4 in case of manufacturing sector and 0.67 to 1.2 in service sector. The kurtosis for a standard normal distribution is three. In our case the values mostly ranged between 1.0 and 2.1 in manufacturing sector and between 0.05 and 1.5 in service sector. These statistics reveal that the distribution of our sample is not standard normal. However, the trends in usage of various categories of application software, the kurtosis were mostly in the range of 3 for both sectors, while for both sectors, the responses were right skewed valued between 0.9 and 2.0.

Table 12: Ranking of Data Items and Variables

Item		Manufacturing Sector		Service Sector	
		Mean	Ranking	Mean	Ranking
7	The packages have in-built best practices followed in the industry	5.080	1	4.950	11
4	Cost of development of packages	5.010	2	5.090	7
9	Faster upgrades in hardware/software	5.010	2	5.210	4
17	Packages are critical to the operation of the organization.	5.010	2	5.190	5
21	The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering.	5.010	2	5.270	1
12	The packages are proven for better reliability	5.000	3	5.090	7
15	Availability of reliable software maintenance support.	4.970	4	5.250	3

5	Complexity of required application packages.	4.940	5	5.030	9
18	Control of the entire life cycle of the package	4.940	5	5.000	10
8	Ease of training	4.930	6	4.900	13
10	Organizations prefer to change processes to gain advantages using packages	4.930	6	4.910	12
2	Applications are becoming obsolete quickly	4.920	7	5.000	10
16	Flexibility available in the software packages	4.870	8	5.030	9
14	Reduced maintenance problems in the packages	4.830	9	5.260	2
19	Packages enable automation of firm specific processes	4.800	10	5.130	6
1	Rapid changes in the business cycle.	4.790	11	5.090	7
20	Availability of a user community	4.750	12	5.210	4
13	Availability of skilled End Users to operate the packages.	4.730	13	5.050	8
6	Shortage of information technology professionals	4.620	14	4.710	14
3	High failure rate of packages during development	4.510	15	4.620	15
Variable	High cost and risk prone tendency of the needed software (Factor 5)	4.979	1	5.058	3
Variable	Quantum Improvement (Factor 6)	4.940	2	5.000	4
Variable	Administrative motivation, system performance (Factor 3)	4.923	3	5.104	2
Variable	Desired Characteristics of the software solution (Factor 1)	4.891	4	5.169	1
Variable	Administrative motivation, HR (Factor 4)	4.878	5	4.853	6
Variable	Shrinkage in systems life cycle (Factor 2)	4.737	6	4.905	5

Ranking of Variables and Data Items: For the growth in usage of COTS/ERP software, the respondents perceived the top three variables as “High Cost and Risk Prone Tendency of the Needed Software,” “Quantum improvements,” and “Administrative motivation, system performance” in manufacturing sector and “Desired characteristics of software solution,” Administrative motivation, system performance,” and “High cost and risk prone tendency of the needed software” in service sector (Table 12). The top six data items are “The packages have in-built best practices followed in the industry,” “Cost of development of packages,” “Faster upgrades in hardware/software,” “Packages are critical to the operation of the organization,” “The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering,” and “The packages are proven for better reliability” for manufacturing sector. However, the top six data items for service sector are “The packages can help in implementation of Just-in-Time/Total-Quality-Management/Business Process Reengineering,” “Reduced maintenance problems in the packages,” “Availability of reliable software maintenance support,” “Faster upgrades in hardware/software,” “Availability of a user community,” and “Packages are critical to the operation of the organization.” The faster upgrades in software and hardware can be argued considering that the COTS/ERP packages are upgraded regularly and with the faster upgrades the organizations can get competitive advantages. In addition, the cost of development of proprietary packages which is relatively higher compared to COTS/ERP packages irrespective of benefits in costs due to automation in development of proprietary packages.

Trends in Usage of Category of Software Packages: The usage of all the four categories of software now and in five years from now (Figures 3 and 4) are approximately equal in percentage ranging from 20.5 to 30.0 in both manufacturing and service sectors. The projected changes over five years in usage of categories of application software in manufacturing sector

(Figure 3) reveals that the respondents perceive a marginal decline in off-the-shelf (Non-ERP), and marginal increase in proprietary (Non - ERP) software. On the other hand, in service sector, the respondents perceive a marginal decline in the requirement of proprietary (ERP) software and increase in the requirements of proprietary (Non – ERP) software. However, the current usage of COTS software (off-the-shelf – Non-ERP and off-the-shelf – ERP) declined from 57.08 percent to 54.84 percent in manufacturing sector, while, in service sector, it declines from 43.99 percent to 43.89. The decline resulted into corresponding increase in the usage of proprietary software (proprietary – non-ERP and proprietary – ERP) in both the sectors. In other words, we can say that most respondents perceive approximately equal usage of proprietary and COTS/ERP software currently as well as after five years.

Figure 3: Current and Projected Change in the Usage of Categories of Application Software – Manufacturing Sector

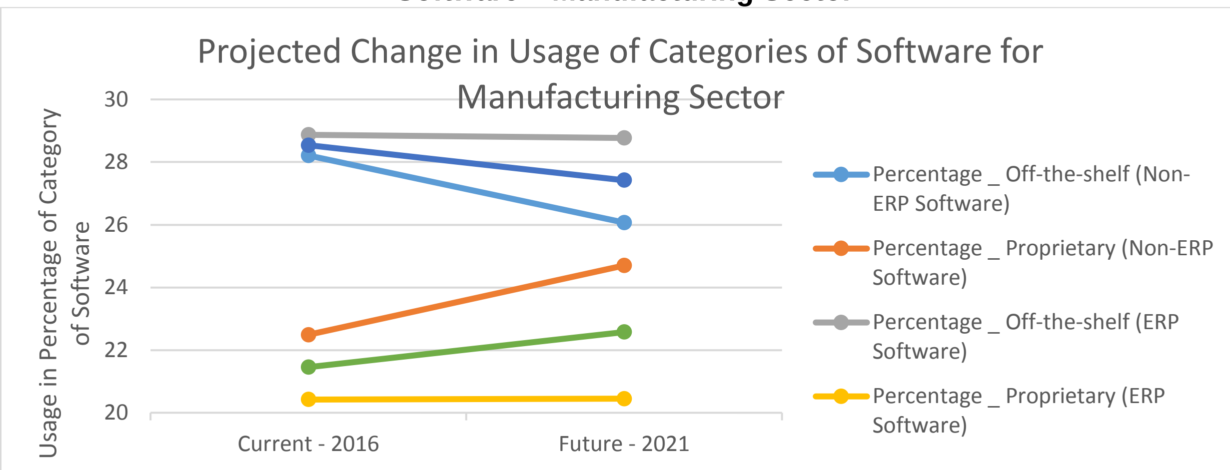
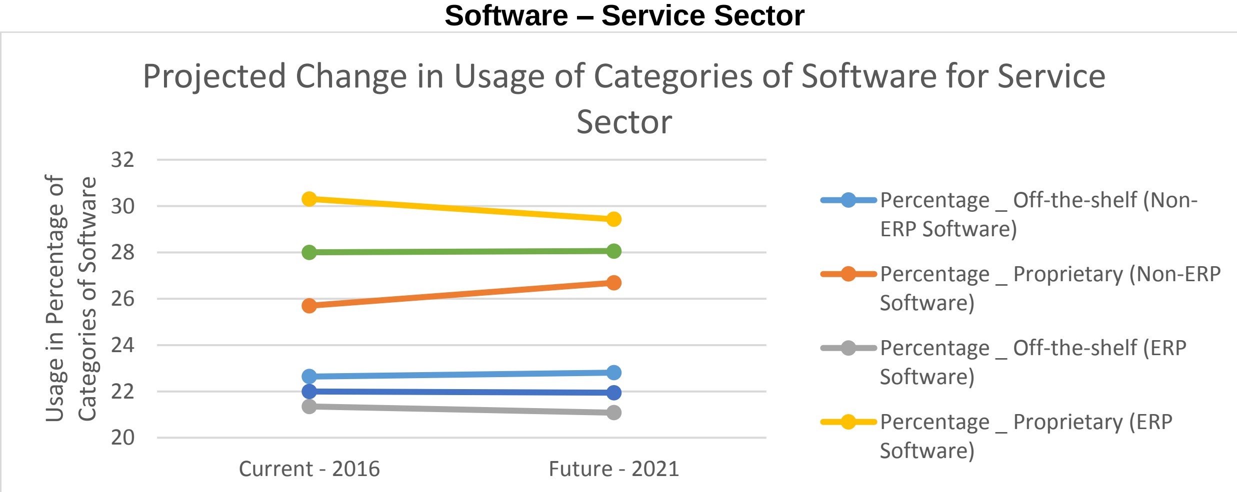


Figure 4: Current and Projected Change in the Usage of Categories of Application Software – Service Sector



Analysis & validation of major hypothesis and contributing factors to support the trends in usage of COTS/ERP and proprietary packages: This section is divided into two parts: t-test analysis and multiple regression analysis. Using these analyses, we will conclude our hypotheses.

t-test to find influencing factors on growth in requirement of COTS software by grouping respondents' perceptions about growth (positive) in and no (including negative) growth in requirement of COTS software: These analyses support our hypotheses. Through the t-test, we found influencing factors on growth in categories of software by grouping respondents' perceptions about growth in COTS, and growth in proprietary application software/no growth in either of category. In order to designate respondents as COTS/ERP Growth, Zero Growth, or Proprietary Growth and to convert the data accordingly the follow process was used. A respondent's belief about their firm's intention to change the organization's percentage of applications could be determined by comparing the respondent's answer to the question about the organization's current usage of COTS vs proprietary sources to their answer about anticipated usage of COTS vs proprietary sources in 5 years. A new attribute was calculated to indicate the preference for COTS or proprietary by taking the value of the response to the item asking about estimated usage percentage of COTS in 5 years then subtracting the estimated current usage percentage of COTS. For example, if a respondent indicated that current usage was 40% COTS and 60% Proprietary but in 5 years the expected distribution would be 50% COTS and 50% Proprietary that respondent would have 10 as their value for the new attribute. Two acquisition methods were available to select from, COTS and proprietary, and the total usage had to equal 100 percent for the survey to advance. Once a value for COTS was determined the value for Proprietary was simply the opposite of the COTS value. If the percent usage 5 years from now and current usage were the same the respondent's belief was that there would be zero change. This not only allows each response to be classified as COTS or Proprietary, but it also provided a measure of the degree of change the respondent thought would occur.

Table 13: Results of t-test showing association between Variables and Growth (Yes or No) in Usage of Various Categories of Software – Manufacturing Sector

Variable	Growth	N		Mean		F	Sig	t		Sig (2-tailed)	
		Y	N	Y	N			Y	N	Y	N
Desired Characteristics of Software Solution	COTS	17	54	5.218	4.907	**3.689**	**0.059**	1.164	1.593	0.248	0.117
	Zero	38	33	4.714	5.095	2.628	0.110	-1.206	-1.236	0.232	0.221
Shrinkage in Systems Life Cycle	COTS	17	54	5.098	4.623	0.897	0.347	1.305	1.447	0.196	0.158
	Zero	38	33	4.579	4.919	**4.259**	**0.043**	-1.090	-1.118	0.280	0.268
Administrative Motivation, System Performance	COTS	17	54	5.250	4.819	**4.422**	**0.039**	1.189	1.523	0.238	0.135
	Zero	38	33	4.836	5.023	0.800	0.374	-0.600	-0.607	0.551	0.546
Administrative Motivation, HR	COTS	17	54	5.157	4.790	2.431	0.124	0.960	1.185	0.340	0.243
	Zero	38	33	4.658	5.131	1.589	0.212	-1.462	-1.487	0.148	0.142
High Cost and Risk Prone Tendency of the Needed Software	COTS	17	54	5.294	4.880	**8.125**	**0.006**	1.208	1.740	0.231	**0.087**
	Zero	38	33	4.934	5.030	1.270	0.264	-0.324	-0.330	0.747	0.742
Quantum Improvement	COTS	17	54	5.470	4.780	2.036	0.158	1.925	2.433	**0.058**	**0.019**
	Zero	38	33	4.740	5.180	**4.377**	**0.040**	-1.428	-1.476	0.158	0.145

We divided the sample into two groups (growth: Yes or No) where respondents predicted growth in the requirement of each categories (COTS and zero growth) of application software (Table 13 and 14). The variable: quantum improvement in both manufacturing as well as service sectors, has positive relationships with the growth in COTS software (including ERP-off-the-shelf) contrary to what was stipulated in our revised model (Figure 2) having significant $p <= 0.05$ for t-test, while F-test is not significant reveals that the model fit is inadequate. In case of manufacturing sector, the factors, desired characteristics of software solution; administrative motivation, system performance; and high cost and risk prone tendency of the needed software have the F-statistics significant, which suggests that there is a good model fit, however, the t-statistics is not significant. These results demonstrate that we can reject the all the null hypotheses arguing that the COTS software also becomes a source of quantum improvement.

Table 14: Results of t-test showing association between Variables and Growth (Yes or No) in Usage of Various Categories of Software – Service Sector

Variable	Growth	N		Mean		F	Sig	t		Sig (2-tailed)	
		Y	N	Y	N			Y	N	Y	N
Desired Characteristics of Software Solution	COTS	22	55	5.532	5.023	1.413	0.238	1.682	1.858	**0.097**	**0.069**
	Zero	38	39	5.102	5.234	0.298	0.587	-0.478	-0.477	0.634	0.635
Shrinkage in Systems Life Cycle	COTS	22	55	5.258	4.764	0.196	0.659	1.414	1.494	0.162	0.142
	Zero	38	39	4.807	5.000	0.005	0.946	-0.605	-0.604	0.547	0.548
Administrative Motivation, System Performance	COTS	22	55	5.443	4.968	0.638	0.427	1.496	1.640	0.139	0.108
	Zero	38	39	5.026	5.180	0.346	0.558	-0.527	-0.526	0.600	0.600
Administrative Motivation, HR	COTS	22	55	4.984	4.800	0.000	0.982	0.534	0.540	0.595	0.592
	Zero	38	39	4.886	4.821	0.001	0.978	0.209	0.209	0.835	0.835
High Cost and Risk Prone Tendency of the Needed Software	COTS	22	55	5.114	5.036	0.412	0.523	0.228	0.223	0.820	0.825
	Zero	38	39	5.171	4.949	0.004	0.947	0.728	0.729	0.469	0.469
Quantum Improvement	COTS	22	55	5.640	4.750	1.694	0.197	2.571	2.972	**0.012**	**0.004**
	Zero	38	39	4.790	5.210	1.361	0.247	-1.287	-1.283	0.202	0.204

Regression Analysis to find influencing factors on growth in requirements of COTS software: To streamline the variation and convert discrete data to range, we used automatic or manual recoding under transform the change in percentage for usage of COTS software in SPSS and it resulted into codes as given below. The discrete number for the range will transform non-linear relationships to linear and in our case, we are finding out the factors influencing the growth in usage of COTS/ERP. In such cases the linear or non-linear relationships will not matter in finding the growth:

- The change in percentage usage of COTS/ERP software were from -100 percent to +100 percent. We used nine range scale from 1 to 9 (-100 to -76; -75 to -51; -50 to -26; -26 to 1, 0, 1 to 25; 26 to 50; 51 to 75; and 76 to 100).

Table 15: Regression Analysis of Growth in Requirements of COTS Software in Manufacturing Sector

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.233[a]	.054	.026	1.0534	.054	1.945	2	68	.151	2.032

a. Predictors: (Constant); Administrative motivation, HR; High cost and risk prone tendency of the needed software

b. Dependent Variable: Growth in the requirement of COTS Software over 5 years

Table 16: Regression Analysis of Growth in Requirements of COTS Software in Manufacturing Sector

	Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.		Sum of Squares	df	F	Sig.
	(Constant)	4.171	.560		7.447	.000	Regression	4.317	2	1.945	0.151
	Administrative motivation, HR	-.082	.110	-.105	-.746	.458	Residual	75.457	68		
	High cost and risk prone tendency of the needed software	.235	.121	.273	1.937	.057	Total	79.775	70		

The F-statistics is not significant (Tables 15 and 16) and therefore, we eliminated Administrative Motivation, HR from the model and got higher quality results. When the regression is conducted, a F-value and significance level of that F-value will be in the output. If the F-value is statistically significant (typically p < .05 or <0.1 in case of small sample size), this signifies that the model (the predictors) did a good job of predicting the outcome variable and that there is a significant relationship between the set of predictors and the dependent variable. The F-statistics is significant having p <=0.071 reveals that the model fit is reasonably good in case of manufacturing sector and the factor: High cost and risk prone tendency of the needed software is significantly positively related with the growth in Requirements of COTS Software having t-test statistics value of p <= 0.071 (Tables 17 and 18). This factor is having association similar to what was predicted in the model shown in Figure 2. When the regression is conducted, an R^2 (coefficient of determination) is presented. This value is the multivariate equivalent of the bivariate correlation coefficient. The R^2 really answers the question, of all of the reasons why the outcome variable can vary, what percent of those reasons can be accounted for by the predictor(s) variables. The value of R^2 is 4.6% which is fairly low. In some cases, it's possible that additional predictors can increase the true explanatory power of the model. However, in other cases, the data contain an inherently higher amount of unexplainable variability. For example, many psychology studies have R-squared values less than 50% because people are fairly unpredictable. The good news is that even when R-squared is low, low P values still indicate a real relationship between the significant predictors and the response variable. The results of multiple regression analyses show that we can reject the null hypothesis for H5 in case of manufacturing sector.

Table 17: Regression Analysis of Growth in Requirements of COTS Software in Manufacturing Sector after eliminating Administrative Motivation, HR from the model

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.215[a]	.046	.033	1.0500	.046	3.355	1	69	.071	2.038

a. Predictors: (Constant); High cost and risk prone tendency of the needed software

b. Dependent Variable: Growth in the requirement of COTS Software over 5 years

Table 18: Regression Analysis of Growth in Requirements of COTS Software in Manufacturing Sector after eliminating Administrative Motivation, HR from the model

Coefficients[a]

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.		Sum of Squares	df	F	Sig.

		B	Std. Error	Beta							
	(Constant)	4.019	.520		7.728	.000	Regression	3.699	1	3.355	.071[b]
	High cost and risk prone tendency of the needed software	.186	.101	.215	1.832	.071	Residual	76.075	69		
							Total	79.775	70		

In case of service sector, the F-statistics is not significant having p <=0.171 reveals that the model fit is not good, however, the factor: quantum improvement is significantly positively related with the growth in the requirement of COTS software having t-test statistics value of p <= 0.065 (Tables 19 and 20). This factor is having positive association which was contrary to negative association predicted in the model shown in Figure 2. When the regression is conducted, an R^2 (coefficient of determination) is presented. This value is the multivariate equivalent of the bivariate correlation coefficient. The R^2 really answers the question, of all of the reasons why the outcome variable can vary, what percent of those reasons can be accounted for by the predictor(s) variables. The value of R^2 is 4.7% which is fairly low. In some cases, it's possible that additional predictors can increase the true explanatory power of the model. However, in other cases, the data contain an inherently higher amount of unexplainable variability. For example, many psychology studies have R-squared values less than 50% because people are fairly unpredictable. The good news is that even when R-squared is low, low P values still indicate a real relationship between the significant predictors and the response variable. The results of multiple regression analyses show that we cannot reject the null hypothesis for H5 in case of service sector.

Table 19: Regression Analysis of Growth in Requirements of COTS Software in Service Sector

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.216[a]	.047	.021	.9959	.047	1.808	2	74	.171	2.262

a. Predictors: (Constant); Shrinkage in systems life cycle, Quantum Improvement

b. Dependent Variable: Growth in the requirement of COTS Software over 5 years

Using the results of t-test and multiple regression analyses, we can reject the null hypothesis for H2 (High cost and risk prone tendency of the needed software will be positively related to the growth in the requirement of COTS/ERP software) in case of manufacturing sector. We can summarize our findings by narrating that the high cost and risk prone tendency of the needed software will be positively associated with growth in requirements of COTS/ERP software. Furthermore, in t-test (manufacturing as well as service sector) as well as regression analysis (service sector) the quantum improvement is positively associated with growth/no-growth in COTS/ERP software. This trend is contrary to what was predicted in the model (Figure 2).

Table 20: Regression Analysis of Growth in Requirements of COTS Software in Service Sector

Coefficients[a]

Model	Unstandardized Coefficients: B	Std. Error	Standardized Coefficients: Beta	t	Sig.		Sum of Squares	df	F	Sig.

	(Constant)	4.607	.442		10.428	.000	Regression	3.587	2	1.808	.171
	Shrinkage in systems life cycle	-.157	.128	-.217	-1.223	.225	Residual	73.400	74		
	Quantum Improvement	.235	.126	.332	1.871	.065	Total	76.987	76		

LIMITATIONS OF THE STUDY

Limitations are inherent in any study. The limitations in this study includes bias and cross loading. As far as bias, the list of variables pertaining to IT related issues might reflect some biases. Even though the literature was thoroughly reviewed and additional perspectives were obtained from IS academicians and managers, it is not claimed that these are the only variables that could be included. Secondly, we need to address the issue of cross loading. The loading of an item on more than one construct could be due to high intercorrelations of the factors, the accidental inclusion of an unidentified factor, or the absence of a factor that could result in items loading cleaner when the questionnaire is refined. While these possibilities are not mutually exclusive, it appears that some of the cross loading occurs on questions that relate to ease of use. Because ease of use is a known determinant of intention to use, (Venkatesh and Davis, 1996) it is probable that refining the items to more clearly to reflect the role of ease of use in the decision process would add explanatory power. An instrument may need to be administrated several times before its construct validity can be ensured.

Therefore, it must be stressed that any interpretation of the findings must be made in lieu of the selected set of variables, issues, and categories. The questionnaire survey respondents were people from various departments such as information systems, administration, accounting/finance, production, etc. An equal representation among the number of respondents from each department could not be achieved. In addition, samples were collected from the manufacturing sector (automobile, computer hardware, pharmaceutical, telecommunication (hardware), and other) and service sector (banking, retail, hotels, computer software, construction, government, healthcare, insurance, technology, transportation, utilities, and other). Other types of organizations (airlines manufacturing, railway, chemicals, airlines operations, etc.) are not included in the sample. Accordingly, any inferences based on the results may be restricted to the organizations listed in the directory. The sample size is 148. This moderate sample size was approximately equally divided among manufacturing and service sectors.

IMPLICATIONS FOR PRACTICE

This study indicates most organizations are now meeting their software needs (both in manufacturing and service sectors) by using approximately an equal percentage of the following four categories of application software: off-the-shelf (Non-ERP), off-the-shelf (ERP), proprietary-ERP, and proprietary-Non-ERP]. This trend can be expected to continue for the next five years. The approximately equal usage of COTS and proprietary software solutions in organizations signifies IT is moving towards a commodity-like function, in addition to playing a vital part in an organization's structure. Organizations who do not build a business strategy around IT as a product or service would rather invest a moderate amount on application software. These organizations should concentrate more on core product/services than IT applications for a competitive advantage. The equal usage of off-the-shelf/ERP solutions in these organizations will require relatively fewer in-house IT professionals for development of proprietary software, maintenance of IT applications and infrastructure. Additionally, for approximately 50 percent of COTS software, relatively fewer IT professionals having skills in business processes will be needed for implementation of readily available application software. Plus, the End-users training

requirements are to be met by IT professionals when the need arises. On the other hand, another 50 percent of organizations prefer proprietary software (developed by IT departments or outsourcers). When organizations develop proprietary software in house, staffing requirements for IT professionals increase. Obviously, if the proprietary software is outsourced, then an organization's needs can be met by fewer IT professionals. Senior level IT professionals will still play an important role in formulating IT strategy and crafting the needed IT architecture to meet the changing needs of the organization's functional departments. The shift towards natural language processing will prompt IT applications to become more simplified. In turn, the availability of knowledge workers and growth in EUC will shift IT professionalsto overseeing operations and maintaining software applications. Generally, End-users will be able to develop many of the smaller one-time applications by themselves. Moreover, End-users will contribute equally with in-house IT professionals to develop, select, and acquire application software.
An assessment of these trends will compel educational institutions to adjust the IT curriculum to cater equally to the development and implementation needs of application software.
Organizations' IT needs will be met in the following four ways: 1) in-house IT departments; 2) outsourcers; 3) application service providers; and 4) software houses. An essential function of an IT department (in any sector) will be to develop and manage vendors. Because technology is advancing so quickly, in-house IT professionals will need more continuing education and frequent consultations with external professionals in the field.
Based on the aforementioned discussion, it can be argued that the current and future usage trends of the various categories of software has far reaching implications for organizations and educational institutions. Correspondingly, it will influence government policies and tax structure. Finally, it can be argued that this trend may lead to a new era regarding applications software. As such, this will open up tremendous opportunities for research.

SUGGESTIONS FOR FURTHER WORK

Future research extensions could include a replication of this study with factors such as organizational maturity, IS sophistication, effect of outsourcing/offshoring and cloud computing on growth in COTS/ERP and proprietary packages, etc.; and to test a variety of such factors. Another suggestion would be to utilize more rigorous methodologies using longitudinal approaches and non-linear relationships. In the future, the survey could yield more generalized results if a broader sample was questioned and a greater number of variables were employed. These suggestions would overcome the number of factors that were cross-loaded in this exploratory research. Other ways to gain a more generalized model include: a comparative study of U.S. organizations with their counterparts in other nations and a study of IT-related issues in other industries in the United States -- i.e., airlines manufacturing, railway, chemicals, airlines operations, etc.

CONCLUDING REMARKS

In this research, we arrived at a better understanding of the current and future trends in the use of categories of application software and its implications for organizations (separately in manufacturing and service sectors) in the United States. The respondent's perceived usage of almost equal percentages of COTS and proprietary solutions prompts us to believe that IT is not as much of a competitive advantage to organizations as it has been in the past.
For the growth in usage of COTS/ERP software, the respondents perceived the top three variables as "High Cost and Risk Prone Tendency of the Needed Software," "Quantum improvements," and "Administrative motivation, system performance" in manufacturing sector and "Desired characteristics of software solution," Administrative motivation, system performance," and "High cost and risk prone tendency of the needed software" in service sector

(Table 12). The manufacturing sector's top six data items are: "The packages have in-built best practices followed in the industry," "Cost of development of packages," "Faster upgrades in hardware/software," "Packages are critical to the operation of the organization," "The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering," and "The packages are proven for better reliability." On the other hand, the top six data items for service sector are "The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering," "Reduced maintenance problems in the packages," "Availability of reliable software maintenance support," "Faster upgrades in hardware/software," "Availability of a user community," and "Packages are critical to the operation of the organization." The faster upgrades in software and hardware can be argued because the COTS/ERP packages are upgraded regularly and with the rapid upgrades the organizations can get competitive advantages. Plus, the cost of developing proprietary packages is relatively higher compared to COTS/ERP packages regardless of the cost savings due to automation in development of proprietary packages.

The current and evolving phase of software in approximately equal usage of COTS and proprietary packages will result in a greater reliance on outsourcers, application service providers, software houses, and consulting organizations. Because more organizations may use external agencies (outsourcers, application service providers, software houses, and consulting organizations) for development and/or maintenance of proprietary packages, the balance between in-house and external agencies may tilt towards external sources and there will be elimination of development activities to a great extent in the organization. This shift is expected to significantly trim the number of in-house IT professionals. The major work of in-house IT professionals will be in implementation of COTS/proprietary software and training to the End-users, in addition to catering application software to the organization's needs. Senior IT professionals will take on the responsibility of developing IT strategies and IT architecture, in collaboration with functional departments. The growth in knowledge workers, usage of COTS/proprietary packaged solutions, and trends towards natural language processing may lead to End-users controlling IT budgets and human resources.

Using the results of t-test and multiple regression analyses, we can reject the null hypothesis for H2 (High cost and risk prone tendency of the needed software will be positively related to the growth in the requirement of COTS/ERP software) in the case of manufacturing sector. To summarize our study: the high cost and risk-prone tendency of the needed software will be positively associated with growth in requirements of COTS/ERP software. Furthermore, in t-test (manufacturing and service sector) as well as regression analysis (service sector) the quantum improvement is positively associated with growth/no-growth in COTS/ERP software. This trend is contrary to what was predicted in the model (Figure 2).

REFERENCES

Agrawal, Vijay K. (2005a). From proprietary software to off-the-shelf/ERP solutions: Identifications of critical factors. *National Social Science Journal*, 23, 9-32.

----: (2005b). Implications of environmental and cultural factors on the trends in usage of various categories of software. *National Social Science Journal*, *25*, 1-15.

Agrawal, Vijay K., Agrawal, Vipin K., Taylor, Allen, and Tenkorang, Frank (2011). *Trends in IT human resources and its determinants.* In Luftman, Jerry *Managing IT Human Resources: Considerations for Organizations and Personnel,* pp. 20-36, Hershey, PA: Business Science Reference (an imprint of IGI Global).

Agrawal, Vijay K., Agrawal, Vipin K., Taylor, Ross (2016). Trends in commercial-off-the-shelf vs. proprietary applications. *Journal of International Technology and Information Management*, 25, 4, 1-36.

Agrawal, Vijay K., Haleem, A. & Sushil. (2001). Trends in the demand for different categories of software and human resources. In *Proceedings of the Annual Conference of Midwest Decision Sciences Institute*.Altman, D. (2004) A More Productive Outsourcing Debate, *Business, 2.0*, May, 39

Applegate, L.M, Austin, R.D. & McFarlan, F.W. (2009). *Corporate information strategy and management: Text and cases.* New York, NY: McGraw Hill/Irwin.

Baker, R., Blumberg, S. J., Brick, J. M., Couper, M. P., Courtright, M., Dennis, J. M., Dillman, D., Frankel, M. R., Garland, P., Groves, R. M., Kennedy, C., Krosnick, J., Lavrakas, P. J., Lee, S., Link, M., Piekarski, L., Rao, K., Thomas, R. K., Zahs, D., (2010). “Research synthesis: AAPOR report on online panels.” *Public Opinion Quarterly* 74:711–81.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*, 99-120.

Bartlett, M.S. (1950). Tests of significance in factor analysis. *British Journal of Psychology*, 3(Part II), 77-85.

Baussel, R.B (1986). *A Practical Guide to Empirical Research*. New York, NY: Harper & Row.

Blankenship, A. B., Breen, G. and Dutka. A. (1998). *State of the Art Marketing Research* Second Edition, Chicago, IL: American Marketing Association.

Brynjolfsson, E. (1996). The contribution of Information Technology to consumer welfare. *Information Systems Research, 7*, 281-300.

Callegaro, M., and DiSogra, C. (2008), Computing Response Metrics for Online Panels. *Public Opinion Quarterly*, 72 (5): 1008-1032

Carr, N.G. (May 2003). IT doesn't matter. *Harvard Business Review*. Boston, MA: Harvard Business School Press.

Carr, Nicholas (2013). *The big switch: Rewriting the world from Edison to Google*. New York, NY: W.W. Norton & Co. Inc.

Churchill, G.A., Jr. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 16, 64-73.

Clemons, E.K. (1990). MAC-Philadelphia national banks strategic venture in shared ATM networks. *Journal of Management Information Systems*, *7*, 5-25.

Clemons, E.K (1991). Evaluation of strategic investments in information technology. *Communications of the ACM*, 34, pp 22-36.

Clemons, E.K. & Kimbrough, S.O. (1986). Information systems, telecommunications, and their effects on industrial organizations. In Maggi, L., Zmud, R., and Wetherbe, J. (eds), *Proceedings of the Seventh International Conference on Information Systems, San Diego, CA,* pp.99-108.

Cross, John, & Michael J. Earl (1997). Transformation of the IT function at British Petroleum. *MIS Quarterly*, Vol.21, December, pp 401-423.

Davis, F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results*. Doctoral Dissertation, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA

Dillman, Don A (1978). *Mail and Telephone Surveys: The Total Design Method*. New York, NY: Wiley Intersciences.

Dillman, Don A (2000). *Mail and Internet Surveys: The Tailored Design Method*, 2nd Edition. New York, NY: John Wiley Co.

Doll, William J., & Torkzaddeh, Gholamreza (1988). The measurement of end-user computing satisfaction. *MIS Quarterly*, June, 259-274.

Edberg, Dana T., & Bowman, Brent J. (1996). User-developed applications: An empirical study of application quality and developer productivity. *Journal of Management Information Systems*, 13, Summer, pp.167.

El Sawy, Omar A., Malhotra, A., Gosain, S., & Young, Kerry M. (1999). IT-intensive value innovation in the electronic economy: Insights from Marshall industries. *MIS Quarterly*, Vol.23, September, pp.305-335.

Emery, J.C. (1990). Misconception about strategic information systems. *MIS Quarterly,* 14, June, pp. VII-VIII.

Ettlie, J.E (1983). Organizational policy and innovation among suppliers to the food processing sector. *Academy of Management Journal*, 26, 27-44.

Ford, J.K., MacCallum, R.C. & Tait. M. (1986). The application of exploratory factor analysis in applied psychology: A critical review and analysis. *Personnel Psychology, 39, 291-314.*

Guadagnoli, E. & Velicer, W.F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin,* 103, 265-275.

Hair, J, Anderson, R.E., Tatham, R.L., Black, W.C. (1995). *Multivariate data analysis*. 4rt Edn. New Jersey, NJ: Prentice Hall Inc.

Hammer, M. (1996). *Beyond reengineering: How the process centered organization is changing our work and our lives*. New York, NY: Harper Collins.

Hastie, Shane & Wojewoda, Stephane (2015). Standish Group 2015 Chaos Report – Q & A with Jennifer Lynch. *InfoQ*, October 4, Retrieved from https://www.infoq.com/articles/standish-chaos-2015

He, Z.M., Kusy, K.M. & Zhao, T. (1998). A survey study of the current IS usage in the Chinese manufacturing industry. *Information and Management, 34*, 285-294.

Heikkilä, J.T., Saarinen, T. & Sääksjärvi, M. (1991). Success of software packages in small businesses: An exploratory study. *European Journal of Information Systems, 1*, 159-169.

Himmel, M. Azua, & Grossman, F. (2014). Security on distributed systems: Cloud security versus traditional IT. *IBM Journal of Research and Development,* Vol. 58, Paper 3.

Hinkin, T.R., Tracey, J.B., & Enz, C.A. (1997). Scale construction: Developing reliable and valid measurement instruments. *Cornell University School of Hotel Administration: The Scholarly Commons*, Retrieved from http://scholarship.sha.cornell.edu/articles/613.

IDC (2016, August 29). *Worldwide IT Spending Forecast to Reach $2.7 Trillion in 2020 Led by Financial Services, Manufacturing, and Healthcare,* Retrieved January 19, 2017, from https://www.idc.com/getdoc.jsp?containerId=prUS41699316

Information Week (2014). Federal IT spending slashed in proposed 2015 budget. March 5, Retrieved from http://www.informationweek.com/government/cybersecurity/federal-it-spending-slashed-in-proposed-2015-budget/d/d-id/1114126

Jeong, James J., & Klein, Gary (1999). Risks to different aspects of system success. *Information and Management*, 36, 263-272.

Jones, M. (1994). Don't emancipate, exaggerate: Rhetoric, reality and reengineering. In R. Baskerville, S. Smithson, C. Ngwenyama & J.I. DeGross (Eds.), *Transforming organization with Information Technology*. (pp. 357-378). North Holland: Elseiver Science.

Kaiser, H.F. (1970). A second-generation little jiffy. *Psychometrika*, 35, 401-415.

Kaiser, H.F. (1974). Little Jiffy, Mark IV. *Educational and psychological measurement*, 34, 111-117.

Kappelman, L., McLean, E., Johnson, V. and Torres, R. (2016) The 2015 SIM IT issues and trends, *Management Information Systems Quarterly Executive*, 15:1, 55-83

Kemerer, C.F. & Sosa, G.L. (1991). Systems development risks in strategic Information Systems. *Information and Software Technology, 33*, 212-223.

Kim, J. & Mueller, C.W. (1978). *Introduction to factor analysis: What it is and how to do it.* Beverly Hills, CA: Sage Publications.

Laudon, K.C. & Laudon, J.P. (1999). *Essentials of management Information Systems: Transforming business and management*. Upper Saddle River, NJ: Prentice Hall.

Laudon, K.C., & Laudon, J.P. (2015). *Management information systems: Managing the digital firm*, 14th Edition. Upper Saddle River, NJ: Pearson Education Limited.

Lewin, S.G., Lewin, S.L. & Meisel, J.B. (1987). A dynamic analysis of the adoption of a new technology: The case of optical scanners. *Review of Economics and Statistics, 69*, 12-17.

Li, Ming Fang & Ye, Richard L. (1999). Information technology and firm performance: Linking with environmental strategic and managerial contexts. *Information and Management*, 35, 43-51.

Lucas, H.C. (2000). *Information Technology for management*, 7th ed. New York, NY: McGraw-Hill, Inc.

Luftman, Jerry, Derksen, Barry, Dwivedi, Rajeev, Santana, Martin, Zadeh, Hossein S., & Rigoni, Eduardo (2015). Influential IT management trends: An international study. *Journal of Information Technology*, 30, 293-305.

Markus, M. Lynne, & Benjamin, Robert I. (1996). Change agentry–The next IS frontier. *MIS Quarterly*, December, 385-407.

Matheson, L. & Tarjan, R. (1998). Culturally induced information impactedness: A prescription for failure in software ventures. *Journal of Management Information Systems, 15*.

McLean, E. R. (1979). *End Users as Application Developers*. MIS Quarterly, 3(4), 37. doi:10.2307/249047

McLean, E.R., Kappelman, L.A. & Thompson, J.P. (1993). Converging end-user computing and corporate computing. *Communications of the ACM, 36*, 79-92.

McNurlin, B. (Ed) (1991). *Trends in Information Technology*. Chicago, IL: Anderson Consulting.

Naukam, Drew (2014). Finance must adapt to cloud-based subscription models. *Financial Executive*, Spring, 10-13.

Network World. (2009). IT spending as a percentage of corporate revenue. *Network World, 26*, 27.

Nidumolu, S.R. & Knotts, G.W. (1998). The effect of customizability and reusability on perceived process and competitive performance of software firms. *MIS Quarterly*, 105-137.

Nunnally, J. C. (1967), *Psychometric Theory*, 1 st ed., New York, NY: McGraw-Hill.

Nunnally, J.C. (1970). *Introduction to psychological measurement.* New York, NY: McGraw-Hill.

Palvia, Prashant, & Wang, Pien (1995). An expanded global information technology issues model: An addition of newly industrialized countries. *Journal of Information Technology Management*, Vol. VI, 29-39.

Porter, M. (1980). *Competitive strategy*. New York, NY: Free Press.

Porter, M.E. (1996). What is a strategy? *Harvard Business Review*, November/December.

Rahman, W., & Kurien, P. (2007*). Blind men and the elephant: demystifying the global IT services industry*. (pp. 136-137) Thousand Oaks, CA: SAGE Publications.

Scott Morton, M.S. (1991). *The corporation of the 1990s: Information Technology and organizational transformation*. Oxford University Press.

Srinivasan, S. (2013). Is security realistic in cloud computing? *Journal of International Technology and Information Management,* Vol. 22, 47-66.

Sturdy, G. R. (2012). *Customer relationship management using business intelligence.* Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Tabachnick, B.G. & Fidell, L.S. (2007). *Using multivariate statistics*. Boston, MA: Pearson Education Inc.

Turban, E., McLean, E. & Whetherbe, J. (2001). *Information Technology for management: Making connections for strategic advantages*, 2nd ed. New York, NY: John Wiley and Sons, Inc.

Turban, E. and Volonino, Linda (2011*). Information technology for management: Improving the strategic and operational performance*, 8th edition. New York, NY: John Wiley and Sons, Inc.

Turban, E., Volonino, Linda, & Wood, Gregory (2015). *Information technology for management: Digital strategies for insight, action, and sustainable performance*, 10th edition. New York, NY: John Wiley and Sons, Inc.

Turner, J., & Kambil, A. (1994). Outsourcing of information systems as a strategy for organizational alignment and transformation. *Unpublished Paper, Stern School, New York University, NY*.

Venkataraman, N., & Short, J.E. (1992). Baxter Healthcare: Evolution from ASAP to value link in the hospital supplies marketplace. In *Proceedings of the Twenty-fifth Annual Hawaii*

International Conference on System Sciences, Vol.4, pp.666-677.

Venktesan, Ravi (2015). IT industry's party is over; now is the time to reinvent or perish. *The Economic Times*, May 31.

Venkatesh, Viswanath & Davis, F.D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, 27, September, 451-481.

Wailgum, T. (October 2007). How Wal-Mart lost its technology edge. *CIO.* Retrieved from http://www.cio.com/article/print/143451

Winter, S.J., Chudoba, K.M. & Gutek, B.A. (1997). Misplaced resources? Factors associated with computer literacy among end-users. *Information and Management*, *32*, 29-42.