Summer 2009

A Determination of the Essential Outcomes for Higher Education Supply Chain Management Program Success

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A DETERMINATION OF THE ESSENTIAL OUTCOMES FOR HIGHER EDUCATION SUPPLY CHAIN MANAGEMENT PROGRAM SUCCESS

A Dissertation

Submitted to the School of Education

Duquesne University

In partial fulfillment of the requirements for

the degree of Doctor of Education

By

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Approved June 25, 2009

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ABSTRACT

A DETERMINATION OF THE ESSENTIAL OUTCOMES FOR HIGHER EDUCATION SUPPLY CHAIN MANAGEMENT PROGRAM SUCCESS

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Dissertation Supervised by Dr. V. Robert Agostino

As one of business and industries newest strategies to improve efficiency, effectiveness, and competitiveness of organizations, supply chain management is evolving into a major business school discipline. The rapid growth of SCM integration concepts enabled by information systems and technology continues to experience significant improvements and changes. These factors create challenges for higher education business schools with keeping current and driving research to advance the discipline. This study surveyed SCM corporate executives to determine if there is agreement on the core concepts that should be included in SCM curriculum, and the level of mastery program graduates should attain for success. The study also considers the potential differences in stakeholder needs dependent on SCM discipline focus or industry. The results of the study identify the SCM knowledge, skills, and abilities expected of SCM executives hiring graduates from higher education undergraduate SCM programs.

DEDICATION

This dissertation is dedicated to my grandchildren, children, parents, and most of all to my loving wife; as they encouraged day to day and lived with what was left of my time and energy not diverted to work and the study.

ACKNOWLEDGMENT

It became apparent quickly to me that a dissertation is a team effort, and I would like to take this moment to thank those who contributed and provided encouragement to help me through the process. Thank you to:

my students, who cajoled, teased, challenged, and encouraged me to continue the dissertation process to completion.

my colleagues, both academic and industry, who have provided support and encouragement to complete a truly meaningful study.

the ILEAD3 Cohort for all of the support and encouragement both in and out of the classroom.

my committee, all of whom helped me “keep it real” and focused; solving world hunger can come later.

A special thank you to the administration of the Duquesne University Palumbo-Donahue School of Business, specifically Alan Miciak, Thomas Pollack, and William Spangler for the direction and enablement they provided to complete this study.

Finally, I would like to thank my father who led by example, motivated with uncompromising values, and supported with true fatherly love; a true friend who I wish was still here to share in this experience.

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CHAPTER I

INTRODUCTION

"If you always do what you have always done, you will always be what you have already become" (Author unknown). The proliferation of information systems, technology, and the concepts they enable in the business world, has produced a continuous and rapid stream of changes in business practices. This is especially true in the field of Supply Chain Management (SCM), one of newest ideas in business and industry, which was born from the reengineering of a number of traditional business processes into an integrated concept enabled by technology and information systems. While base functions that make up this new discipline have been part of every business for all of recorded history, it is the combination and integration of these previously separately executed processes that has resulted in the establishment of the new and rapidly growing field of SCM.

The significant enhancements to the supply chain processes and techniques over the past decade have been credited with propelling business organizations like Dell, Wal-Mart, Toyota, and Honda to world renowned status (Cox, 2004; Kim, 2006; Lapide, 2005). It is essential that the business colleges offering SCM programs prepare graduates for this dynamic environment by aggressively pursuing the establishment of complementary learning environments and academic curriculum. It is also essential that the SCM graduates possess the knowledge, skills, and abilities to be competitive in this ever changing business world.

However, unlike many other higher education disciplines, such as elementary education and law, there are no standards by which to evaluate the performance of SCM

graduates. Without specific required outcomes it is difficult to assess if the graduate is prepared for the business world, if the educational program is providing the proper levels and mix of skills and knowledge, and where changes should be made, or how effective those changes might be.

Background

Few higher education undergraduate business programs employ program level methods of outcomes assessment to determine the level of knowledge and skill gained by a graduate during his or her tenure in a program. For some business disciplines there are professional organizations that provide certification or licensing programs, such as Certified Public Accountant (CPA), that are recognized by hiring organizations. However, few business colleges have developed techniques to ascertain the degree of professional development a graduate has achieved.

Rapid changes in business and industry have raised questions on the part of universities, business schools, and those hiring business school graduates as to how well programs are preparing students for the business world (Macfarlane & Ottewill, 2001). The rapid growth in new SCM systems, technologies, and processes has compounded this concern as businesses aggressively pursue new solutions toward being more competitive in the marketplace.

For example, focused research has been presented to support integration of computer skills as essential for SCM curriculum content (Rao, Stenger, & Wu, 1998) and as an effective method to enhance supply chain education (Pei-Chun, Su-Min, & Jenhung, 2007). From the basics of applying spreadsheets (Tyworth & Grenoble, 1991) to advanced information systems that enable SCM decisions, the profession and its

educational requirements have advanced significantly. Information systems and technology have enabled many changes in SCM and raised awareness of the corporate benefits and academic challenges associated with those changes (Webster, 2008).

As a result a number of questions are emerging regarding business school outcomes for SCM programs. What are the essential knowledge, skills, and abilities for success in SCM? How can a business school teach all of the traditional SCM concepts as well as the myriad of new practices being continuously developed? How well do students from an SCM program learn these concepts and apply them in the business world?

As a consequence of these concerns, universities, accreditation organizations, and the business community are looking for a means to evaluate the knowledge, skill, and ability level of all business school graduates. Specifically, Duquesne University, in Pittsburgh PA, has initiated a program to evaluate and promote the development of outcomes assessment across the various university colleges and programs (Duquesne University, 2004). At the same time the Duquesne University Business School accreditation organization, The Association to Advance Collegiate Schools of Business Internationally, has established long term strategic initiatives to develop outcomes assessments at both the course and major level (AACSB, 2003). The program level outcomes assessment requirements are proving challenging for business schools to integrate into existing programs (Henninger, 1994). The mix of knowledge, skills, and abilities has also been shown to be critical in developing and assessing SCM curriculum (Dischinger et al., 2006). At the same time the issue of academic and professional alignment cannot be ignored. The concerns regarding academic programs meeting the

challenges of the information age in a manner that supports and contributes to professional development and success is a major factor in SCM program development (Bennis & O'Toole, 2005). It is not sufficient for a program graduate to master the foundational SCM knowledge without the ability to apply techniques to effectively solve problems and communicate results. Confirming student progress through the levels of Bloom's Taxonomy (Schultz, 2007) from *remembering* and *understanding* to *evaluating* and *creating* is essential to the effective development of higher education business programs and preparing students for a professional career.

However, lacking an agreed upon set of outcomes by which to assess the performance of pending graduates, it is not possible to develop an outcomes assessment program. Therefore, to ultimately achieve the university, college, and professional stakeholder goal of assessing students before graduation there is a need to determine the outcomes for the Duquesne University SCM program.

While this study will be structured and completed in a predetermined time frame, it is expected that these efforts will not be a single event, but rather will establish an ongoing process to monitor the effectiveness of the SCM program. Due to the rapid and continuous change in the SCM business segment, there will be a need to continuously review and update both the outcomes and the follow-up effectiveness assessment tools. It is also expected that the results of this study will provide a foundation for a formal process to evaluate the effectiveness of faculty and courses in meeting the needs of the market place through the SCM program graduates.

Supply Chain Management Defined

Over the past century the various traditional business disciplines that forecast sales, plan production, procure material, manufacture product, distribute product, and support the customers, have become viewed as an integrated series of activities that must be coordinated and managed as a single business process. It has also become apparent that few if any companies can effectively compete as standalone entities in the supply chain process. That is, there are often many companies linked to execute the complete supply chain, and, that if done well, result in a satisfied customer. These integrated processes are very effectively depicted by the Supply Chain Council in Figure 1(Supply-Chain-Council, 2007).

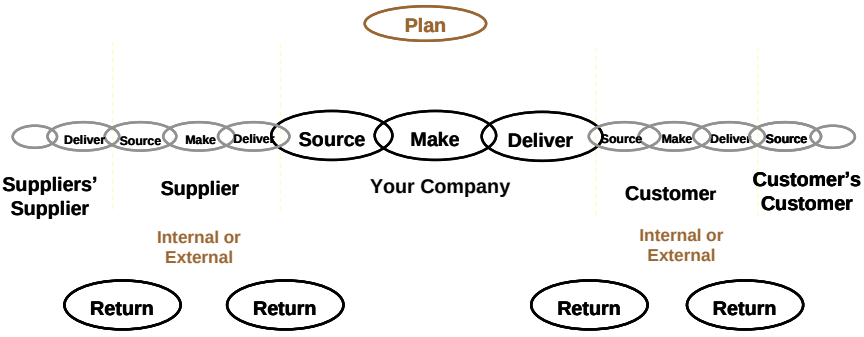

Figure 1: Supply Chain Concept
Source: Supply Chain Council – Supply Chain Operations Reference (SCOR) Model

Figure 1 identifies the links in the supply chain from the perspective of a company in the middle of the process. For example, if "Your Company" produced and sold ballpoint pens, one component required to complete the manufacturing process, or Make, would be a spring. This would require the sourcing of a spring either from an outside supplier or from a sub-assembly operation in your company. To make a spring one must

source spring wire, and to make spring wire spring steel must be sourced and made into wire, etc. until the supply chain begins at the ore mine.

While the strategic macro view of the supply chain depicted in Figure 1 is beneficial in explaining the scope of the concept and the relationship between the processes that comprise the supply chain, it does not show the complexity of the processes. It is the detail of managing strategic, tactical, and operational execution of the disciplines integrated into these processes that presents the challenge. Specifically, each set of source, make, deliver, and return can be viewed as an integrated business process that is comprised of traditional, though continuously enhanced, business disciplines. Figure 2 depicts the Duquesne University Supply Chain Management Model which reflects the specific SCM disciplines involved in coordinating any one set of the source, make, deliver, and return segment of the macro supply chain shown in Figure 1.

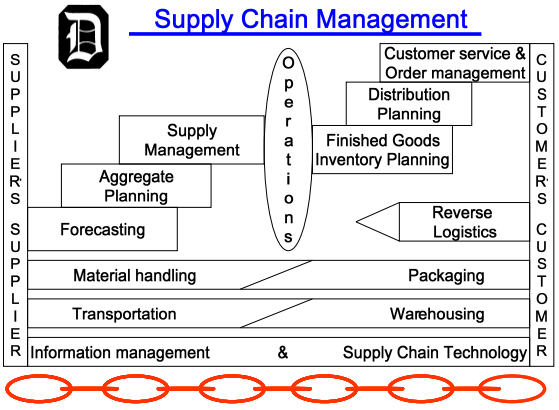

Figure 2. Duquesne University Supply Chain Management Model

The resulting efficient and effective coordination of the activities presented in the macro process in Figure 1, by integration of the disciplines depicted in Figure 2, has become known as Supply Chain Management. Each of the disciplines depicted in Figure 2 have been an integral part of any successful business for all of recorded history.

However, it has been in the past 60 years that the SCM disciplines have developed and integrated exponentially. This integration has been fueled by a number of improvements in business operating efficiency and effectiveness that ultimately has resulted in increased profitability and competitiveness for those organizations who have successfully implemented SCM. As this evolution of processes, techniques, and relationships progressed so too did the titles and definitions of the resulting concepts. Today, the Council for Supply Chain Management Professionals defines supply chain management as:

> Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (CSCMP, 2006).

There are two significant factors that impact formal education and professional development in the field of SCM. First is the fact that while all of the disciplines encompassed in SCM have been around for all of recorded history in some form, they are now being viewed as an integrated business process with expanded scope and educational requirements (Aquino, 2008). The value of this new perspective has gained recognition in industry and elevated SCM to a strategic role requiring restructuring of organizations and their strategic plans (Stank, Davis, & Fugate, 2005). This integration has occurred in a relatively short period of time due to many influences from both in and out of the SCM disciplines, and as a result the complexity of linking concepts has been compounded by the strategic visibility SCM has achieved. The significant historical factors will be reviewed in greater detail in Chapter 2.

The second factor, while somewhat related to the historical issues, is found in the ever growing complexity of SCM operations. As technology and science are mixed with the art of business management, new creative solutions are being developed and implemented constantly. This ever expanding array of processes and techniques to address specific and general SCM needs places a tremendous demand on higher education SCM programs and supporting research (Frankel, Bolumole, Eltantawy, Paulraj, & Gundlach, 2008). Also, as with many technology supported changes, there does not appear to be any end to the enhancements in sight requiring a strong focus on keeping SCM educational programs up-to-date.

Research Question

Given the current and projected state of global SCM there is an overriding question that must be addressed to ensure SCM higher education programs are meeting the needs of all stakeholders;

> *How can higher education faculty ensure that students completing a Supply Chain Management program have acquired and can demonstrate the knowledge, skills, and abilities needed to be successful in an SCM career in the field?*

While I am ultimately interested in addressing this very broad issue, the literature research, formal and informal surveys, and course work leading up to this proposal have uncovered five sub-questions that must be addressed before this all encompassing question can be completely answered. These five questions are:

1. What are the critical higher education program outcome knowledge, skills, and abilities required or expected by industry of undergraduate SCM majors?

2. How does one assess that the industry outcome requirements for undergraduate SCM majors have been met?
3. How does one ensure the program and its courses provide students the opportunity to gain the knowledge, skills, and abilities identified in the SCM program outcomes and remain up to date?
4. How does one ensure that the SCM courses and program meet the university/school vision, mission, and goals?
5. What teaching techniques and skills best support the SCM program outcomes?

A Gantt approach to assessing the relationship and sequence of these questions quickly uncovers the need to thoroughly understand the answers to question one before any of the other issues can be addressed. To that end, research must be focused on determining what is needed to understand:

What are the critical higher education program outcome knowledge, skills, and abilities required or expected by industry of undergraduate SCM majors?

In order to determine if graduates are prepared for the business world it is essential to understand the knowledge, skills, and abilities each stakeholder is looking for in a prospective professional SCM candidate. Having personally been involved with the SCM discipline in industry for over thirty years, I am acutely aware of the breadth of requirements from the business community. The history of SCM which follows, presents a picture of a professional field in flux with stakeholders approaching it from different perspectives and at differing levels of accomplishment. The variability in status of SCM implementation, and the continuous changes the field is experiencing, make getting the

answer to this question a formidable undertaking. Yet without developing the goals of an SCM program, effective assessment and instructional best practices cannot be developed.

Due to the newness and the dynamic nature of growth, the SCM profession does not have a standard method of assessing the knowledge and skills of a prospective SCM professional. While the professional societies like the Institute for Supply Management (ISM) and APICS - The Association for Operations Management (APICS), which are reviewed greater depth under the history section, focus on subsets of the supply chain through professional certification programs, these have been for the most part tactically focused and not aligned with the mission of higher education institutions. It is important to note that these two major professional societies; The ISM (I. f. S. M.-. ISM, 2007) and APICS (A.-A. f. O. M.-. APICS, 2007), have instituted changes to their certifications to address the more strategic role of SCM. The critical issue still remains that each addresses only a portion of SCM and together still do not cover all critical concepts of the integrated discipline processes.

To date the research into assessment and advancement of supply chain and logistics education has predominately focused on the business, leadership, and managerial skills required of graduates to succeed in the industry (P. R. Murphy & Poist, 2006; Poist, Scheraga, & Semeijn, 2001; Richey, Tokman, & Wheeler, 2006). The knowledge, skills, and abilities in business leadership and management are extremely important to graduate success, and without these, SCM knowledge alone would be of little benefit to a graduate. That said, there is a need for all business school graduates to have a solid foundation in business leadership and management. What differentiates SCM majors from other majors are the focused studies into the techniques, concepts, and tools

of the disciplines that make up SCM. This aspect of SCM education has not been addressed as an all encompassing business process.

Research Question Summary

In summary, based on my research to date there are five questions that must be answered to completely address the full scope of my subject interest; "*How can higher education faculty ensure that students completing a Supply Chain Management program have acquired and can demonstrate the knowledge, skills, and abilities needed to be successful in a career in supply chain management and/or graduate studies in the field?"* However, I have pared down the scope of this study to focus only on the program needs for SCM undergraduates preparing for careers in industry and as a result focus answering the first of the five questions:

What are the critical higher education program outcome knowledge, skills, and abilities required or expected by industry of undergraduate SCM majors?

Gathering and assessment of data to answer this question will provide an opportunity to more deeply explore the drivers behind the data. The history and evolution of SCM portrays a business process with many roots and varied responsibilities. The focus of this research implies that it is possible to prepare a graduate for any aspect of SCM. It is important to test this assumption from three perspectives. First, due to the ever increasing scope of responsibility of SCM directors, vice presidents, and chief supply chain officers, is there a common set of supply chain professional knowledge, skills, and abilities that are required for

success in the field of SCM? To address this question the following hypotheses will be tested:

H1: All SCM business leaders (managers, directors, vice presidents, and chief supply chain officers) agree on the level and scope of SCM knowledge, skills, and abilities required of graduates from a higher education SCM four year program.

Second, given the breadth of disciplines that comprise SCM and the differing approaches to development and implementation evident through the various SCM professional societies and corporate organizational structures, can a student be prepared to enter the marketplace through numerous SCM portals, or disciplines? Specifically, does an SCM higher education program with a set of standard core courses and electives provide the graduate with the knowledge, skills, and abilities to enter one of the many potential start points in professional SCM? To address this question the following hypothesis will be tested:

H2: SCM majors are expected to possess the same level of knowledge, skills, and abilities for all disciplines that make up SCM.

Finally, SCM is an essential part of all organizations regardless of the industry in which they exist, and a solid foundation in SCM fundamentals and best practices is required and will prove effective in any environment. Industries, and the companies within industries, approach the marketplace with varied strategies. As a result the supply chains developed to support these varied approaches likewise vary. This fact creates a question regarding the scope of knowledge required of an SCM graduate to succeed in these differing

environments and thus the knowledge, skills and abilities required by the potential employers. Therefore, a third hypothesis will be tested:

H3: SCM majors are expected to possess the same knowledge, skills, and abilities for all industries.

Importance of Study

The need to keep up-to-date with the business marketplace demands for professional knowledge, skills, and abilities is critical to the success of any higher education business program (Rutner & Fawcett, 2005). The business community is demanding accountability of higher education programs with a focus on current market needs (Kretovids, 1999). Specifically, the leaders of the rapidly growing field of SCM are demanding higher education programs that meet the marketplace needs and keep up-to-date (Lancioni, Forman, & Smith, 2001). Accreditation organizations critique the school programs based on how well they support the vision, mission, goals, and outcomes identified as essential to the organizations success (Baker, 2004). The Duquesne University, the A.J. Palumbo School of Business Administration, and the business school accrediting agency, The Association to Advance Collegiate Business Schools Internationally (AACSB) have established long term strategic initiatives focused on outcomes assessments (AACSB, 2003). University stakeholders including students, parents, the community, and those that hire graduates are all demanding a level of accountability (Dugan, 2004). Likewise, colleges and universities receiving state or federal funding are finding an increasingly higher demand for accountability from the granting organizations (Volkwein, 2003).

The ever changing state of SCM in industry and its rapid growth has proven to be both a blessing and curse to academic programs. The very concept of integrated SCM requires improved collaboration between partners and this includes education, both to implement new processes and enhance the relationship (Maylett & Vitasek, 2007). Therefore, it is essential to identify the true needs of business to properly enable the curriculum development to meet those needs and attract students. The continuous global growth of SCM in business and industry has not been tracked by corresponding growth in higher education SCM programs. While universities in North America, and in particular the United States, have been adding and expanding SCM programs, universities in the rest of the world have been lagging the demand for SCM higher education support (Wu, 2007). The perceived value of SCM by business leaders is driving up demand for graduates from four year SCM programs. However, the lack of public understanding of the scope and role of SCM leaves the supply of qualified graduates well below the demand (Knemeyer & Murphy, 2004). This talent gap provides excellent opportunity for universities to take the lead in raising awareness of SCM and developing programs to prepare graduates to fill the pent up human resource demand (McCrea, 2008).

This research will take the first step and lay the foundation for SCM assessment by identifying and prioritizing the significant learning outcomes essential for the Duquesne University SCM program graduate's success. Follow up work on the assessment will establish the Duquesne University SCM program as one of the first in the United States with a formal outcomes assessment methodology. Then with the outcomes and assessment pieces in place the remaining four questions identified above can be addressed to ensure the continued success of the program (Elford, 1996).

This research will also provide a model for other universities facing similar accreditation requirements for confirmation of SCM program effectiveness. Finally, the research will provide a model for other business school disciplines that also currently lack specific program outcomes to utilize in meeting similar outcomes assessment requirements.

Limitations of Study

This research is focused specifically on the SCM knowledge, skills, and abilities and will not address general business skills and leadership and management abilities essential to all business disciplines. These factors are certainly important to SCM graduate success and therefore program curriculum. In fact many studies indicate these qualities as important or more important than specific SCM abilities for career success (Gammengaard & Larson, 2001; P. R. Murphy & Poist, 2006; Myers, Griffith, Daugherty, & Lusch, 2004; van Hoek, Chatham, & Wilding, 2002). A selection of general business skills that are critical to SCM concept development have been included in this study and all will be incorporated in later research when addressing question four regarding the total business/university learning experience.

Summary

The lack of outcomes standards for higher education programs in the rapidly changing business field of Supply Chain Management presents an opportunity to make a significant educational contribution. The need for such an assessment is evidenced by the universities, accreditation agencies, and the business world's demands for formal methodologies to establish program accountability and assure SCM programs are

effective. By developing a comprehensive set of SCM knowledge, skills, and abilities outcomes required from a higher education program, a critical component will be in place to meet the Duquesne University SCM program assessment needs.

CHAPTER II:

LITERATURE REVIEW

The literature review has been divided into three primary topic areas. The first segment deals with the history of SCM, the trends, professional societies, and significant factors affecting the growth and direction of the discipline. The second area is focused on methods for development of outcomes assessment. While the dissertation question is dedicated to the study of SCM outcomes for a higher education program, most of the pertinent research available on the subject addresses both outcomes and assessment. Finally, the literature review concentrated on the critical content matter of SCM education and training along with the methods previously utilized to determine the SCM outcomes by researchers, professional societies, and institutions of higher education.

History of Supply Chain Management Education

There are a number of significant historic factors that have affected the evolution and growth of the profession of SCM and associated programs in higher education. Three of these factors have been selected for review to provide evidence of the magnitude of change which has occurred over a relatively short period of time, and some of the struggles which industry professionals and academics face in keeping current and competitive in the SCM field. The three areas of influence reviewed below are infrastructure, professional societies, and education; in addition some examples of SCM in practice will be provided.

Infrastructure

Any organized practice, academic, business, personal, etc., can be viewed from the perspective of people, processes, and tools. That is to say that people complete tasks

by applying methods and tools in a manner intended to accomplish a goal. As new techniques and tools are introduced, people have the capability to apply higher level learning skills including analysis, evaluation, and creation of new processes to take advantage of the improvements (Schultz, 2007). This is the case with SCM which, as a profession, has been able to grow and improve empowered by enhancements not strictly intended for SCM, yet very beneficial to the supply chain processes.

The infrastructure of the supply chain is comprised of a variety of physical structures, processes, and tools that enable organization to complete the flow of goods, services and related information as required for success in their endeavors. Two such factors that have changed and had a significant impact on SCM professionalism and education are discussed below; physical infrastructure and information systems and technology.

A series of changes that had a significant impact on the development of SCM focused in the area of transportation. In 1956, President Dwight Eisenhower initiated what has become the most influential infrastructure change in our country's history; the interstate highway system (Reid, 2006). The interstate highways not only reduced the time and cost of getting people and things from one location to another, they significantly changed the demand for the various modes of transportation; truck, rail, air, water, and pipeline. The logistics planning portion of SCM began to realign strategies to take advantage of the new service levels provided by the highways. This had a noted impact on many geographic areas that, due to the new highway system access, were now deemed *desirable* for locating manufacturing, distribution, or service center locations. The

demand for knowledge and skills in the areas of network planning, site selection, and transportation management grew significantly.

Enhancements in the area of aircraft and ship design, improved power and efficiency of propulsion units, improvement of port facilities, and continued population growth, and associated demand for things, over the past forty years have changed the supply chain playing field. More parts of the world are accessible faster and more efficiently enabling expanded global markets and sourcing, and thus requiring new processes, skills, and knowledge in order to take advantage of the opportunities presented.

As a more educated professional work force gained an understanding of the benefits of quality, efficiency, and process integration, they began to realize the opportunities that could be gained by taking a more gestalt view of the business of getting products and services to customers. This approach led to the recognition that the total cost of ownership and maximized efficiency could only be derived from viewing the supply chain processes from a more integrated perspective (D. J. Bowersox, 2007). This also required higher education to provide not only the new information, but the processes and methods required to analyze data and apply the results.

During the 1970's and 1980's another significant change was introduced into the society and business processes that had a profound impact on the evolution of SCM. The introduction and eventual proliferation of information systems and supporting technology closed some of the gaps that existed in the information hungry business logistics processes. There were three noteworthy phases to the rapid development of SCM information systems and technology (IS&T). First, the general availability of the

computer to businesses allowed for the storage and retrieval of vast amounts of data quickly and accurately. This offset the slow and highly error prone document flow process that had existed for all of written history. However, business managers quickly recognized the need for better ways to gather and share the critical information that was buried in this new wealth of data. The rapid introduction of a series of technology enhancements helped to satisfy this need.

The second phase involved enhanced data collection. The bar code, while invented in 1932, was first introduced to the US consumer in 1967 at a Kroger's grocery store in Cincinnati, OH. However, it was not until 1973 that the retail industry agreed on acceptable bar code standards, which is still used today for nearly all domestic retail store transactions (Adams, 2007). This seemingly simple, and today taken for granted, technology has revolutionized how data in SCM is gathered. Few products today make it through production, distribution, and purchase without multiple interactions with bar codes. The scanners that read and decipher the codes and share the encrypted data with the computer data bases are being continuously improved allowing greater data exchange flexibility. Radio Frequency (RF) technology removed the wires from the bar code scanners enabling them to communicate remotely with the computers in stores, distribution centers, manufacturing plants, transportation facilities, etc.

Finally, in 1968 electronic data interchange (EDI) was introduced as a coordinated industry effort that provided standard formats for the exchange of documents from computer to computer (ASC-X12, 2007). This permitted the traditional paper documents such as purchase order, invoices, and bills of lading to be transferred electronically, and eventually the data integrated directly into user systems. By the mid

1980's industry was reengineering SCM processes based on data being transferred and used by business partners in hours and minutes that had previously taken days and weeks to be gathered and shared.

The enhanced data availability provided by bar codes, RF data gathering, and EDI dramatically improved the visibility of material, products, services, and cash in the supply chain, and business logistics exploded as a new frontier for improved business profitability and competitiveness. However, there was one important piece missing; the ability to edit data to secure meaningful information, and then use logic to make better decisions with that information. As with many business disciplines, business logistics saw an explosion of decision support systems (DSS) in the 1990's that combined advanced mathematical algorithms with artificial intelligence to produce recommendations to improve operational, tactical, and strategic business decisions.

The rapid growth of IS&T tools enabled new and creative methods of running business logistics and further eroded the barriers between the individual disciplines of SCM. It also allowed organizations to efficiently and effectively share information across the business enterprise. Marketing could instantaneously inform forecasting, purchasing, engineering, manufacturing, etc. of proposed changes in product offerings or promotions. Engineering and purchasing could quickly keep up to date on revisions to product designs, while manufacturing could share capacity issues with financial planners. Materials management and purchasing were able to access and update pertinent data regarding inventories, material schedules, and costs (Dobler & Burt, 1996). To enable this cross-disciplinary exchange an entire software industry was born to provide what became known as Enterprise Resource Management (ERP) software. These capabilities

challenged business logistics to become more integrated in the business value chain rather than operate as a somewhat autonomous business discipline (Closs, 2007). At the same time the value of working closely with critical customers and suppliers became evident and was again enabled by these new IS&T developments.

This new paradigm of stretching and integrating business logistics with the business enterprise and up and down the supply chain with enhanced information, technology, and DSS, lead industry to redefine the scope of logistics and rename it supply chain management. Empowered by enhanced information availability and enabled by focused SCM information systems, SCM leaders began to shift the focus of the discipline from strictly completing the day to day operations to developing long term strategic initiatives to support the corporate goals (Bloomberg, LeMay, & Hanna, 2002; Dobler & Burt, 1996).

Professional Organizations

Professionalism and training of the SCM disciplines can first be seen in the United States in 1904 when a group of purchasing agents in Buffalo, NY got together to improve the professionalism of the trade. In 1915, a number of similar metropolitan based purchasing groups banded together to form the first national SCM professional society, the National Association of Purchasing Agents (NAPA). The organization's goals were for the members "to impress the business world with the importance of the purchasing function to economic well-being" and "to encourage purchasing people to improve themselves to make greater contributions to the companies they serve" (NAPM, 1991). The association found only two years later in 1917 that World War I (WWI)

would provide the forum by which the purchasing disciplines value was first truly recognized for its contribution and complexity.

From 1950 to the present, more supply chain related professional societies were introduced and all evolved significantly to reflect the changing membership and market demands. Three of the most active current SCM professional societies have been selected for review to demonstrate the growth and changes experienced in SCM. The National Association of Purchasing Agents mentioned earlier, began to realize their goals of advancing the value and professionalism of their discipline. NAPA saw its members transition from administrators to managers with a shift in focus from only cost improvement to total value added potential of the procurement process. To keep the organization properly positioned and identified in the business community the name was changed in 1968 to the National Association of Purchasing Managers (NAPM). In 1974 NAPM established its first certification for purchasing professionals; Certified Purchasing Manager (CPM), which is still widely recognized in industry today (NAPM, 1991). The NAPM changed their name to the Institute for Supply Management in 2004, and the organization members have voted to change the CPM to modify the assessment process to reflect the new skill requirements and establish a new certification of Certified Supply Management Professional (CSMP) beginning in 2008 (I. f. S. M.-. ISM, 2007).

Likewise, the American Production and Inventory Control Society (APICS) was founded by 20 production control managers in 1957 to raise the professionalism and education of those responsible for forecasting, production planning, and inventory control. The organization grew with the regional chapter and annual national education conference format to a 1995 membership of 75,000 with a focus on education (Ging,

2007). APICS formalized its educational role by establishing the certifications that became standards in industry, Certified in Production and Inventory Management (CPIM) in 1978 and in 1989 the Certified in Integrated Resource Management (CIRM). In an effort to remain current with the industry trends and needs the organization changed their name in 1994 to APICS – The Educational Society for Resource Management and again changed it to APICS – The Association for Operations Management in 2005. In addition, APICS established another certification; Certified Supply Chain Professional (CSCP) in 2006 (Kelly, 2007).

In 1968 a new organization was formed from the joint efforts of supply chain academics and practitioners to focus the segment of the supply chain involved with the delivery of product from the manufacturer to the final consumer. This organization took on the name of The National Council of Physical Distribution Management (NCPDM). Rather than the traditional view of transportation, warehousing, packaging, material handling, distribution planning, inventory allocation, and customer service as independent functions, the NCPDM members began to promote these as part of an integrated process (CSCMP, 2007a). The group was successful in researching integrative techniques that were effectively applied in the market place and Physical Distribution Management (PDM) quickly became a well understood, if not practiced, corporate strategic concept. Similarly the front end of the supply chain, including forecasting, aggregate planning, materials planning and purchasing, became a target for integration which evolved into the Materials Management (MM) strategy (D. J. Bowersox, 2007). The benefits of coordinating the processes of demand recognition through procurement of

materials and resources produced immediate cost improvement results and became a primary focus for many companies in the automotive industry.

Despite the fact that the various SCM professional societies laid claim to some of the same disciplines, industry began to focus on integration before and after the manufacturing process. However, the more advanced companies quickly recognized the potential, and the challenge, of integrating the entire SCM process. The subsequent strategic focus on combining Materials Management and Physical Distribution Management became known as Logistics Management, or more specifically Business Logistics Management, to differentiate it from military logistics (John J Coyle, Bardi, & Langley, 2003). In 1985 the members of NCPDM voted to change the organizations name to the Council of Logistics Management (CLM) to reflect the market evolution beyond PDM and MM. Then again in 2005 the CLM membership voted to change the organizations name to the Council for Supply Chain Management Professionals (CSCMP) to keep current with the responsibilities and interests of its membership (CSCMP, 2007a). While "visionaries" debate the renaming of professional organizations to reflect the SCM change as business implements the practices (Davis-Sramek & Fugate, 2007), the trend of realignment continues.

The value of SCM professional society certifications as both a barometer of the market needs and a method of professional validation is evident in the literature (Reese, 2006b), and the number of businesses and professionals who participate in the certification programs. The recent proliferation of SCM related certifications by these and other SCM organizations is a good indication of the value growth of SCM in industry and the perceived need for validation of expertise in the field.

It must be noted that there are a number of other SCM professional societies and a few certification organizations that have developed during this time period. The selection of the three societies described above is by no means meant to be an assessment of the value of other organizations. These three were selected as typical examples of the changes that professionals, and the societies they maintain, have gone through over the past few decades in response to the continuing evolution of SCM. The results of a survey of both SCM business practitioners and academics on the value of SCM professional organizations ranked CSCMP, ISM, and APICS, along with the Warehouse Education Research Council (WERC) as the top four SCM professional associations (Rutner & Fawcett, 2005).

Higher Education

While often hidden in the background, the traditional disciplines that make up SCM have can be found in all of recorded time. The first book of the Old Testament records the forecasting, planning, inventory management, warehousing, and transportation organized by Joseph during the seven years of plenty followed by the seven years of famine (Genesis 41, New King James Version). Hannibal (Stephen, 2007), Napoleon (Bering, 2007), and Hitler (Alexander, 2000) all had tremendous successes and failures associated with good and poor military logistics planning. Global trade facilitated by SCM is recorded throughout all history from the ancient Silk Road (Wild, 1992) to Christopher Columbus (Vilches, 2004) to the Transcontinental Railroad (Francviglia & Bryan Jr., 2002). In every case economic, political, social, and environmental factors can be identified as driving the successes and failures of the above examples.

Some of the earliest formal and published work related to SCM appears in the area of operations management in the late 1700's (Render & Heizer, 1997). Adam Smith is credited with introducing, in 1776, operating efficiency through the concept of division of labor (Bloomberg et al., 2002). Eli Whitney introduced operating efficiencies from the standardization of interchangeable parts (Russel & Taylor, 2000).

Thus SCM began as a loosely fit set of independent but interrelated disciplines and evolved into an integrated cross-functional discipline (Dischinger et al., 2006). The foundations for integrated SCM began in the United States following the Second World War (WWII). Logistics is a critical component of any war and WWII was no exception. Logistical planning for WWII challenged US armed services because it was fought on a variety of globally dispersed fronts. This need drove the development of creative methods for assessing requirements and distributing resources. After the war the US federal government unknowingly provided the catalyst for migrating this enhanced logistical knowledge from the military to industry through the 1944 Servicemen's Readjustment Act generally referred to as the GI Bill. By subsidizing higher education for veterans not only did more people enter colleges and universities, the interests and expectations of those people changed the higher education student profile, and colleges and universities had to adapt (Gutek, 2000).

Many of the millions of GI's who planned, executed, or benefited from the logistics of the war were now focusing their academic pursuits on better ways to run businesses. The assessment of the successes and failures of the all parties in the war led to a migration of the resulting best practices to new business strategies (Pinkerton, 2001). This was evident in many ways including the eventual use of the term *logistics* to

describe the integrated business process required to satisfy customer requirements. In 1958 Funk and Wagnall defined logistics as "The branch of military science that embraces the details of moving, evacuating, and supplying armies"(Funk & Wagnal, 1958). By 2005 the definition provided by the Council for Supply Chain Management read "Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements" (CSCMP, 2007b).

One specific example of a significant post war business concept that became a critical factor in SCM development came from an American who had to go to Japan to get business to apply his ideas. Dr. Edward Deming, who espoused a strategy of total quality as the foundation for business success, could not convince US automotive companies of the benefits of his approach. In 1950 his ideas were embraced by Japanese manufacturers and are credited with the tremendous success of Japan's automotive and electronics industries (Magnier, 1999). While Deming focused on statistical quality, he strongly advocated the integration of quality initiatives up and down the supply chain, which became the driver for many of the SCM techniques and concepts considered best practices today (Lo & Yeung, 2006). Taichi Ohno of Toyota is credited with introducing the concept of *lean production* which has had a significant impact on the quality and productivity of manufacturing operations around the world (Russel & Taylor, 2000). The lean concept has migrated to other business disciplines through initiatives such as *lean warehousing* and *lean sales office*.

Years later, the US automotive manufacturers found it necessary to redesign their supplier and manufacturing process and incorporate Dr. Deming's techniques in order to respond to the rapidly growing competition from Japanese automobiles in the US. Deming's image is still displayed at the headquarters of many globally competitive Japanese companies including Toyota (Holt, 1993). In his 2005 acceptance message for the American Society for Quality's Deming Medal, Dr. Shoichiro Toyoda, Chairman and former President of Toyota, recognized the 1950 contributions of Dr. Deming as significant to the global success of his company (Wisdom, 2007).

Integrated SCM concepts were presented in academic research in the early 1900's when in 1912 Arch Shaw identified that marketing had two major components; demand and supply (B.J. LaLonde & Dawson, 1969). In concert with the professional organizations and the supply chain concept changes developing in business, higher education responded by first offering courses and then full programs in various segments of SCM (D. J. Bowersox, 2007). Prior to 1950 higher education courses in areas such as purchasing and transportation were found within marketing or operations programs (Ronald H. Ballou, 2007). These individual courses were designed to improve the understanding of segments of SCM that were integrated with other well established business disciplines. The first evidence of the physical distribution integration appeared in academia in the early 1960's when Michigan State University offered a course focused on integrating and balancing the PDM disciplines (Ronald H. Ballou, 2007).

From the early 1970's to the present higher education SCM program development tracked closely with that of industry and professional societies. The strong symbiotic relationship between SCM industry professionals and educators is evident in the

professional society evolution and curriculum development (Gravier & Farris, 2008). Such a relationship has naturally driven an expectation for higher education alignment with and support for business needs. A recent study into content offered in eight globally recognized international business schools found the most consistent and frequent course offerings were operations and supply chain management (Arain & Tipu, 2007).

While this may not be surprising, what is interesting is how the driving forces have transitioned over that time period. In the 1960's and 1970's researchers in higher education were quickly grasping best SCM practices, offering recommended improvements, and challenging the business community to become more efficient and effective in operating segments of the supply chain. However, the pace of change in business soon surpassed that of higher education resulting in at least two challenges in SCM program development. First, the continuous and rapid change in concepts and techniques in the SCM business world make it difficult for faculty to remain current. In some cases, faculty members are not accustomed to having to change course content on a continuous basis and administration must provide support to be successful (Macfarlane & Ottewill, 2001). Industry is changing at a much faster pace in the past twenty years compared to the 50's and 60's. One of the primary traits of a successful corporation is responsiveness, yet at the same time universities are not known for quick reaction times. Whether due to culture, procedure, or resources, institutions of higher education often struggle with keeping up to commercial industry (Whordley, 2004). Second, the undeniable role that information systems and technology play in the design and operations of supply chains mandates enhanced integration into SCM curriculum (Gammengaard & Larson, 2001). The volume and complexity of information system and

technology changes, to a great degree, place both resource and content burdens on institutions that want to keep programs up-to-date. Software and training are expensive and time consuming, and while the goal of higher education is not training in specific software packages, it is necessary for faculty and student to gain a level of familiarity in order to understand the strategic application of such tools.

SCM in Practice

While historic evidence of the importance of SCM as reflected in education, professional societies, and IS&T growth has been presented, the real test of a business disciplines value comes in its practice. There are also many modern examples of the entrepreneurs and business moguls who implemented SCM related strategies to succeed in business. Henry Ford built his automobile empire around the strategy of mass production which was established on a foundation of controlling supply, manufacturing, and transportation through vertical integration, i.e. ownership of the supply chain from the ore mine to the dealers (D. Bowersox & Cooper, 1992; Williams, Esper, & Ozment, 2002). Sam Walton started Wal-Mart with a strategy of outstanding customer service supported by proactive SCM integrated through information systems and technology (Tong & Tong, 2006; Walton & Huey, 1992). Michael Dell built a technology empire based on a philosophy of direct interaction with customers and supplier integration (Dell & Fredman, 2006). In addition, not only have these SCM pioneers significantly improved their internal operations, but they have also had a positive influence on the productivity and competitiveness of their supply chain partners. (Cook & Hagey, 2003; Stanley E. Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007).

While there are a number of other factors that played a role in the significant growth of SCM over the past 60 years, those summarized above have been among the most significant and provide a good view of the complexity and dynamics of the field. Creativity in cross-functional integration and collaboration, supported by information systems and technology remain a strong catalyst for continued enhancement of SCM. The speed and volume of change in SCM continues to grow as more organizations recognize the benefits experienced by the front-runners in supply chain development.

The Challenge

The twentieth century provided many changes to our personal and professional lives. Automobiles, airplanes, televisions, cell phones, computers, and a myriad of inventions and technologies have crept into our day-to-day lives, and in many cases gradually transitioned from novelties, to niceties, to necessities. In addition, consumer behavior has changed with increased expectations of products and services, and restructured family roles increasing demands on supply chains (Paul R. Murphy & Wood, 2008). In order to meet competition and satisfy the consumers, companies are on a continuous quest to become more efficient and effective in how they run their operations and to meet customer demands while meeting financial goals. The businesses that have provided and promoted these innovations have also experienced a variety of changes. The general business trends of organizational consolidation, IS & T enhancements, and continuous governmental regulation changes, have escalated the importance and challenges of SCM in industry and education (John J. Coyle, Langley, Gibson, Novack, & Bardi, 2008). The globalization of business has presented many challenges and

opportunities for all professionals within these organizations but especially for those involved with SCM (Handfield, 2004).

As part of this business efficiency quest, organizations have found that, if properly applied, process and technology integration can enable changes in strategies and the aggregation of activities. By taking an all encompassing gestalt view of the business processes that lead to value creation and customer satisfaction, SCM continues to provide a variety of improvement opportunities. However, all product, services, industries, cultures, and customers are not the same, so how does a company meet the myriad of needs that are present in this supply chain process, and be successful? Companies are continuously looking for new ways to improve the product and process to provide greater value to the customer, so how does one stay up-to-date on the best practices, and remain competitive?

These issues result in two challenges. Firstly, the theoretical and practical integration of the various SCM processes is still in progress and industries/companies are developing a variety of techniques at different rates in support of differing strategies. The concept of an integrated SCM process is the result of a rather rapid evolution from a series of independent business disciplines through a number of mergers to SCM. The most recent transition, from logistics to SCM is still in progress and has only recently gained favor in industry (Larson, Poist, & Halldorsson, 2007). Therefore, those seeking to grow professionally or hire new professionals see the future need from different perspectives. The second challenge is related to the first in that the dynamic nature of the SCM development process is continuously changing the knowledge, skills, and abilities needed to be successful in the field. Bernard J. La Londe, Emeritus Professor of

Transportation and Logistics, The Ohio State University, has studied the changes in SCM for more than 30 years. At the 2000 CLM National Education Conference in New Orleans, LA he stated that if a logistics or SCM professional does not remain focused on continuous professional development, within three years he or she will be out of date (B. J. LaLonde, 2000). This same continuous development advice holds true for SCM faculty and the curriculum they manage.

The rapid growth and evolution of SCM combined with the continued adoption and implementation of a wide variety of best practices to fit the myriad of business scenarios that exists in the marketplace today presents a significant challenge to those involved in higher education programs focused in the field. While the focus of this research is the determination of the most important SCM knowledge, skills, and abilities outcomes by a four year higher education SCM program graduate, the potential ramifications of these findings may be far reaching. As evidenced by the introduction to SCM earlier, the history and rapid changes and growth of the field creates significantly inflates the potential content of an SCM program. Yet at the same time, few business schools are in a position to expand the curriculum requirements and program completion time to accommodate such increases (Lancioni, Forman, & Smith, 2000). Therefore, in order for faculty and administrators to provide a comprehensive SCM program new instructional methods and tools will undoubtedly be required.

The good news is that during the timeframe when the SCM methodologies and technologies were changing, educational best practices have also been evolving. Educational leadership methods, application of technology in education, and a more learner centered focus can provide educators the ability to address the ever growing

content and sophistication of SCM material (Weimer, 2002). The information system and technology explosion that is creating increasing demands on SCM education is also providing solutions in education. Access to digital information, distance learning tools, and classroom hardware and software are combining for a much more productive learning environment (Tomei, 2001).

However, these instructional improvements require that higher education SCM faculty not only keep current on SCM techniques and concepts, but they must improve their knowledge and skills in education methodologies (Macfarlane & Ottewill, 2001). In addition, the continued growth in educational content and methodology requires the students to transition to be more proactive learners. This involves both the development of higher level learning skills and a learning strategy that recognizes that higher education is one step in the process of lifelong learning (Huba & Freed, 2000). For higher education business programs to meet the ever growing needs of the stakeholders, including students and industry, student learning development will need to transition to be more proactive where focused assessment is critical (Froh & Hawkes, 1996).

Before the instructional and learning practices of faculty and student can be analyzed in any detail, the outcomes the program is to produce must be established. Program and curriculum backward design require the establishment of the final goals before instructional best practices and course design can be initiated (Wiggins & McTighe, 2001). These educational best practices have been included to show the integrative nature of business school program development and provide some hope that the challenges presented above regarding growth of scope and depth of SCM content can be managed.

Outcomes and Assessment

The search for literature in the specific area of SCM outcomes has produced very limited results. While there is a great deal written about the need for enhanced and focused SCM and logistics education in both professional and academic journals, specifics on subject matter and content are lacking (Reese, 2006a). Given the existence of certifications by SCM professional societies and the number of SCM higher education programs, it is apparent that some method or methods exist to establish the learning outcomes of these programs. Queries of SCM professional societies have identified the use of expert panels or focus groups (Holcomb, 2001) comprised of SCM professionals and educators who have identified the goals of their society's certification programs and then developed instruments to assess achievement of these goals. While each organization attempts to convene a representative group professionals and scholars, the scope of input is limited to a relatively small panel of volunteers.

SCM Outcomes and Assessment

Four specific studies were conducted in related SCM areas that provide strong insight into the requirements for assessing the outcomes for SCM. The first study focused on the foundational education for success in managing physical distribution and logistics (Dadzie, 1998). This work included a number of the disciplines found in SCM and provided a good starting point for a more comprehensive assessment of total SCM.

The second was a study commissioned by CAPS Research, a center for global supply management research, to assess the knowledge, skills, and abilities essential to success in the supply management – purchasing discipline (Giunipero & Handfield, 2004). This research was conducted through administering a very extensive survey to a

series of focus groups comprised of supply management – purchasing executives. The results provided a detailed look into the strategic, tactical, and operational requirements for success in the purchasing workplace through various levels of professional development. The survey questions and results provided a strong foundation for the strategic and tactical concepts to be assessed in the supply management segment of SCM.

A third study comparing the business, logistics and, management skill requirements of senior versus entry level logistics managers provided great insight into the critical components of the knowledge, skill, and ability requirements for the field (P. R. Murphy & Poist, 2006). However, the business skills and management skills dominated the work and identified only broad scope SCM concepts so that detailed factors were not addressed. Specifically, the study assessed 36 business skills (including four SCM), 36 management skills, and only 18 logistics skills. These related SCM skills categories did not address the full scope of SCM but did provide a sounding board for critiquing SCM outcomes development tools. This work by Murphy and Poist strongly reinforces the need to look at the complete business school higher education experience in assessing the potential success of any business school graduate.

Finally, a study into methodology for selection of supply chain managers provided solid insight into the skills and abilities requirements of the field (Richey et al., 2006). Like the Murphy, Poist (2006) work, Richey, Tokman, and Wheeler concentrate on higher level managerial skills with their "three hurdle method" that includes assessment of *general intelligence, need to achieve,* and *adaptability*. However, in addressing these higher level skills the authors identify a number of SCM foundational skills that are essential to managerial success.

Higher Education Outcomes and Assessment

Despite the lack of specific research in the area of SCM outcomes there exists a solid base of research in the area of outcomes assessment in general and specifically in other higher education disciplines. This provides a good foundation for development of the assessment and effectiveness instruments. To begin, the definition of assessment is "any method used to better understand the current knowledge that a student possesses" (R.J. Dietel, J.L. Herman, & R.A. Knuth, 1991). One factor that has become very apparent from the research planning is the need to identify various levels of goals (i.e. course, program, school) and ensure there is linkage and continuity in curriculum development (Banta, Lund, & Black, 1995). Specific work has provided valuable insight into the critical factors that must be addressed such as a clear and appropriate program mission statement, applicability of the organizations goals and objectives, adequacy of the assessment tools, and the impact of the program on the student. Volkwein's "Institutional Effectiveness Model" provides a solid structure to address these factors and upon which to build the Duquesne University SCM outcomes assessment initiative (Volkwein, 2003). However, outcomes, while highly valued, are considered a given in this modeling process in that the outcomes to be assessed are known. The importance of meaningful and pertinent outcomes is frequently presented as a process of identifying the goals and objectives of a course or program before focusing on specific outcomes to be assessed (Banta, 1996; Geis, 1996). It is well documented that "Intended learning outcomes reflecting the discipline should also be developed for each academic program and for each course in the program."(Huba & Freed, 2000). Likewise, these goals need to

be linked with the real world needs of the market place to ensure the relevance of the subject matter (Macfarlane & Ottewill, 2001).

Duquesne University and the A.J. Palumbo School of Business Administration each have accreditation methodologies that identify outcomes assessment as a concept of growing importance. In addition, the University accreditation body, Middle States Commission on Higher Education (MSCHE) has developed material for evaluation programs (MSCHE, 2003). These guidelines have proven to be very insightful into assessment development and the accreditation organizations views on the topic.

Research into knowledge, skills, and abilities for business success in other business disciplines provides insight into both content and methodology for conducting such needs assessment. The Quality Assurance Agency for Higher Education in England addressed the identification of appropriate subject matter for higher education through the use of structured benchmarking and focus groups (QAA, 2004). While some of the areas of concentration included business in general, nothing was specifically focused on SCM. However, the technique of focus groups and benchmarking of both subject matter and best practices may prove beneficial in developing the final set of SCM outcomes.

James Frederickson developed a model to support the graduation of accounting majors who possess the competencies required of those who hire such graduates (Frederickson, 1995). Frederickson focused on 27 competencies classified into seven categories to help assess needs and evaluate sub-domains. In addition, his work focused on prioritizing needs as the rapid growth of demands for accounting skills combined with university and business school requirements was stressing the accounting programs. As

mentioned earlier, the ever increasing demand for additional SCM knowledge, skills, and abilities is a critical issue for SCM program development as well.

Finally, a related study in the field of marketing focused on the methodology of business in assessing the skills and personal characteristics of those being considered for sales and marketing positions (Kimball, 1998). These studies provide a guideline of critical issues for establishing program outcomes and solid insight into a methodology for identifying the most significant outcomes of a successful higher education SCM program.

SCM Knowledge, Skills, and Abilities

The historic review of SCM has provided a great deal of insight into the critical concepts and techniques that have been developed and proven in the field of SCM. The need to identify the specific knowledge, skills, and abilities which graduates from an SCM higher education should possess requires a more in-depth analysis. This analysis was conducted from two different perspectives. First, the textbooks used currently by many higher education programs are a good indicator of what the academic community sees as the foundational SCM concepts, techniques, and processes important for success in the marketplace. Second, the professional society certification programs provide great insight into what the marketplace SCM professionals' value in knowledge, skills, and abilities to succeed in the business world. Each of these reviews is summarized below.

SCM Textbooks

The interest and continued focus on SCM in business and research has resulted in a number of textbooks on the subject. These textbooks are a great resource for determining the appropriate knowledge, skills and abilities SCM program graduates require for success in the marketplace. Many of these textbooks are intended and

appropriate for courses focusing on specific aspects or disciplines of SCM. Given the recent history of SCM and the fact that many authors and university programs grew up during the SCM rapid changing times, both books and programs have a tendency to concentrate on one or two aspects of SCM while ignoring or merely mentioning other areas. For example, a popular introductory SCM text book The Management of Business Logistics: A Supply Chain Perspective (John J Coyle et al., 2003) dedicates eight of the 14 chapters to inventory, warehousing, and transportation concepts with little to other SCM disciplines and nothing to production. That said however, this text is a tremendous source of information on the knowledge, skills, and abilities required to succeed in those focal areas.

In general, the current SCM textbooks fall into categories that match the historic growth of SCM and the professional societies; specific disciplines such as transportation (John J. Coyle, Bardi, & Novack, 2006) or purchasing (Burt, Dobler, & Starling, 2003; Leenders, Johnson, Flynn, & Fearon, 2006; Monczka, Trent, & Handfield, 2008), or the first phase logistics aggregation of materials management and physical distribution (Bloomberg et al., 2002; John J Coyle et al., 2003). Those authors who have addressed the logistics phase of SCM development still tend to define logistics from the perspective of select disciplines but do not full scope SCM.

In addition to viewing SCM from the discipline content perspective, there is a need to consider the various levels of operations and hence knowledge, skills, and abilities to perform in each. Specifically, the day-to-day tasks to execute the business of the supply chain are classified as operations, the three to twelve month mid-range planning responsibilities are considered tactical activities, and the long range planning is

strategic in nature. Some of the concepts introduced in textbooks are more operational training and specific to disciplines and industries, such as production and inventory planning in retail (Martin, 1995). Many, while identifying strategic issues, focus on a combination of SCM operations and technical concepts (Ronald H. Ballou, 2004; D. J. Bowersox, Closs, & Cooper, 2007; John J Coyle et al., 2003). Finally, others concentrate on mid to long range concepts and techniques of SCM are the focus of the more strategic textbooks (Stanley E. Fawcett, Ellram, & Ogden, 2007; Simchi-Levi, Kaminsky, & Simchi-Levi, 2008; Wisner, Leong, & Tan, 2005). These strategic textbooks provide insight into the critical integration issues of SCM and the higher level organizational goals to be supported by effective SCM.

The similarities and differences of focus in these textbooks has provided great insight into both the common thread of SCM knowledge, skills, and abilities the authors have determined critical for success in the field, and the special areas that not all address. For example, a review of the chapter contents of 40 SCM textbooks (Table 1) identified the most frequently addressed SCM concepts and uncovered the following:

- Over 69% of the textbooks addressed SCM information systems, inventory management, forecasting, and collaboration, with information systems the most frequently identified (82.5%).
- 50% to 65% of the textbooks addressed aggregate planning, materials planning, purchasing, transportation, project management, SCM metrics, quality, and operations.
- Less than 50% of the textbooks addressed concepts related to warehousing, packaging, material handling, customer service, distribution planning, business

process management, global concepts, models, and reverse logistics. With packaging, and reverse logistics addressed in 12.5% of the textbooks, these are the least frequently identified concepts.

While this sample of textbooks contained a mix of SCM, SCM Operations, and discipline specific books, it provides a good representation of the most frequently addressed SCM concepts and techniques being taught in business schools today. These textbooks provided input into the specific aspects of each SCM discipline and concept that should be considered in a higher education SCM program. Regardless of the focus of the textbook (i.e. individual discipline, integrated SCM and operations, strategic SCM), all perspectives provide a potential benefit to the undergraduate that must be considered. This review of textbook strategy is by no means a criticism of the authors or publishers. It has already been stated that the full scope of SCM is very extensive and difficult to capture in one book or program. On the contrary, the book review provided great insight into the priorities placed on specific SCM concepts, techniques, and processes by the authors and their research teams. This is valuable input into the business role and benefit of each discipline and the knowledge, skills and abilities essential to succeed in the field.

SCM Professional Society Certifications

As stated earlier, the professional societies' use of membership focus groups has led to supply chain segment specific certifications. This is not to imply the certification programs are lacking in content or direction, but it does appear they are generally biased toward the discipline interests of the developing organization and its members. While keeping this bias in mind, the content areas of a number of SCM certifications were evaluated as they provide insight into the specific needs of the professional society

membership, and in aggregate represent the vast majority of the knowledge, skills, and abilities required for success in integrated SCM. The examination description and study materials for the following certifications were reviewed:

- Certified Purchasing Manager (CPM) from the ISM
- Certified Professional Supply Management (CPSM) from the ISM
- Certified Production and Inventory Manager (CPIM) from APICS
- Certified Supply Chain Professional (CSCP) from APICS
- Certified Transportation and Logistics (CTL) from the American Society of Transportation and Logistics (AST&L)
- Certified Supply Chain Manager (CSCM) from the International Supply Chain Education Alliance (ISCEA)

It was interesting to note from a review of the detailed ISM documentation on the newly developed CPSM certification, that the development team comprised of three administrators and 16 ISM professional members included only two affiliated with higher education, and both held CPM certification (I. f. S. M.-. ISM, 2006). The CPSM exam was developed by practitioners to set standards for practitioners within the supply management segment of SCM.

From the outlines and the study material for the six reviewed certification exams provided by the four professional societies, there are consistencies in major SCM disciplines addressed by each. A comparison of the same factors used in the textbook review (Table 2) produced the following:

- 100% of the exams addressed information systems and technology, inventory, and metrics.

- Greater than 80% of the exams focused on forecasting, material planning, operations, collaboration, quality, and planning.
- 50 to 75% of the exams focused on aggregate planning, purchasing, warehousing, and global SCM.
- 15 to 35% of the exams have questions related to customer service, distribution planning, reverse logistics, and business process reengineering.
- No references could be found related to factors in packaging.

The degree to which each examination addresses each concept varies significantly. ISM goes into great depth in assessing the test takers knowledge in purchasing planning and techniques. However, ISCEA has only one reference to the topic and APICS addresses it from a strategic perspective only in the CSCP exam.

The review of the professional society examination composition provided visibility into the expectations of the professionals in their respective segments of SCM. Once again it must be acknowledged that this study is focused on SCM concepts and techniques, and the fact that all certification examinations address general business factors of profitability (return on investment, return on assets, etc), organization, goals and strategies, and human relations is recognized as important and a critical component of the comprehensive business program.

Conclusion

The robust research in the areas of SCM history, outcomes assessment, and SCM knowledge, skills, and abilities has provided a strong foundation to support the research questions of this dissertation. A great deal is available from research published in textbooks and journals and by professional societies. While the information on SCM

history and outcomes assessment has a relatively long shelf life, there are three questions about assuming this SCM subject matter is that which is desired by the hiring managers of graduates from SCM higher education SCM programs.

First is the lead-time to publication. Textbooks and many journal articles take years to develop and many months to get to market. Therefore, the content is potentially out of date before it is published, and given that it may be a few more years before revisions or follow up research is provided, the pertinence of such material is often questionable. It is recognized that not everything in SCM changes continuously, rather the addition of new concepts, the evolution of techniques, and shifts in business priorities change over time.

Second, the issue of SCM breadth of scope often results in research being biased toward one segment or discipline. This often results in textbooks and articles giving priority to the researcher's areas of interest which may or may not align with the business marketplace. While there are a number of textbooks with SCM in the title, few define and emphasize the same components of the discipline.

Finally, most higher education business programs allocate two years of the four year experience for major studies. This fact, combined with the magnitude of the content of full scope SCM studies, often requires that higher education SCM programs establish a strategic focus of study for the curriculum and prioritize the content matter to establish a challenging yet achievable goal for students. However, this generally results in emphasis on selected SCM techniques, concepts, and disciplines even if the entire supply chain is foundation for study.

Organizations focus on hiring individuals that possess desired knowledge, skills, and abilities and develop methods to assess the existence of each (Sackett & Roth, 1996). Therefore, while the research into SCM history and content has been very enlightening the lack of available information on outcomes or methods for determining appropriate outcomes for a higher education SCM programs leaves one important question. Given the wide array of SCM subject matter identified in the literature review, what specific knowledge, skills, and abilities should a graduate possess upon graduation from a four year higher education SCM program? The outcomes assessment literature review provided great insight into the need for confirming outcomes and methods for accomplishing same. The next chapter will address the methodology proposed for this research to assess the importance of the major SCM disciplines, concepts, and techniques uncovered in the literature review.

CHAPTER III

METHODS

The SCM Outcomes literature review has provided a wide variety of concepts and content areas upon which to focus an SCM higher education program. As a result the magnitude of potential knowledge, skills, and abilities identified far exceeds that which could be practically included in a four year SCM program. This conclusion requires execution of a methodology to not only confirm which of the SCM concepts and techniques identified in the literature should be included, but in addition, to determine the degree of mastery necessary and to prioritize and weight these factors.

One method considered was the use of focus groups (Holcomb, 2001) to identify both content and priority. However, compiling a truly full scope focus group or groups would be a significant undertaking that may border on being impossible, if not impractical. As noted earlier, the professional societies that have developed, maintain, and administer certifications in aspects of SCM use the focus group approach to developing their outcomes, and as the groups are generally comprised of organization members and subject matter academics, the results do not reflect comprehensive SCM needs.

A more practical approach to gaining true insight into the requisite knowledge, skills, and abilities, and the prioritization of each, for SCM career success is the use of a survey. The lack of an existing survey comprehensive enough to accomplish this task required the development of an instrument to poll those SCM managers and leaders responsible for staffing their organizations.

Instrument

Research confirmed that an appropriate survey of SCM knowledge, skills, and abilities does not exist. However, there are a number of other research examples of surveys to assess the knowledge, skills, and abilities required for success in other business disciplines (Benson & Dresdow, 1998; Frederickson, 1995; Kimball, 1998; QAA, 2004) or in segments of SCM (Giunipero & Handfield, 2004; P. R. Murphy & Poist, 2006; Richey et al., 2006). The lack of an existing survey to achieve the specific goals of this study required that an instrument be designed, and as a result the cross-sectional Supply Chain Management Higher Education Survey was developed. (Appendix A). This attitudes survey is intended to assess the value of the most commonly identified strategic and tactical elements of SCM, and to identify any other factors that industry SCM decision makers consider as critical knowledge, skills, and abilities for success of graduates of a four year higher education SCM program.

The instrument was designed with a focus on two critical components. First, that the survey structure and methodology would be effective in achieving the instruments goals of assessing the importance of selected SCM knowledge, skills, and abilities to business executives. Second, that the content of the survey would provide data to identify differences in the business world needs for an SCM higher education graduate (Fowler Jr., 2002).

Proper format and design of the instrument were a primary focus with the goal that effective initiation would increase the probability that the respondents will actively participate and complete the survey (Alreck & Settle, 1995). Due to the number of SCM concepts to be assessed, survey design was considered critical as it would have a

significant impact on the percentage of responses. In addition the survey design strategy was to keep the survey as easy as possible to complete while meeting the needs of the research (Peterson, 2000).

Research shows that a major factor in the declining academic survey response rate is that the survey is not considered relevant (Baruch, 1999). Therefore, great care was taken to focus on the major concepts for each SCM discipline as identified in the literature review process. Baruch (1999) also found that surveys focused on the SCM target population comprised of business executives and managers had the lowest response rate. Sample introduction letters and critiques by marketing faculty were employed in the development of the introduction to the survey to entice response. The very nature of the self reporting instrument requires some degree of interest in the outcomes for respondents to be willing to participate (Gay & Airasian, 2003).

The survey development process included the use of a focus group to critique the content areas and question structure (Holcomb, 2001). The involvement of *experts* from the SCM marketplace was incorporated to improve the format and significance of the questions in the instrument (Converse & Presser, 1986). The enthusiasm and level of detailed response of the focus group was very encouraging. The hope was that the survey would be received in a similar manner by the SCM stakeholders.

Respondents were promised anonymity and no personal or company identification was requested on the survey. The survey consists of 78, five point Likert Scale questions. Response options to those questions are as follows:

- 0 = None (Not required for SCM graduates).
- 1 = Some Exposure (Familiarity of the topic sufficient).

- 2 = General Knowledge (Able to discuss the topic and research solutions).
- 3 = Working Knowledge (Able to apply and analyze).
- 4 = Mastery (Proficient application and ability to instruct others).

The scale questions are divided into 11 SCM knowledge areas and each area contains an open ended question for the respondent to provide additions to the list of activities or add general comments. The two remaining sections of the survey include an SCM discipline factor ranking section, and one section containing eight demographic questions. As not all companies organize their supply chain administration the same, and discipline responsibilities vary from organization to organization, respondents were permitted to skip SCM knowledge areas which they did not feel qualified to address or in which they have no interest.

While logistics research mail surveys to targeted populations supported by pre-qualification and financial incentives have produced strong response rates (Larson, 2005), the desire to gain insight across industries and across SCM disciplines increased the required sample size significantly. An electronic online survey method was employed due to the geographic disparity of the sample population, and the effectiveness of the method for data collection (Shannon & Bradshaw, 2002). Research indicates that while the general response rates to all academic research surveys is on the decline, response rates for online logistics and SCM surveys is exceeding the traditional survey methods of mail and fax (Griffis, Goldsby, & Cooper, 2003). The survey was administered on-line through the established survey provider SurveyMonkey (SurveyMonkey, 2008). The Duquesne University Business School webmaster assisted by providing a business school

webpage that presented an explanation of the survey and a link to the Survey Monkey site.

Participants

The Supply Chain Management Higher Education Survey focus population was that group of industry stakeholders comprised of SCM decision makers who have hired or potentially would hire graduates from a higher education four year SCM program. With the goal of gaining the views of a diverse group of SCM leaders, the SCM professional societies were considered as potential sources of a comprehensive list names to survey. The members of the Council for Supply Chain Management Professionals (CSCMP) come from a wide variety of SCM disciplines providing a good opportunity to assess the needs of all segments of SCM. Therefore, the membership of this organization was selected for the SCM Higher Education Survey.

CSCMP as a not-for-profit SCM educational professional society supports legitimate academic research by providing researchers access to one of three mailing databases it maintains; current members, past and present members, and associates, past and present members. The current CSCMP members were selected because as dues paying members of the organization they would generally be interested in the advancement of SCM and willing to participate in the survey. A CSCMP profiling option permitted the selection of a subset of current members involved in SCM that hold the titles of director, vice president, or chief supply chain officer. This prescribed subset produced a list of 2124 useable names with mailing and email addresses which was purchased from CSCMP.

Procedures

The survey procedure began with an application for review and approval of the survey by the Duquesne University Institutional Review Board (IRB). As the SCM Higher Education survey is anonymous and requests the opinions of adult business executives, an expedited approval was sought and received.

Upon receipt of IRB approval, the research administrators at CSCMP were contacted and an order placed to purchase the membership subset described earlier. CSCMP provided an Excel file containing the names, mailing addresses, and email addresses of the 2124 qualifying members.

At the same time an account was established with SurveyMonkey and the survey formatted and loaded (Appendix A). Ten faculty members and friends agreed to test the survey online to critique the format, check spelling, and establish a time to complete the survey. All of those testing the instrument were able to complete it in less than fifteen minutes, and the introduction and instructions to the survey were amended to reflect this time requirement.

A personalized letter of introduction (Appendix B) to the research and the survey was mailed by United States Postal Service to the 2124 CSCMP members identified in the profile. As the population being sampled is comprised of ranking corporate executives there is little financial or physical incentive that can be provided to motivate them to complete the survey. The success of the survey response rate was based on the expectation that the executive members of CSCMP are truly interested in the future of SCM education. These hiring executives expect accountability on the part of higher education institutions in providing graduates with the proper foundational SCM

knowledge, skills, and abilities and this is sufficient motivation for them to invest 15 minutes to complete the survey. As some incentive to complete the survey, the respondents were offered the opportunity to receive a summary of the findings. To keep the survey responses anonymous the SCM Higher Education Survey ended with an option to link to another survey (Attachment C) where the respondent could provide contact mail and/or email information.

The introductory letter explained the purpose of the research and included a notice that an email with the web link would be sent to the recipient a few days after the letters receipt, but if the recipient wanted to complete the survey immediately, the web link was provided. Twenty of the letter recipients used the web link on the letter to access and complete the survey.

One week after the introductory letter was mailed, an email (Attachment D) was sent to the 2124 selected CSCMP members again briefly explaining the research and requesting the recipients support to take the survey by clicking on a link to the Duquesne website. In response to the email 114 additional surveys were completed over the next week. Nine days after the first email a second email (Attachment E) was sent as a reminder and encouragement to participate in the survey. The second email produced an additional 41 surveys over the next ten days.

The resulting 175 survey responses provided an 8.24% response rate which was lower than the 17.5% desired response and the 10% planned minimum. Given a concern with the timing of the last reminder due to weekends and a holiday (Thanksgiving), the decision was made to send a third email reminder (Attachment F). Explaining the need

for additional response to provide significant results, the final email produced an additional 43 responses taking the total responses to 218, or a 10.26% response rate.

Given the breadth of disciplines included in the survey, respondents were instructed to leave blank any questions or segments they did not feel qualified to answer. Of the 218 response 21 left some segment of the survey blank. In some cases it did appear the respondent quit the survey while in other responses the sections left blank were in the middle of the survey indicating a decision not to address the specific discipline area or question. All responses were included in the statistical analysis as any input is considered of value.

A total of 106 of the 218 respondents chose to provide contact information and request a copy of the survey results. An introduction and synopsis of Chapter 4 of the dissertation will be sent to those respondents upon completion of the research.

Sixty five days after the survey was introduced the SurveyMonkey site was closed and the data down loaded to Microsoft Excel files. The raw data was backed up on two computers and multiple portable storage drives. The serial identifiers were maintained to ensure uniqueness of each record. The data was then analyzed as described below.

Data Analysis

The SCM Higher Education Survey response data in the Excel file was analyzed and coded. All literal responses were converted to numerical equivalents for statistical analysis. The open-ended question responses were reviewed for each of the 11 question segments. Many of the "other" responses to the first question set' "General SCM Knowledge" were addressed later in the survey. While "other" responses in the remaining 10 question sets provided depth of interest on the part of the respondent, there

was no single theme strong enough to add another question option to any segment. The focus on developing coding categories was to establish groupings that are definitive enough to allow most if not all of the open ended responses to fit into only one category (Fowler Jr., 2002).

The demographic data was also coded for statistical analysis and required the aggregation by common threads of responses for two questions. Question 14, "Select the area of SCM that best describe the scope of your responsibilities" produced a wide variety of responses and combinations. Therefore, it was decided to aggregate the responses into one of four options; "Total Supply Chain Management", "Materials Management", "Physical Distribution", or a specific discipline. If a respondent selected only "Total Supply Chain Management", "Materials Management", or "Physical Distribution", those responses were coded accordingly. If the respondent selected two or more disciplines in either the Materials Management set of disciplines (Forecasting, Production and Inventory Planning, or Supply Management) or the Physical Distribution set of disciplines (manufacturing, transportation, warehousing, materials handling, packaging, or customer service and order management) then the response was coded for that discipline set. "SCM Systems and Technology" were considered part of both discipline sets. Finally, if the respondent selected only one discipline, or one from each of the discipline sets, their responses were coded for the individual discipline(s).

Question 15 "Select the industry category that best describes your business" also required response aggregation as the distribution of responses across the options provided in the survey did not produce sufficient data for statistical significance. The North American Industry Classification System (NAICS) Standard Industrial Classification

(SIC) logic was utilized to aggregate the responses into three major categories (NAICS, 2009); manufacturing, wholesale and retail trade (distributor, wholesaler, retailer), and transportation and services (transportation, warehousing, information, consulting, education). This aggregation resulted in responses per category of 75 manufacturing, 35 wholesale and retail trade, and 83 transportation and service. Twenty-five respondents did not provide an industry selection.

With the coding complete in Excel, the data was transferred to the Statistical Package for the Social Sciences (SPSS for Windows, Release 15.0) for statistical analysis. The analysis for the three hypothesis addressing the SCM knowledge, skills, and abilities required for success upon graduation is described below.

The first set of analytical test with SPSS were focused on assessing the first hypothesis that all those involved with leading SCM operations agree on the desired outcomes of a university program.

> H_1: All SCM business leaders (managers, directors, vice presidents and chief supply chain officers) agree on the level and scope of SCM knowledge, skills, and abilities required of graduates from a higher education SCM four year program.

To test this position SPSS was used to develop the descriptive statistics of frequency of distribution, measures of central tendencies, and measures of variability for all responses to each of the 78 discipline questions and the discipline rankings. This provided insight into the perceived importance of each element, the desired level of mastery of each element, the value placed on each discipline, and the level of agreement across all respondents.

The second hypothesis focuses on determining if there are any differences in the expectations of SCM leaders who are responsible for different segments of SCM

H_2: SCM majors are expected to possess the same level of knowledge, skills, and abilities for all disciplines that make up SCM.

To complete this statistical assessment SPSS was used to provide Analysis of Variance (ANOVA) focused on responses categorized by SCM disciplines. A one-way ANOVA with descriptive statistics and post-hoc Scheffe test was run for each of the 78 discipline questions and the nine discipline rankings. Given the total of 87 samples being evaluated, a confidence interval of .001 was used.

Finally, the third hypothesis is designed to assess if there are any differences in knowledge, skill, and ability expectations for different industries.

H_3: SCM majors are expected to possess the same knowledge, skills, and abilities for all industries.

The statistical assessment techniques for the industry comparison are the same as those used in the discipline comparison. Once again a one-way ANOVA with descriptive statistics and post-hoc Scheffe test was run for each of the 78 discipline questions and the nine discipline rankings, and a confidence interval of .001 was used.

Preliminary results of the ANOVA procedure uncovered variety in F-ratio values and their significance. Therefore, for both of the ANOVA applications described above, the Scheffe post-hoc test was run to provide a very conservative test of the results to prevent rejecting the hypothesis when in fact they are true (Type I error).

Risks

Securing the mailing and email list from CSCMP that was comprised of the profile selected members removed much of the risk of non-representative responses. There is still a concern that the resulting data will not provide statistically significant results to answer the study questions. While the statistical analysis would be informative, it would not provide the hoped for foundation findings to support SCM program development.

Note: Upon completion of the SCM Higher Education Survey, and while preparing for administration of the instrument, an article was published on the development of an SCM MBA program at Eastern Michigan University (Sauber, McSurely, & Tummala, 2008). The task force developing the program used a three factor Likert scale; Awareness, Knowledge, and Skill to assess the level of mastery for 120 SCM concepts. After faculty assessment, the concepts were reviewed by 33 SCM practitioners and the results were used to develop seven new courses for the program. A complete list of the concepts assessed and the results were not provided in the article.

CHAPTER IV

RESULTS

Introduction

The data captured from the Supply Chain Management Higher Education Survey was rich in information regarding the views of corporate SCM executives and their expectations of the SCM skills, knowledge, and abilities which graduates from four year SCM higher education programs should possess. The survey responses were provided by individuals from a number of differing positions including SCM directors (85), vice presidents (67), chief supply chain officers (20), and responses were received from six managers, while 16 selected the "other" option, most of which were CEO's or presidents of SCM companies. Twenty-four respondents did not provide their title.

The data captured from the survey provided a strong picture of the target population's views regarding the importance of each SCM concept presented. The specific results for each of the disciplines and the respondents overall ranking of discipline importance will be assessed and presented in this chapter. The survey also included demographic data such as age, gender, time in position, etc, that go beyond the scope of this study, but will be utilized for additional analysis in the future.

The first eleven SCM categories focused on assessing the level of knowledge, skills, and abilities expected of graduates and the five point scale response options were as follows:

None = Not required for SCM graduates
Some Exposure = Familiarity of the topic sufficient
General Knowledge = Able to discuss the topic and research solutions
Working Knowledge = Able to apply and analyze
Mastery = Proficient application and able to instruct others

Despite the definitions provided, it is recognized that some level of personal interpretation is required by respondents of each option except “None”. Some respondents provided statements in the Comments option indicating the Mastery of any of the concepts in the section was not possible in an academic environment while others responded to the same questions with Mastery as the expected level of achievement. The twelfth section of the survey asked respondents to rank the identified nine major SCM disciplines in order of importance with 1 being most important and 9 the least.

This chapter will focus on the statistical analysis results derived from the survey responses. The following provides a review these results as required to address each of the three dissertation question presented in Chapter I. The eleven SCM skills, knowledge, and abilities sections and the SCM discipline ranking section will be presented for each dissertation question.

Dissertation Question 1

H1: All SCM business leaders (managers, directors, vice presidents, and chief supply chain officers)agree on the level and scope of SCM knowledge, skills, and abilities required of graduates from a higher education SCM four year program.

Descriptive statistics were compiled to assess the amount of agreement among all respondents regarding level of mastery for the identified concepts in each SCM discipline. For the discipline segments, the responses for each concept are presented including the minimum and maximum response, the mean, the standard deviation, and the frequency distribution by level of mastery option. The results for each question category are presented and critiqued below.

General SCM Knowledge

The General SCM Knowledge category of the survey consists of seven questions addressing both the foundational factors of SCM terms, abbreviations, and concepts and the more strategic issues of competitiveness and profitability, along with the role SCM plays in the overall corporate value chain. All of the respondents agreed there was some level of importance to each of the factors, with no one selecting 'none' as a response.

The means of the responses for all seven questions ranged from a low of M = 2.546 for SCM Strategy to a high of M = 3.107 with the higher scores focused on the more basic concepts of SCM scope, metrics, and terminology and lower scores for strategy and integration (see Table 1). Therefore, the respondents expect SCM graduates to have a higher level of mastery in the basic concepts areas than in the more strategic areas.

The standard deviations (*SD*) ranging from .7333 to .8880 indicate a strong agreement by the respondents on all questions. The strongest level of agreement was for a level of *working knowledge* of "SCM Scope" while the most diverse set of responses was related to the level of mastery for "SCM Strategy". The means for SCM Scope (M = 3.107), SCM Metrics (M = 2.977), SCM Abbreviations (M = 2.871), SCM in Value Chain (2.785), and SCM Role in Corporate Profitability (M = 2.772) place all of these concepts in the top ten levels of mastery expected by respondents for all 78 concepts surveyed.

Table 1
Descriptive Statistics for General SCM Knowledge

General SCM Knowledge	n	Minimum	Maximum	*M*	*SD*
SCM Scope	214	1	4	3.107	0.733
SCM Abbreviations	217	1	4	2.871	0.759
SCM Role in Corporate Profitability	215	1	4	2.772	0.773
SCM Strategy	216	1	4	2.546	0.888
SCM Metrics	215	1	4	2.977	0.764
SCM Integration	214	1	4	2.650	0.852
SCM in Value Chain	214	1	4	2.785	0.757

Note: SCM = Supply Chain Management

The frequency distributions for the SCM *general knowledge* responses provided in Table 2 confirm that more than 90% of the respondents indicated a preference for graduates to possess from *general knowledge* to *mastery* of all identified concepts except SCM Strategy. Within this segment, SCM Strategy received the most widely distributed set of responses, and along with SCM Integration had no single level over 40%.

Table 2
Frequency Distribution for SCM General Knowledge

SCM General Knowledge	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
SCM Scope					
Frequency	0	2	41	103	68
Percent	0.000	0.935	19.159	48.131	31.776
SCM Abbreviations					
Frequency	0	7	57	110	43
Percent	0.000	3.226	26.267	50.691	19.816
SCM Role in Corporate Profitability					
Frequency	0	7	73	97	38
Percent	0.000	3.256	33.953	45.116	17.674
SCM Strategy					
Frequency	0	27	75	83	31
Percent	0.000	12.500	34.722	38.426	14.352
SCM Metrics					
Frequency	0	8	41	114	52
Percent	0.000	3.721	19.070	53.023	24.186
SCM Integration					
Frequency	0	17	77	84	36
Percent	0.000	7.944	35.981	39.252	16.822
SCM in Value Chain					
Frequency	0	7	68	103	36
Percent	0.000	3.271	31.776	48.131	16.822

Note: SCM = Supply Chain Management

The open ended question for this category resulted in thirty-one "other" answers, twenty-five of which recommended the addition of topics that are addressed in later question categories. The remaining six were all focused on experiential learning and the importance of graduates possessing real world SCM experiences. The survey focused on SCM knowledge, skills, and abilities that are of importance for career success and not pedagogical methods.

Forecasting

The second category included six questions focusing on Forecasting discipline knowledge, skill, and abilities. Forecasting produced a full range of responses from those indicating each of the concepts should not be included in an SCM higher education curriculum to those who would like graduates to have mastered the concepts before graduation (see Table 3). The average of the responses was highest (M = 2.7464) for a near *working knowledge* of "Forecasting Role in SCM" and lowest (M = 2.263) for "Forecasting APS" with mastery expectations closer to *general knowledge*.

The standard deviation (*SD*) for "Model development" and "Model execution" was slightly higher than the other elements, indicating some disagreement on the level of mastery required for these concepts. The response distributions indicate a strong overall preference for *general knowledge* or *working knowledge* for each forecasting concept. The highest mean in the forecasting category, Role in SCM (M = 2.746), was in the top 25% of all 78 concepts assessed.

Table 3
Descriptive Statistics for Forecasting

Forecasting	n	Minimum	Maximum	*M*	*SD*
Role in SCM	209	0	4	2.746	0.739
Data sources	209	0	4	2.411	0.774
Model development	210	0	4	2.390	0.886
Model execution	208	0	4	2.361	0.901
APS	209	0	4	2.263	0.822
CPFR	210	0	4	2.290	0.834

Note: SCM = Supply Chain Management. APS = Advanced Planning and Scheduling. CPFR = Collaborative Planning Forecasting and Replenishment.

The Frequency Distribution for Forecasting responses (see Table 4) provides better insight into the distribution of responses for each level. For all six Forecasting

concepts those selecting *general knowledge* and *working knowledge* comprised between 72% and 84% all respondents.

Table 4
Frequency Distribution for Forecasting

Forecasting	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Role in SCM					
Frequency	1	4	72	102	30
Percent	0.478	1.914	34.450	48.804	14.354
Data sources					
Frequency	1	22	88	86	12
Percent	0.478	10.526	42.105	41.148	5.742
Model development					
Frequency	2	31	80	77	20
Percent	0.952	14.762	38.095	36.667	9.524
Model execution					
Frequency	1	39	70	80	18
Percent	0.481	18.750	33.654	38.462	8.654
APS					
Frequency	2	33	93	70	11
Percent	0.957	15.789	44.498	33.493	5.263
CPFR					
Frequency	2	30	98	65	15
Percent	0.952	14.286	46.667	30.952	7.143

Note: SCM = Supply Chain Management. APS = Advanced Planning and Scheduling. CPFR = Collaborative Planning Forecasting and Replenishment.

The open ended question of the forecasting section produced twenty-one responses with thirteen requesting attention to specific details of the concepts included in the questions. Three others recommended a focus on Sales and Operations Planning (SOP) which is addressed under the Production and Inventory Planning section. Finally, there were five recommendations to address forecasting from a more strategic view due to the variety of tools and methods utilized, and the variability of industry approaches.

Production and Inventory Planning

The six questions focused on the category of Production and Inventory Planning produced a variety of responses with all but Inventory Techniques and Inventory Costing ranging from *not required for SCM graduates* to *mastery* (see Table 5). The means for all six questions were very close with the lowest being $M = 2.3204$ and the highest $M = 2.863$ indicating that SCM students should possess between a *general knowledge* and *working knowledge* level of mastery for all the identified forecasting concepts. The standard deviations (*SD*) for all questions are also very similar ranging from .7096 to .8260 indicating an overall agreement among all respondents as to the level of mastery expected. The Inventory Planning mean of 2.868 is in the top ten mastery means of all 78 concepts evaluated.

Table 5
Descriptive Statistics for Production and Inventory Planning

Production & Inventory Planning	n	Minimum	Maximum	*M*	*SD*
Production Plan Models	207	0	4	2.512	0.710
Inventory Techniques	205	1	4	2.868	0.732
Inventory Costing	204	1	4	2.603	0.778
Production Inventory Plan - SOP	205	0	4	2.483	0.826
Production Inventory Plan - DRP	206	0	4	2.471	0.824
Inventory Collaboration - VMI	206	0	4	2.320	0.811

Note: SOP = Sales and Operations Planning. DRP = Distribution Resource Planning. VMI = Vendor Managed Inventory

A more in-depth review of the response distribution (see Table 6) uncovered the fact that while four of the concepts were identified as *not required for SCM graduates*, the actual number of such responses was minimal. The responses are heavily focused, and relatively evenly distributed between *general knowledge* and *working knowledge* for

all concepts except Production Planning Models and Inventory Techniques which have a higher concentration of *working knowledge* responses. There is general agreement among respondents for all elements of the Production and Inventory Planning category.

Table 6
Frequency Distribution for Production and Inventory Planning

Production and Inventory Planning	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Prod Plan Models					
Frequency	2	12	79	106	8
Percent	0.966	5.797	38.164	51.208	3.865
Inventory Techniques					
Frequency	0	7	49	113	36
Percent	0.000	3.415	23.902	55.122	17.561
Inventory Costing					
Frequency	0	12	82	85	25
Percent	0.000	5.882	40.196	41.667	12.255
SOP					
Frequency	1	18	90	73	23
Percent	0.488	8.780	43.902	35.610	11.220
Prod Inventory Plan - DRP					
Frequency	2	21	78	88	17
Percent	0.971	10.194	37.864	42.718	8.252
Inventory Collaboration VMI					
Frequency	1	29	92	71	13
Percent	0.485	14.078	44.660	34.466	6.311

Note: SOP = Sales and Operations Planning. DRP = Distribution Resource Planning. VMI = Vendor Managed Inventory

The open ended response option for this category resulted in nine responses, four which recommended specific methods to be addressed in the concepts presented and cautions about the risks of DRP applied in the wrong scenario. There were three recommendations to include the role inventory plays in strategic planning and two suggestions for specific topics to be addressed in Inventory Techniques.

Supply Management

The fourth SCM segment assessed included nine questions focused on the expanded value added role of purchasing now referred to as supply management. The mean of responses was fairly consistent ranging only .08 from 2.27 to 2.35 for all concepts except Contract Law which was lower at $M = 1.907$ and Profitability Impact which was high at $M = 2.69$ (see Table 7). The fact that all the responses but Profitability Impact included selections from the full range of the Likert scale indicates some diversity in expectations. Profitability Impact is ranked in the top 25% of all 78 concepts assessed. At the other end of the spectrum with a mean of 1.907 Contract Law ranked in the lowest 10% of all concepts evaluated.

Table 7
Descriptive Statistics for Supply Management

Supply Management	n	Minimum	Maximum	*M*	*SD*
Master Scheduling	204	0	4	2.338	0.755
Purchasing	203	0	4	2.256	0.817
Supplier Assessment	203	0	4	2.355	0.857
Procurement Strategy	203	0	4	2.350	0.862
Contract Law	205	0	4	1.907	0.826
Spend Analysis & TCO	205	0	4	2.532	0.837
Strategic Sourcing	205	0	4	2.366	0.856
Supplier Collaboration	204	0	4	2.270	0.843
Profitability Impact	203	1	4	2.690	0.813

Note: TCO = Total Cost of Ownership

The frequency distributions presented in Table 8 provide insight into the fact that *general knowledge* was the most frequent response for all concepts except Spend Analysis and Profitability Impact which had more responses for *working knowledge*. In all cases except Contract Law the responses for *general knowledge* and *working knowledge* combined for between 76% and 84% of all responses. Contract Law produced

the widest variability of responses with the highest number of *none* and the smallest number of *mastery* selections.

Table 8
Frequency Distribution for Supply Management

Supply Management	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Master Scheduling					
Frequency	1	21	101	70	11
Percent	0.490	10.294	49.510	34.314	5.392
Purchasing					
Frequency	1	34	91	66	11
Percent	0.493	16.749	44.828	32.512	5.419
Supplier Assessment					
Frequency	2	27	89	67	18
Percent	0.985	13.300	43.842	33.005	8.867
Procurement Strategy					
Frequency	2	28	88	67	18
Percent	0.985	13.793	43.350	33.005	8.867
Contract Law					
Frequency	5	60	94	41	5
Percent	2.439	29.268	45.854	20.000	2.439
Spend Analysis & TCO					
Frequency	4	14	76	91	20
Percent	1.951	6.829	37.073	44.390	9.756
Strategic Sourcing					
Frequency	2	27	88	70	18
Percent	0.976	13.171	42.927	34.146	8.780
Supplier Collaboration					
Frequency	3	30	93	65	13
Percent	1.471	14.706	45.588	31.863	6.373
Profitability Impact					
Frequency	0	14	66	92	31
Percent	0.000	6.897	32.512	45.320	15.271

Note: TCO = Total Cost of Ownership

Manufacturing

The higher education outcomes of the Manufacturing segment of the supply chain were assessed by seven critical concepts and the descriptive statistics for the survey

responses are presented in Table 9. While six of the seven concepts drew a full range of responses, from *none* to *mastery*, the standard deviation provides evidence of general constancy of response. Five of the concepts, all except Plant Layout & Design and Strategies, produced means that were very closely aligned and clustered between 2.244 and 2.345 or within a .101 range. Plant Layout and Design resulted in the lowest average response of all 78 questions in the survey.

Table 9
Descriptive Statistics for Manufacturing

Manufacturing	N	Minimum	Maximum	*M*	*SD*
Production Scheduling	201	1	4	2.259	0.763
Total Quality Management	200	0	4	2.245	0.818
Lean Manufacturing	200	0	4	2.345	0.818
Six Sigma	201	0	4	2.244	0.816
Manufacturing Resource Planning	200	0	4	2.280	0.790
Plant Layout & Design	201	0	4	1.642	0.819
Strategies	198	0	4	2.091	0.826

The frequency distribution for Manufacturing concept questions uncovers that in all cases *general knowledge* was the most common response (see Table 10). However, for all concepts, except Plant Layout and Design, *general knowledge* and *working knowledge* accounted for between 72% and 81% of the responses. The Plant Layout and Design concept question resulted in 81% of the responses in the *some exposure* and *general knowledge* categories.

Table 10
Frequency Distribution for Manufacturing

Manufacturing	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Production Scheduling					
Frequency	0	30	98	64	9
Percent	0.000	14.925	48.756	31.841	4.478
Total Quality Management					
Frequency	1	35	88	66	10
Percent	0.500	17.500	44.000	33.000	5.000
Lean Manufacturing					
Frequency	1	27	88	70	14
Percent	0.500	13.500	44.000	35.000	7.000
Six Sigma					
Frequency	1	35	89	66	10
Percent	0.498	17.413	44.279	32.836	4.975
Manufacturing Resource Planning					
Frequency	1	30	90	70	9
Percent	0.500	15.000	45.000	35.000	4.500
Plant Layout & Design					
Frequency	11	80	83	24	3
Percent	5.473	39.801	41.294	11.940	1.493
Strategies					
Frequency	2	44	95	48	9
Percent	1.010	22.222	47.980	24.242	4.545

Transportation Management

Six of the nine concepts presented for the transportation management segment of the supply chain produced a full range of responses, while all had consistent standard deviations (see Table 11). While Law and Regulations did not draw any *none* responses, its mean was one of the ten lowest in the study, along with Indirect and Special Carrier.

Table 11
Descriptive Statistics for Transportation Management

Transportation	N	Minimum	Maximum	*M*	*SD*
Mode & Carrier Select	200	1	4	2.460	0.844
Law & Regulations	201	1	4	1.945	0.743
Indirect & Special Carrier	199	0	4	1.864	0.814
3PL & 4PL	200	1	4	2.295	0.782
Domestic Documentation	201	0	4	2.134	0.893
International Documentation	200	0	4	2.100	0.891
Pricing	201	0	4	2.308	0.880
Global Logistics	200	0	4	2.410	0.834
Transportation Management Systems	201	0	4	2.184	0.831

Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

Table 12 provides the frequency distributions for the transportation management concepts and once again the most common response for all was *general knowledge.* Seventy-four to 80% of the respondents selected general knowledge or working knowledge for Mode and Carrier Select, 3PL and 4PL, Pricing, Global Logistics, and Transportation Management Systems, while Law and Regulations and Indirect and Special Carrier resulted in 79.9% and 80.1% of responses respectively for *some exposure* and *general knowledge*. Domestic Documentation and International Documentation responses presented a very normal distribution around *general knowledge*.

Table 12
Frequency Distribution for Transportation Management

Transportation	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Mode & Carrier Select					
Frequency	0	25	79	75	21
Percent	0.000	12.500	39.500	37.500	10.500
Law & Regulations					
Frequency	0	56	105	35	5
Percent	0.000	27.861	52.239	17.413	2.488
Indirect & Special Carrier					
Frequency	4	63	94	32	6
Percent	2.010	31.658	47.236	16.080	3.015
3PL & 4PL					
Frequency	0	29	94	66	11
Percent	0.000	14.500	47.000	33.000	5.500
Domestic Documentation					
Frequency	3	46	86	53	13
Percent	1.493	22.886	42.786	26.368	6.468
International Documentation					
Frequency	3	49	85	51	12
Percent	1.500	24.500	42.500	25.500	6.000
Pricing					
Frequency	2	32	87	62	18
Percent	0.995	15.920	43.284	30.846	8.955
Global Logistics					
Frequency	1	24	85	72	18
Percent	0.500	12.000	42.500	36.000	9.000
Transportation Management Systems					
Frequency	1	41	89	60	10
Percent	0.498	20.398	44.279	29.851	4.975

Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

Distribution Management - Warehousing

Responses to the critical Distribution Management concepts provided consistent results for each concept with the standard deviations ranging from .745 to .887 (see Table 13). Four of the six Distribution Management concepts received responses in all five Likert scale options. The higher means of Warehouse Purposes (M = 2.605) and

Distribution Network Design (*M* = 2.585) ranked them in the top 30% of all 78 concepts evaluated.

Table 13.
Descriptive Statistics for Distribution Management

Distribution Management	N	Minimum	Maximum	*M*	*SD*
Whse. Purposes	200	1	4	2.605	0.776
Distribution Network Design	200	1	4	2.585	0.745
Whse. Specifications & Selection	200	0	4	2.065	0.827
Whse. Layout & Design	200	0	4	1.920	0.887
Whse. Operations	198	0	4	2.318	0.803
Whse. Management Systems	199	0	4	2.201	0.835

Note: Whse. = Warehouse

The Distribution Management concepts frequency distribution results are similar to previous categories with *general knowledge* being the most frequently selected level of accomplishment for all concepts except Distribution Network Design where more respondents selected *working knowledge* (see Table 14). Warehouse Layout and Design was the only concept that did not have between 72% and 85% of the responses in combination of *general knowledge* and *working knowledge*, as its responses were concentrated in *some exposure* and *general knowledge* (72.5%).

Table 14
Frequency Distribution for Distribution Management - Warehousing

Distribution Management	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Whse. Purposes					
Frequency		10	85	79	26
Percent		5.000	42.500	39.500	13.000
Distribution Network Design					
Frequency		12	78	91	19
Percent		6.000	39.000	45.500	9.500
Whse. Specifications & Selection					
Frequency	3	46	93	51	7
Percent	1.500	23.000	46.500	25.500	3.500
Whse. Layout & Design					
Frequency	5	64	81	42	8
Percent	2.500	32.000	40.500	21.000	4.000
Whse. Operations					
Frequency	1	29	84	74	10
Percent	0.505	14.646	42.424	37.374	5.051
Whse. Management System					
Frequency	2	37	89	61	10
Percent	1.005	18.593	44.724	30.653	5.025

Note: Whse. = Warehouse

Material Handling and Packaging

The five Material Handling and Packaging concepts included in the survey all received a full range of level of mastery responses (see Table 15). The standard deviations indicate a consistency in responses for all concepts, however, Material Handling Equipment Selection, Packaging Types and Purposes, and Packaging Materials were in the ten lowest averages of all 78 concepts assessed by the survey.

Table 15
Descriptive Statistics for Material Handling and Packaging

Material Handling & Packaging	N	Minimum	Maximum	*M*	*SD*
MH Equipment Selection	198	0	4	1.702	0.823
MH Principles	200	0	4	2.195	0.866
Packaging Types & Purposes	200	0	4	1.965	0.779
Packaging Materials	200	0	4	1.700	0.757
Auto Identification	199	0	4	2.221	0.805

Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

The distribution frequencies for Material Handling and Packaging identify that the most frequent response for all concepts was *general knowledge* (see Table 16). Packaging Materials (39.5%) and Material Handling Equipment Selection (40.9%) have the highest percentage of respondents indicating *none* or *some exposure* as the expected level of concept mastery.

Table 16
Frequency Distribution for Material Handling and Packaging

Material Handling & Packaging	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
MH Equipment Selection					
Frequency	10	71	89	24	4
Percent	5.051	35.859	44.949	12.121	2.020
MH Principles					
Frequency	1	43	85	58	13
Percent	0.500	21.500	42.500	29.000	6.500
Packaging Types & Purpose					
Frequency	2	52	103	37	6
Percent	1.000	26.000	51.500	18.500	3.000
Packaging Materials					
Frequency	6	73	101	15	5
Percent	3.000	36.500	50.500	7.500	2.500
Auto Identification					
Frequency	1	33	97	57	11
Percent	0.503	16.583	48.744	28.643	5.528

Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

Customer Service

Responses to the five customer service concepts indicate a need for a high level of mastery by graduates (see Table 17). While there is a broad range of response distribution for all concepts, the standard deviations (.738 to .852) indicate a concurrence of choices. The Customer Service concept Role of SCM mean of $M = 2.631$ places it in the top 25% of all survey concepts evaluated.

Table 17
Descriptive Statistics for Customer Service

Customer Service	N	Minimum	Maximum	*M*	*SD*
Distribution Channels	199	1	4	2.497	0.738
Customer Service Strategies	199	0	4	2.508	0.840
Role in SCM	198	1	4	2.631	0.794
Customer Relations Management	199	0	4	2.276	0.852
Reverse Logistics	199	0	4	2.206	0.818

The frequency distribution for the customer service concepts identifies that three of the five (Distribution Channels, Customer Service Strategies, and Role in SCM) drew a slightly higher number of responses for *working knowledge*, while the remaining concept responses were concentrated on *general knowledge*. However, between 74% and 86% of all responses were for either *general knowledge* or *working knowledge*, and no more than two responses were received for the *none* option for any concept.

Table 18
Frequency Distribution for Customer Service

Customer Service	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Distribution Channels					
Frequency	0	16	81	89	13
Percent	0.000	8.040	40.704	44.724	6.533
Customer Service Strategies					
Frequency	1	21	74	82	21
Percent	0.503	10.553	37.186	41.206	10.553
Role in SCM					
Frequency	0	11	79	80	28
Percent	0.000	5.556	39.899	40.404	14.141
Customer Relationship Management					
Frequency	1	34	88	61	15
Percent	0.503	17.085	44.221	30.653	7.538
Reverse Logistics					
Frequency	2	35	91	62	9
Percent	1.005	17.588	45.729	31.156	4.523

Information Systems and Technology

The descriptive statistics for the seven concepts assessed under SCM information systems and technology identify some variability in responses with SCM Data Collection (*SD* = .916) and Systems Specification, Analysis, and Design (*SD* = .908) producing two of the highest three standard deviations found in the study (see Table 19). While the

means are clustered near the mid value of the Likert scale, all but Auto Identification have a full range of responses.

Table 19
Descriptive Statistics for Information Systems and Technology

	N	Minimum	Maximum	*M*	*SD*
Enterprise Resource Planning	196	0	4	2.347	0.805
Decision Support Systems	198	0	4	2.091	0.813
E-Business	196	0	4	2.097	0.801
SCM Data Collection	198	0	4	2.253	0.916
Auto Identification	198	1	4	2.040	0.848
Systems Specification, Analysis & Design	197	0	4	1.949	0.908
IS & IT Assessment & Selection	194	0	4	1.876	0.879

Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

The frequency distributions for the SCM information systems and technology concepts identifies that the majority of respondents selected *general knowledge* for all concepts (See Table 20). For Enterprise Resource Planning, Decision Support Systems, and E-Business between 73% and 82% of the respondents chose *general knowledge* or *working knowledge*. The concepts of Auto ID, Systems Specification, Analysis, and Design, and IS & IT Assessment and Selection between 72% and 75.3% of the responses were in the *some exposure* and *general knowledge* level of mastery. SCM Data Collection responses were more evenly distributed across *some exposure*, *general knowledge*, and *working knowledge*.

Table 20
Frequency Distribution for SCM Information Systems and Technology

Information Systems & Technology	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Enterprise Resource Planning					
Frequency	2	22	91	68	13
Valid Percent	1.020	11.224	46.429	34.694	6.633
Decision Support Systems					
Frequency	4	40	93	56	5
Valid Percent	2.020	20.202	46.970	28.283	2.525
E-Business					
Frequency	1	44	93	51	7
Valid Percent	0.510	22.449	47.449	26.020	3.571
SCM Data Collection					
Frequency	2	39	83	55	19
Valid Percent	1.010	19.697	41.919	27.778	9.596
Auto ID					
Frequency		56	89	42	11
Valid Percent		28.283	44.949	21.212	5.556
Systems Specification, Analysis & Design					
Frequency	6	57	86	37	11
Valid Percent	3.046	28.934	43.655	18.782	5.584
IS & IT - Assessment & Selection					
Frequency	7	59	87	33	8
Valid Percent	3.608	30.412	44.845	17.010	4.124

Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

General Skills for SCM

For the 11 general business skills selected as critical to SCM career success four, Computer – PC Office (M = 3.395), Ethics (M = 3.316), Communications (M = 3.245), and Problem Solving and Decision Making (M = 3.184) ranked one through four respectively as the top averages for all 78 concepts assessed. Simulation Modeling had

the lowest mean (*M* = 2.179) for the general business skills concepts and the standard deviation of .910 ranked in the top 3 for all concepts evaluated in the survey.

Table 21
Descriptive Statistics for General Skills for SCM

General Skills	N	Minimum	Maximum	*M*	*SD*
Cross Functional Teams	195	0	4	2.723	0.783
Six Sigma	196	0	4	2.214	0.807
Lean	195	0	4	2.333	0.791
Process Mapping	194	1	4	2.768	0.847
Project Management	196	0	4	2.765	0.881
Simulation Modeling	195	0	4	2.179	0.910
Communications	196	1	4	3.245	0.710
Problem Solving & Decision Making	196	1	4	3.184	0.677
Ethics	196	0	4	3.316	0.830
Negotiations	196	0	4	2.582	0.846
Computer - PC Office	195	1	4	3.395	0.683

As the concepts included in the General Skills for SCM section come from a variety of business areas is not surprising that the responses vary significantly from concept to concept (see Table 22). The concepts of Ethics, Computer, Communications, and Problem Solving and Decision Making produced four of the five highest response totals for *mastery* of a concept which resulted in between 83% and 89.7% of the responses in the *working knowledge* or *mastery* categories. The first six concepts, Cross Functional Teams, Six Sigma, Lean, Project Management, and Simulation Modeling resulted in 70% to 81% of the responses for *general knowledge* or *working knowledge*.

Table 22
Frequency Distribution for General Skills for SCM

General Skills	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Cross Functional Teams					
Frequency	1	11	55	102	26
Percent	0.513	5.641	28.205	52.308	13.333
Six Sigma					
Frequency	1	37	84	67	7
Percent	0.510	18.878	42.857	34.184	3.571
Lean					
Frequency	1	28	79	79	8
Percent	0.513	14.359	40.513	40.513	4.103
Project Management					
Frequency	1	14	56	84	41
Percent	0.510	7.143	28.571	42.857	20.918
Process Mapping					
Frequency		20	37	105	32
Percent		10.309	19.072	54.124	16.495
Simulation Modeling					
Frequency	4	43	73	64	11
Percent	2.051	22.051	37.436	32.821	5.641
Communications					
Frequency		2	25	92	77
Percent		1.020	12.755	46.939	39.286
Problem Solving & Decision Making					
Frequency		2	24	106	64
Percent		1.020	12.245	54.082	32.653
Ethics					
Frequency	1	4	28	62	101
Percent	0.510	2.041	14.286	31.633	51.531
Negotiations					
Frequency	1	17	71	81	26
Percent	0.510	8.673	36.224	41.327	13.265
Computer - PC Office					
Frequency		1	19	77	98
Percent		0.513	9.744	39.487	50.256

SCM Discipline Ranking

The final section of assessment included a request to rank the nine SCM disciplines identified in the survey from the most important (1) to the least important (9). This forced ranking was intended to determine how the SCM executives value the various traditional disciplines that make up SCM, and if they agree. Table 23 provides insight into the wide variability of responses received. Every discipline received a vote for each of the nine ranking options. The lowest mean, therefore overall highest ranked discipline was Supply Management (M = 4.199), and the highest mean or overall least important Material Handling and Packaging (M = 6.454). However, the highest and lowest rankings are only 2.255 points apart and the standard deviations for all disciplines range from 2.140 to 2.878.

Table 23
Descriptive Statistics for Ranking of SCM Disciplines

Discipline Ranking	N	Minimum	Maximum	*M*	*SD*
Forecasting	179	1	9	4.453	2.473
Production & Inventory Plan	186	1	9	4.263	2.461
Supply Management	181	1	9	4.199	2.249
Manufacturing	181	1	9	5.232	2.226
Transportation	181	1	9	5.000	2.140
Distribution Management - Warehousing	182	1	9	5.648	2.214
Material Handling & Packaging	183	1	9	6.454	2.863
Customer Service	190	1	9	4.726	2.878
Information Systems & Technology	190	1	9	5.216	2.641

A review of the frequency distribution for the nine discipline ranking shows that that the greatest agreement among the respondents was 63 selections of the ninth ranking for Material Handling and Packaging. However, Material Handling and Packaging received the fourth highest number of first ranking choices. Supply Management that had

the lowest mean received the third most first ranking selections and the highest number of fifth place rankings (31) both for the discipline and for the place. These results reflect the lack of agreement among respondents.

Table 24

Frequency Distribution for Ranking of SCM Disciplines

SCM Disciplines	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Forecasting									
Frequency	19	29	31	22	18	10	24	13	13
Percent	10.61	16.20	17.32	12.29	10.06	5.59	13.41	7.26	7.26
Production & Inventory Plan									
Frequency	28	28	26	28	15	19	17	14	11
Percent	15.05	15.05	13.98	15.05	8.06	10.22	9.14	7.53	5.91
Supply Management									
Frequency	27	23	23	31	23	19	18	14	3
Percent	14.92	12.71	12.71	17.13	12.71	10.50	9.94	7.73	1.66
Manufacturing									
Frequency	11	10	21	25	34	28	19	15	18
Percent	6.08	5.52	11.60	13.81	18.78	15.47	10.50	8.29	9.94
Transportation									
Frequency	12	18	18	18	36	31	25	17	6
Percent	6.63	9.94	9.94	9.94	19.89	17.13	13.81	9.39	3.31
Distribution Management - Warehousing									
Frequency	5	17	16	18	22	26	34	31	13
Percent	2.75	9.34	8.79	9.89	12.09	14.29	18.68	17.03	7.14
Material Handling & Packaging									
Frequency	22	8	12	5	4	16	20	33	63
Percent	12.02	4.37	6.56	2.73	2.19	8.74	10.93	18.03	34.43
Customer Service									
Frequency	39	19	20	13	21	16	17	16	29
Percent	20.53	10.00	10.53	6.84	11.05	8.42	8.95	8.42	15.26
Information Systems & Technology									
Frequency	17	29	11	24	14	23	17	35	20
Percent	8.95	15.26	5.79	12.63	7.37	12.11	8.95	18.42	10.53

Dissertation Question 2

H2: SCM majors are expected to possess the same level of knowledge, skills, and abilities for career success in any of the disciplines that make up SCM.

The level of agreement among the SCM Higher Education Survey respondents was then assessed from the perspective of the disciplines for which each is responsible. Based on the demographic responses to SCM areas of responsibility, respondents were categorized into SCM Responsibility groupings that included the activities of:

- Total SCM – responsible for much or all of the SCM disciplines
- Materials Management - responsible for much or all of the forecasting, planning, and purchasing activities.
- Physical Distribution - responsible for much or all of the manufacturing, distribution, and customer service activities.
- Other – responsible for activities not addressed above.

The distribution of respondents for each SCM Responsibility category was: Total SCM 113, Materials Management 15, Physical Distribution 55, Other 9, and 26 did not provide their responsibilities. The descriptive statistics and Analysis of Variance (ANOVA) with appropriate post-hoc tests, of the data for each of the 12 question categories are reviewed below to assess the level of agreement between discipline leaders on the level of mastery of SCM knowledge, skills, and abilities required for success.

Given that each respondent was asked a total of 78 questions and a desire to establish an 95% confidence level, the level of significance that is used to assess each question is an $\alpha = .001$ (.05/78 = .000641).

General SCM Knowledge

A summary of the descriptive statistics for responses by SCM Responsibility groups regarding the value of the General SCM Knowledge concepts is presented Table 25. The consistently low standard deviation indicates a strong agreement on each SCM General Knowledge element within each group. The only concept that has a standard deviation greater than .9 is SCM Strategy as assessed by the Total SCM group (*SD* = .936) which indicates a disagreement regarding the level of mastery required.

Table 25
General SCM Knowledge comparison by SCM Responsibility

General Knowledge		Total SCM	Materials	Physical Distrib	Other	Total
SCM Scope						
	n	112	15	54	9	190
	M	3.018	3.467	3.204	3.222	3.116
	SD	0.771	0.640	0.655	0.667	0.733
SCM Abbreviations						
	n	113	15	55	9	192
	M	2.770	3.000	2.927	3.333	2.859
	SD	0.791	0.845	0.604	0.500	0.742
SCM Role in Corporate Profitability						
	n	112	15	55	9	191
	M	2.688	2.867	2.891	2.889	2.770
	SD	0.828	0.834	0.658	0.601	0.774
SCM Strategy						
	n	113	15	55	9	192
	M	2.540	2.400	2.582	2.556	2.542
	SD	0.936	0.828	0.832	0.726	0.885
SCM Metrics						
	n	112	15	55	9	191
	M	2.982	3.000	3.000	2.889	2.984
	SD	0.771	0.756	0.745	0.601	0.750
SCM Integration						
	n	112	15	54	9	190
	M	2.625	2.600	2.704	2.556	2.642
	SD	0.892	0.828	0.838	0.527	0.853
SCM in Value Chain						
	n	112	15	54	9	190
	M	2.759	2.933	2.833	2.778	2.795
	SD	0.774	0.884	0.694	0.667	0.752

Note: SCM = Supply Chain Management

The results of an ANOVA comparing the means of the four SCM Responsibility groups for the six General Knowledge questions are presented in Table 26. While the results indicate some variability in the average responses for each group related to SCM Scope and SCM Abbreviations, the remaining mean square (*MS*) results are closely

aligned. The resulting *F* values produce *p* values significantly greater than α = .001, therefore there is no evidence that any difference exists between the General SCM Knowledge requirements based on SCM discipline group needs.

Table 26
Analysis of Variance Results: General SCM Knowledge by SCM Responsibility Group

General SCM Knowledge		*SS*	*df*	*MS*	*F*	*p*
SCM Scope	Between Groups	3.440	3	1.147	2.176	0.092
	Within Groups	98.012	186	0.527		
	Total	101.453	189			
SCM Abbreviations	Between Groups	3.476	3	1.159	2.142	0.096
	Within Groups	101.727	188	0.541		
	Total	105.203	191			
Corp Profitability	Between Groups	1.834	3	0.611	1.020	0.385
	Within Groups	112.030	187	0.599		
	Total	113.864	190			
SCM Strategy	Between Groups	0.392	3	0.131	0.164	0.920
	Within Groups	149.275	188	0.794		
	Total	149.667	191			
SCM Metrics	Between Groups	0.100	3	0.033	0.058	0.982
	Within Groups	106.853	187	0.571		
	Total	106.953	190			
SCM Integration	Between Groups	0.332	3	0.111	0.150	0.930
	Within Groups	137.331	186	0.738		
	Total	137.663	189			
SCM in Value Chain	Between Groups	0.515	3	0.172	0.300	0.826
	Within Groups	106.480	186	0.572		
	Total	106.995	189			

* significant at α = .001. Note: SCM = Supply Chain Management

Forecasting

An assessment of the statistics related to the four SCM Responsibility groups regarding the importance of the selected Forecasting concepts is presented in Table 27. A review of standard deviation for each group shows the positive agreement among the members of each group on the value of most of the Forecasting concepts; especially strong is the Material group on Data Sources (*SD* = .488) and CPFR (*SD* = .

488). The responses were more widely distributed within the Total SCM group for two concepts; Model Development (SD = .941) and Model Execution (SD = .933). The Physical Distribution group also had varied responses for Model Execution (SD = .917). The consistency between the means for all concepts except the four cited above provides an indication of a level of agreement between the four discipline groups.

Table 27.
Forecasting Comparison by SCM Responsibility

	Total SCM	Material	Physical Dist	Other	Total
Role in SCM					
n	113	15	54	9	191
M	2.788	2.733	2.648	2.667	2.738
SD	0.829	0.594	0.588	0.500	0.736
Data sources					
n	113	15	54	9	191
M	2.460	2.333	2.352	2.333	2.414
SD	0.813	0.488	0.731	0.707	0.762
Model development					
n	113	15	55	9	192
M	2.407	2.333	2.345	2.222	2.375
SD	0.941	0.617	0.844	0.667	0.877
Model execution					
n	111	15	55	9	190
M	2.369	2.333	2.218	2.444	2.326
SD	0.933	0.617	0.917	0.726	0.896
APS					
n	113	15	54	9	191
M	2.310	2.533	2.056	2.111	2.246
SD	0.803	0.743	0.834	0.601	0.806
CPFR					
n	113	15	55	9	192
M	2.319	2.333	2.182	2.444	2.286
SD	0.805	0.488	0.945	0.726	0.823

Note: SCM = Supply Chain Management. APS = Advanced Planning and Scheduling. CPFR = Collaborative Planning Forecasting and Replenishment.

The Analysis of Variance results comparing the means of the SCM Responsibility groups for the six Forecasting concepts produced results similar to those of General SCM

Knowledge (see Table 28). While some variety exists for the between and within means for APS, the *p* values for all Forecasting concepts are greater than α = .001. There is no significant difference between the response averages of each SCM discipline category regarding the importance of each Forecasting concept presented.

Table 28
Analysis of Variance Results: Forecasting by SCM Responsibility Group

Forecasting		*SS*	*df*	*MS*	*F*	*p*
Role in SCM	Between Groups	0.760	3	0.253	0.464	0.708
	Within Groups	102.151	187	0.546		
	Total	102.911	190			
Data sources	Between Groups	0.606	3	0.202	0.344	0.793
	Within Groups	109.719	187	0.587		
	Total	110.325	190			
Model development	Between Groups	0.400	3	0.133	0.171	0.916
	Within Groups	146.600	188	0.780		
	Total	147.000	191			
Model execution	Between Groups	0.975	3	0.325	0.401	0.752
	Within Groups	150.793	186	0.811		
	Total	151.768	189			
APS	Between Groups	3.820	3	1.273	1.991	0.117
	Within Groups	119.615	187	0.640		
	Total	123.435	190			
CPFR	Between Groups	0.976	3	0.325	0.477	0.699
	Within Groups	128.268	188	0.682		
	Total	129.245	191			

* significant at α = .001. Note: SCM = Supply Chain Management. APS = Advanced Planning and Scheduling. CPFR = Collaborative Planning Forecasting and Replenishment.

Production and Inventory Planning

The descriptive statistics by SCM Responsibility groups for the Production and Inventory Planning concepts are provided in Table 29. With all standard deviations below .880, there is general agreement among the members of the Responsibility groups as to the level of concept mastery for each concept. Not including the Other grouping, the Physical Distribution segment has the lowest

mean in all categories except Inventory Costing, indicating a slightly less level of mastery.

Table 29
Production & Inventory Planning Comparison by SCM Responsibility

	Total SCM	Material	Physical Dist	Other	Total
Production Planning Models					
n	113	15	54	9	191
M	2.522	2.600	2.500	2.444	2.518
SD	0.769	0.507	0.575	0.527	0.687
Inventory Techniques					
n	112	14	54	9	189
M	2.911	3.071	2.741	2.667	2.862
SD	0.766	0.475	0.678	0.500	0.716
Inventory Costing					
n	112	15	53	9	189
M	2.652	2.333	2.604	2.444	2.603
SD	0.791	0.724	0.768	0.527	0.769
SOP					
n	112	15	54	9	190
M	2.536	2.600	2.389	2.444	2.495
SD	0.879	0.737	0.763	0.527	0.821
DRP					
n	113	15	54	8	190
M	2.504	2.467	2.426	2.625	2.484
SD	0.846	0.640	0.767	0.744	0.802
Inventory Collaboration -VMI					
n	113	15	53	9	190
M	2.354	2.333	2.283	2.333	2.332
SD	0.778	0.816	0.841	0.707	0.791

Note: SOP = Sales and Operations Planning. DRP = Distribution Resource Planning. VMI = Vendor Managed Inventory

An ANOVA comparing the means for the four Responsibility groups on each Production and Inventory Planning concept is provided in Table 30. Once again the *p* values are all well above the $\alpha = .001$confirming that there is no significant difference in the level of mastery of the six Production and Inventory Planning concepts expected of

a graduate from an SCM higher education program between SCM Responsibility group executives.

Table 30
Analysis of Variance Results: Production & Inventory Planning by SCM Responsibility Group

Production - Inventory Planning		*SS*	*df*	*MS*	*F*	*p*
Production Planning Models	Between Groups	0.169	3	0.056	0.118	0.950
	Within Groups	89.517	187	0.479		
	Total	89.686	190			
Inventory Techniques	Between Groups	2.017	3	0.672	1.318	0.270
	Within Groups	94.406	185	0.510		
	Total	96.423	188			
Inventory Costing	Between Groups	1.584	3	0.528	0.891	0.447
	Within Groups	109.654	185	0.593		
	Total	111.238	188			
SOP	Between Groups	0.982	3	0.327	0.481	0.696
	Within Groups	126.513	186	0.680		
	Total	127.495	189			
DRP	Between Groups	0.393	3	0.131	0.201	0.895
	Within Groups	121.060	186	0.651		
	Total	121.453	189			
Inventory Collaboration - VMI	Between Groups	0.182	3	0.061	0.096	0.962
	Within Groups	117.929	186	0.634		
	Total	118.111	189			

* significant at $\alpha = .001$. Note: SOP = Sales and Operations Planning. DRP = Distribution Resource Planning. VMI = Vendor Managed Inventory

Supply Management

Within the four Responsibility groups there is general agreement on the level of mastery expected of a graduate for most of the nine concepts identified for Supply Management (see Table 31). The exceptions are found in the Material group view of Purchasing (*SD* = .915), Total SCM group view of Contract Law (*SD* = .900), and Material group view of Profitability Impact (*SD* = .915), where the high standard deviations indicate a broader array of responses by group members.

Table 31

Supply Management Comparison by SCM Responsibility

Supply Management	Total SCM	Material	Physical Dist	Other	Total
Master Scheduling					
n	112	15	55	9	191
M	2.357	2.400	2.309	2.111	2.335
SD	0.793	0.828	0.717	0.601	0.763
Purchasing					
n	111	15	55	9	190
M	2.216	2.467	2.309	2.000	2.253
SD	0.857	0.915	0.663	0.707	0.803
Supplier Assessment					
n	113	15	53	9	190
M	2.345	2.733	2.396	2.111	2.379
SD	0.884	0.704	0.817	0.782	0.851
Procurement Strategy					
n	111	15	55	9	190
M	2.378	2.533	2.273	2.222	2.353
SD	0.885	0.834	0.827	0.667	0.853
Contract Law					
n	113	15	55	9	192
M	1.894	1.933	1.891	2.111	1.906
SD	0.900	0.704	0.685	0.782	0.820
Spend Analysis & TCO					
n	113	15	55	9	192
M	2.522	2.667	2.582	2.333	2.542
SD	0.857	0.488	0.809	0.866	0.818
Strategic Sourcing					
n	113	15	55	9	192
M	2.398	2.533	2.327	2.333	2.385
SD	0.872	0.834	0.840	0.866	0.855
Supplier Collaboration					
n	113	15	54	9	191
M	2.265	2.533	2.278	2.111	2.283
SD	0.856	0.743	0.856	0.782	0.842
Profitability Impact					
n	112	15	54	9	190
M	2.688	2.867	2.704	2.667	2.705
SD	0.839	0.915	0.768	0.707	0.815

Note: TCO = Total Cost of Ownership

Insight into the relationship of responses between the four SCM Responsibility groups' members is provided in the ANOVA results presented in Table 32. Once again while there is some variability between the groups concept to concept, there are no significant differences with the lowest *p* value for Supplier Assessment at .298.

Table 32
Analysis of Variance Results: Supply Management by SCM Responsibility

Supply Management		*SS*	*df*	*MS*	*F*	*p*
Master Scheduling	Between Groups	0.606	3	0.202	0.344	0.794
	Within Groups	109.949	187	0.588		
	Total	110.555	190			
Purchasing	Between Groups	1.584	3	0.528	0.816	0.486
	Within Groups	120.290	186	0.647		
	Total	121.874	189			
Supplier Assessment	Between Groups	2.674	3	0.891	1.237	0.298
	Within Groups	134.041	186	0.721		
	Total	136.716	189			
Procurement Strategy	Between Groups	1.068	3	0.356	0.486	0.693
	Within Groups	136.306	186	0.733		
	Total	137.374	189			
Contract Law	Between Groups	0.419	3	0.140	0.205	0.893
	Within Groups	127.893	188	0.680		
	Total	128.313	191			
Spend Analysis & TCO	Between Groups	0.757	3	0.252	0.374	0.772
	Within Groups	126.910	188	0.675		
	Total	127.667	191			
Strategic Sourcing	Between Groups	0.557	3	0.186	0.251	0.860
	Within Groups	138.922	188	0.739		
	Total	139.479	191			
Supplier Collaboration	Between Groups	1.242	3	0.414	0.580	0.629
	Within Groups	133.491	187	0.714		
	Total	134.733	190			
Profitability Impact	Between Groups	0.440	3	0.147	0.218	0.884
	Within Groups	125.055	186	0.672		
	Total	125.495	189			

* significant at $\alpha = .001$.

Manufacturing

The descriptive statistics for the Manufacturing concept comparison between the four Responsibility groups indicate that within the groups there is general agreement on the level of mastery expected from an SCM graduate (see Table 33). All standard deviations fall between *SD* = .561for Materials group on Production Scheduling and *SD* = .866 for the Other group on Manufacturing Resource Planning, except *SD* = .928 for the Other group on Plant Layout and Design, however, with such a small sample size for the group this could be expected.

Table 33
Manufacturing Comparison by SCM Responsibility

Manufacturing	Total SCM	Material	Physical Dist	Other	Total
Production Scheduling					
n	113	15	54	9	191
M	2.319	2.200	2.259	2.111	2.283
SD	0.827	0.561	0.650	0.601	0.750
Total Quality Management					
n	113	14	54	9	190
M	2.221	2.357	2.444	2.111	2.289
SD	0.810	0.745	0.793	0.782	0.800
Lean Manufacturing					
n	112	15	54	9	190
M	2.384	2.133	2.463	2.222	2.379
SD	0.819	0.640	0.818	0.667	0.799
Six Sigma					
n	113	15	54	9	191
M	2.221	2.133	2.407	2.222	2.267
SD	0.832	0.640	0.813	0.833	0.812
Manufacturing Resource Planning					
n	112	15	54	9	190
M	2.321	2.533	2.222	2.333	2.311
SD	0.785	0.743	0.793	0.866	0.786
Plant Layout & Design					
n	113	15	54	9	191
M	1.602	1.600	1.778	1.889	1.665
SD	0.830	0.632	0.839	0.928	0.823
Strategies					
n	112	15	52	9	188
M	2.089	2.333	2.115	2.222	2.122
SD	0.844	0.816	0.784	0.667	0.815

The Analysis of Variance for the Manufacturing concepts as assessed by the Responsibility groups is provided in Table 34. The survey response by the four Responsibility groups for the seven Manufacturing concepts were not significantly different between the groups with all *p* values well over $\alpha = .001$.

Table 34
Analysis of Variance Results: Manufacturing by SCM Responsibility Group

Manufacturing		*SS*	*df*	*MS*	*F*	*p*
Production Scheduling	Between Groups	0.543	3	0.181	0.319	0.812
	Within Groups	106.190	187	0.568		
	Total	106.733	190			
Total Quality Management	Between Groups	2.173	3	0.724	1.133	0.337
	Within Groups	118.906	186	0.639		
	Total	121.079	189			
Lean Manufacturing	Between Groups	1.510	3	0.503	0.785	0.503
	Within Groups	119.206	186	0.641		
	Total	120.716	189			
Six Sigma	Between Groups	1.587	3	0.529	0.799	0.496
	Within Groups	123.795	187	0.662		
	Total	125.382	190			
Manufacturing Resource Planning	Between Groups	1.184	3	0.395	0.635	0.593
	Within Groups	115.495	186	0.621		
	Total	116.679	189			
Plant Layout & Design	Between Groups	1.653	3	0.551	0.812	0.489
	Within Groups	126.902	187	0.679		
	Total	128.555	190			
Strategies	Between Groups	0.882	3	0.294	0.439	0.725
	Within Groups	123.304	184	0.670		
	Total	124.186	187			

* significant at $\alpha = .001$.

Transportation Management

The summary of descriptive statistics for the SCM Responsibility data of the Transportation Management concepts is provided in Table 35. The standard deviations indicate some disparity in the responses of the Total SCM group for a number of the nine identified concepts. Specifically, Mode and Carrier Selection (*SD* = .906), Domestic Documentation (*SD* = .952), International Documentation (*SD* = .957), Pricing (*SD* = .902), and Transportation Management Systems (*SD* =

.901) all produced standard deviations over .9. In addition, the Other group, while a small sample size, resulted in a high standard deviation for Transportation Management Systems (*SD* = .928).

Table 35

Transportation Management Comparison by SCM Responsibility

Transportation	Total SCM	Material	Physical Dist	Other	Total
Mode & Carrier Select					
n	113	15	54	9	191
M	2.451	2.133	2.667	2.333	2.482
SD	0.906	0.640	0.727	0.707	0.839
Law & Regulations					
n	113	15	55	9	192
M	1.947	1.867	1.964	2.111	1.953
SD	0.822	0.640	0.637	0.601	0.747
Indirect & Special Carrier					
n	112	15	54	9	190
M	1.804	1.667	2.037	2.000	1.868
SD	0.879	0.488	0.726	0.707	0.809
3PL & 4PL					
n	112	15	55	9	191
M	2.214	2.200	2.527	2.333	2.309
SD	0.832	0.676	0.663	0.707	0.777
Domestic Document					
n	113	15	55	9	192
M	2.071	1.933	2.309	2.111	2.130
SD	0.952	0.704	0.791	0.782	0.885
International Document					
n	112	15	55	9	191
M	2.054	1.933	2.236	2.111	2.099
SD	0.957	0.704	0.816	0.782	0.892
Pricing					
n	113	15	55	9	192
M	2.248	2.000	2.527	2.556	2.323
SD	0.902	0.756	0.836	0.527	0.868
Global Logistics					
n	113	15	54	9	191
M	2.389	2.267	2.574	2.222	2.424
SD	0.891	0.704	0.716	0.833	0.829
Transportation Management System					
n	113	15	55	9	192
M	2.212	2.000	2.236	2.111	2.198
SD	0.901	0.655	0.719	0.928	0.833

Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

A comparison of the means between the four SCM Responsibility segments for the Transportation Management concepts is provided in the ANOVA output in Table 36. Once again, while all the *p* values are well over α = .001, two of the lowest *p* values in the SCM disciplines analysis are found for the 3PL and 4PL (*p* = .097) and Pricing (*p* = .084) concept segments.

Table 36
Analysis of Variance Results: Transportation Management by SCM Responsibility

Transportation		*SS*	*df*	*MS*	*F*	*p*
Mode & Carrier Select	Between Groups	3.970	3	1.323	1.908	0.130
	Within Groups	129.716	187	0.694		
	Total	133.686	190			
Law & Regulations	Between Groups	0.347	3	0.116	0.205	0.893
	Within Groups	106.231	188	0.565		
	Total	106.578	191			
Indirect & Special Carrier	Between Groups	2.773	3	0.924	1.421	0.238
	Within Groups	120.938	186	0.650		
	Total	123.711	189			
3PL & 4PL	Between Groups	3.809	3	1.270	2.139	0.097
	Within Groups	110.966	187	0.593		
	Total	114.775	190			
Domestic Document	Between Groups	2.743	3	0.914	1.170	0.323
	Within Groups	147.001	188	0.782		
	Total	149.745	191			
International Document	Between Groups	1.682	3	0.561	0.702	0.552
	Within Groups	149.428	187	0.799		
	Total	151.110	190			
Pricing	Between Groups	4.986	3	1.662	2.248	0.084
	Within Groups	138.993	188	0.739		
	Total	143.979	191			
Global Logistics	Between Groups	2.089	3	0.696	1.013	0.388
	Within Groups	128.560	187	0.687		
	Total	130.649	190			
Transportation Management System	Between Groups	0.760	3	0.253	0.362	0.781
	Within Groups	131.719	188	0.701		
	Total	132.479	191			

* significant at $\alpha = .001$. Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

Distribution Management – Warehousing

The next SCM Responsibility group comparison includes of the descriptive statistics for six concepts of the Distribution Management discipline (see Table 37). A general agreement exists within the four SCM Responsibility

groups on the importance of each Distribution Management concept with most standard deviations below .89. There are however two exceptions; the Total SCM group produced a *SD* = .922 for the Warehouse Layout and Design concept, and the small Other group responses to Warehouse Management Systems resulted in a *SD* = 1.054, each indicating a disparity among group responses.

Table 37
Distribution Management - Warehousing Comparison by SCM Responsibility

Distribution Management	Total SCM	Material	Physical Dist	Other	Total
Whse. Purposes					
n	113	15	55	9	192
M	2.513	2.867	2.727	2.667	2.609
SD	0.781	0.834	0.732	0.866	0.778
Distribution Network Design					
n	113	15	55	9	192
M	2.602	2.600	2.545	2.556	2.583
SD	0.797	0.737	0.633	0.527	0.733
Whse. Specifications & Selection					
n	113	15	55	9	192
M	2.018	1.800	2.164	2.333	2.057
SD	0.876	0.676	0.739	0.707	0.820
Whse. Layout & Design					
n	113	15	55	9	192
M	1.841	1.733	2.073	2.222	1.917
SD	0.922	0.704	0.858	0.667	0.882
Whse. Operations					
n	113	14	54	9	190
M	2.274	2.286	2.426	2.222	2.316
SD	0.826	0.726	0.792	0.833	0.807
Whse. Management System					
n	112	15	55	9	191
M	2.188	2.133	2.273	2.111	2.204
SD	0.865	0.743	0.781	1.054	0.837

Note: Whse. = Warehouse

The Distribution Management analysis of variance comparison between SCM Responsibility groups is provided in Table 38. The resulting *p* values for all six Distribution Management concepts are higher than $\alpha = .001$ indicating no significant difference between each discipline groups average selection of level of mastery expected.

Table 38
Analysis of Variance Results: Distribution Management - Warehousing by SCM Responsibility

Distribution Management		*SS*	*df*	*MS*	*F*	*p*
Whse. Purposes	Between Groups	2.831	3	0.944	1.572	0.198
	Within Groups	112.873	188	0.600		
	Total	115.703	191			
Distribution Network Design	Between Groups	0.128	3	0.043	0.078	0.972
	Within Groups	102.538	188	0.545		
	Total	102.667	191			
Whse. Specifications & Selection	Between Groups	2.478	3	0.826	1.233	0.299
	Within Groups	125.892	188	0.670		
	Total	128.370	191			
Whse. Layout & Design	Between Groups	3.336	3	1.112	1.438	0.233
	Within Groups	145.331	188	0.773		
	Total	148.667	191			
Whse. Operations	Between Groups	0.941	3	0.314	0.478	0.698
	Within Groups	122.112	186	0.657		
	Total	123.053	189			
Whse. Management System	Between Groups	0.443	3	0.148	0.208	0.891
	Within Groups	132.594	187	0.709		
	Total	133.037	190			

* significant at $\alpha = .001$. Note: Whse. = Warehouse

Material Handling and Packaging

The SCM Responsibility grouped responses to the level of mastery question for the five Material Handling and Packaging concepts are presented in the descriptive statistics provided in Table 39. Once again there is a general

agreement within the SCM Responsibility groups on the level of mastery expected for all concepts except for Material Handling Principles where the Total SCM group and the Other group have high standard deviations; *SD* = .898 and *SD* = .972 respectively. Also, the Other group shows some disagreement with a SD = .928 for Auto Identification. The mean values for the SCM discipline groups are all relatively low indicating that the overall lower scores for the concepts in this discipline found in the total response analysis are also evident across all Responsibility groups.

Table 39
Material Handling and Packaging Comparison by SCM Responsibility

Material Handling & Packaging	Total SCM	Material	Physical Dist	Other	Total
MH Equipment Selection					
n	111	15	55	9	190
M	1.676	1.400	1.800	1.778	1.695
SD	0.865	0.737	0.730	0.667	0.811
MH Principles					
n	113	15	55	9	192
M	2.124	2.200	2.345	2.222	2.198
SD	0.898	0.862	0.751	0.972	0.858
Packaging Types & Purpose					
n	113	15	55	9	192
M	1.947	1.933	2.036	2.000	1.974
SD	0.822	0.704	0.693	0.707	0.769
Packaging Materials					
n	113	15	55	9	192
M	1.681	1.600	1.764	1.667	1.698
SD	0.805	0.632	0.666	0.707	0.747
Auto Identification					
n	112	15	55	9	191
M	2.232	2.200	2.200	2.111	2.215
SD	0.794	0.775	0.826	0.928	0.802

Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

The analysis of variance comparing the responses between the four SCM Responsibility groups related to the Material Handling and Packaging concepts is provided in Table 40. While there is some minor variability in the *p* values, the fact that all *p* values are greater than α = .001confirms there are no significant differences between the expected level of mastery between the discipline groups.

Table 40
Analysis of Variance Results: Material Handling and Packaging by SCM Responsibility

Material Handling & Packaging		*SS*	*df*	*MS*	*F*	*p*
MH Equipment Selection	Between Groups	2.015	3	0.672	1.022	0.384
	Within Groups	122.280	186	0.657		
	Total	124.295	189			
MH Principles	Between Groups	1.822	3	0.607	0.823	0.482
	Within Groups	138.657	188	0.738		
	Total	140.479	191			
Packaging Types & Purpose	Between Groups	0.328	3	0.109	0.183	0.908
	Within Groups	112.542	188	0.599		
	Total	112.870	191			
Packaging Materials	Between Groups	0.421	3	0.140	0.249	0.862
	Within Groups	106.058	188	0.564		
	Total	106.479	191			
Auto Identification	Between Groups	0.146	3	0.049	0.074	0.974
	Within Groups	122.053	187	0.653		
	Total	122.199	190			

* significant at α = .001. Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

Customer Service

The descriptive data of the summarized SCM Responsibility groups for the five Customer Service concepts is depicted in Table 41. The standard deviation for group is below .89 for all SCM group concept pairings except four. Both the Material and Other groups have standard deviations over. 90 for the Customer Service Role in SCM; SD = .910 and SD = .928 respectively, indicating

variability in responses within the groups. The Total SCM group has SD = .904 for Customer Service Strategies and SD = .906 for Customer Relationship Management again showing some variety in the expected level of mastery.

Table 41
Customer Service Comparison by SCM Responsibility

Customer Service	Total SCM	Material	Physical Dist	Other	Total
Distribution Channels					
n	113	15	55	9	192
M	2.469	2.533	2.545	2.667	2.505
SD	0.768	0.743	0.741	0.500	0.745
Customer Service Strategies					
n	113	15	55	9	192
M	2.575	2.400	2.473	2.444	2.526
SD	0.904	0.828	0.716	0.726	0.837
Role in SCM					
n	113	15	54	9	191
M	2.664	2.600	2.574	2.889	2.644
SD	0.809	0.910	0.716	0.928	0.794
Customer Relationship Management					
n	113	15	55	9	192
M	2.230	2.333	2.364	2.444	2.286
SD	0.906	0.617	0.802	0.882	0.854
Reverse Logistics					
n	113	15	55	9	192
M	2.239	2.000	2.236	2.111	2.214
SD	0.848	0.655	0.816	0.782	0.819

While the descriptive statistics indicate a small amount of variability within select group/concept data, the analysis of variance for the Customer Service concepts indicates strong agreement between the SCM Responsibility groups (see Table 42). With all *p* values at between $p = .711$ and $p = .835$ being greater than $\alpha = .001$, there is no significant differences between the means of the SCM Responsibility groups.

Table 42

Analysis of Variance Results: Customer Service by SCM Responsibility

Customer Service		*SS*	*df*	*MS*	*F*	*p*
Distribution Channels	Between Groups	0.484	3	0.161	0.287	0.835
	Within Groups	105.511	188	0.561		
	Total	105.995	191			
Customer Service Strategies	Between Groups	0.728	3	0.243	0.343	0.795
	Within Groups	133.142	188	0.708		
	Total	133.870	191			
Role in SCM	Between Groups	0.877	3	0.292	0.460	0.711
	Within Groups	118.914	187	0.636		
	Total	119.791	190			
Customer Relationship Management	Between Groups	0.944	3	0.315	0.428	0.733
	Within Groups	138.301	188	0.736		
	Total	139.245	191			
Reverse Logistics	Between Groups	0.880	3	0.293	0.433	0.730
	Within Groups	127.365	188	0.677		
	Total	128.245	191			

* significant at $\alpha = .001$.

Information Systems and Technology

The seven Information System and Technology concepts generated a wide variety of responses within the SCM Responsibility groups (see Table 43). The small sample size Other group had the greatest disparity of responses with six of the seven concept standard deviations exceeding .92. The Total SCM respondents varied for SCM Data Collection (*SD* = .947) and Systems Analysis and Design (*SD* = .949), while the Material groups responses varied for IS and IT Assessment and Selection (*SD* = .926). These higher standard deviations indicate disagreement among the members regarding the level of mastery for these concepts.

Table 43
Information Systems and Technology Comparison by SCM Responsibility

Information Systems & Technology	Total SCM	Material	Physical Dist	Other	Total
Enterprise Resource Planning					
n	113	15	54	9	191
M	2.336	2.467	2.333	2.333	2.346
SD	0.841	0.834	0.727	1.000	0.812
Decision Support Systems					
n	113	15	55	9	192
M	2.115	2.200	1.982	2.444	2.099
SD	0.843	0.775	0.733	1.014	0.816
E-Business					
n	113	15	54	9	191
M	2.106	1.933	2.093	2.333	2.099
SD	0.817	0.594	0.807	1.000	0.805
SCM Data Collection					
n	113	15	55	9	192
M	2.239	2.067	2.309	2.556	2.260
SD	0.947	0.884	0.879	0.882	0.918
Auto ID & Voice					
n	113	15	55	9	192
M	2.053	2.000	2.055	2.111	2.052
SD	0.854	0.756	0.870	0.928	0.848
Systems Analysis & Design					
n	112	15	55	9	191
M	1.982	1.800	1.927	2.111	1.958
SD	0.949	0.775	0.858	1.054	0.911
IS & IT Assessment & Selection					
n	112	15	54	9	190
M	1.848	2.000	1.852	2.111	1.874
SD	0.872	0.926	0.878	1.054	0.882

Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

The Information Systems and Technology concepts between SCM Responsibility groups resulted in high *p* values for all seven concepts ranging from *p* = .391 for Decision Support Systems to *p* = .992 for Auto ID & Voice (see

Table 44). Given all *p* values are greater than α = .001 there is no significant difference between the means of each group.

Table 44
Analysis of Variance Results: Information Systems and Technology by SCM Responsibility

Information Systems and Technology		*SS*	*df*	*MS*	*F*	*p*
Enterprise Resource Planning	Between Groups	0.239	3	0.080	0.119	0.949
	Within Groups	124.955	187	0.668		
	Total	125.194	190			
Decision Support Systems	Between Groups	2.011	3	0.670	1.007	0.391
	Within Groups	125.108	188	0.665		
	Total	127.120	191			
E-Business	Between Groups	0.914	3	0.305	0.466	0.706
	Within Groups	122.196	187	0.653		
	Total	123.110	190			
SCM Data Collection	Between Groups	1.529	3	0.510	0.601	0.615
	Within Groups	159.450	188	0.848		
	Total	160.979	191			
Auto ID & Voice	Between Groups	0.072	3	0.024	0.033	0.992
	Within Groups	137.407	188	0.731		
	Total	137.479	191			
Systems Analysis & Design	Between Groups	0.703	3	0.234	0.279	0.840
	Within Groups	156.962	187	0.839		
	Total	157.665	190			
IS & IT Assessment & Selection	Between Groups	0.845	3	0.282	0.359	0.783
	Within Groups	146.123	186	0.786		
	Total	146.968	189			

* significant at α = .001. Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

General Skills for SCM

The final knowledge and skills category includes eleven business concept of importance to SCM. The descriptive statistics provided in Table 45 indicate a

general agreement within the SCM Responsibility groups for most concepts. Once again the small sample size Other group produced a number of within group high standard deviations including; Cross-Functional Teams (*SD* = 1.014), Project Management (*SD* = 1.054), Negotiations (*SD* = 1.000), and the largest variation in the all SCM disciplines group assessments, Ethics (*SD* = 1.453). Both Total SCM and Physical Distribution produced some in group variability in Simulation Modeling concept with SD = .928 and SD = .920, respectively. Finally, the Material group had some disparity of responses in the Ethics concept assessment with SD = .910.

Table 45

General Skills for SCM Comparison by SCM Responsibility

General Skills	Total SCM	Material	Physical Dist	Other	Total
Cross-Functional Teams					
n	112	15	55	9	191
M	2.741	3.000	2.709	2.444	2.738
SD	0.780	0.655	0.762	1.014	0.778
Six Sigma					
n	113	15	55	9	192
M	2.195	2.133	2.327	2.111	2.224
SD	0.800	0.743	0.840	0.782	0.804
Lean					
n	112	15	55	9	191
M	2.366	2.200	2.345	2.333	2.346
SD	0.783	0.676	0.844	0.707	0.785
Process Mapping					
n	113	14	54	9	190
M	2.779	2.714	2.722	3.000	2.768
SD	0.894	0.825	0.763	0.707	0.841
Project Management					
n	113	15	55	9	192
M	2.770	2.800	2.764	2.889	2.776
SD	0.886	0.862	0.860	1.054	0.878

Table 45 (continued)

General Skills for SCM Comparison by SCM Responsibility

General Skills	Total SCM	Material	Physical Dist	Other	Total
Simulation Modeling					
n	113	15	54	9	191
M	2.177	2.333	2.148	2.111	2.178
SD	0.928	0.724	0.920	0.782	0.900
Communications					
n	113	15	55	9	192
M	3.204	3.333	3.327	3.444	3.260
SD	0.734	0.724	0.640	0.726	0.705
Problem Solving & Decision Making					
n	113	15	55	9	192
M	3.159	3.333	3.200	3.444	3.198
SD	0.689	0.816	0.590	0.726	0.673
Ethics					
n	113	15	55	9	192
M	3.301	3.400	3.455	2.889	3.333
SD	0.778	0.910	0.715	1.453	0.814
Negotiations					
n	113	15	55	9	192
M	2.575	2.667	2.673	2.333	2.599
SD	0.843	0.816	0.840	1.000	0.844
Computer PC Office					
n	113	14	55	9	191
M	3.292	3.500	3.600	3.333	3.398
SD	0.677	0.650	0.655	0.707	0.680

The between group analysis of variance for the eleven General Skills for SCM concepts by SCM Responsibility groups is provided in Table 46. All *p* values are well above $\alpha = .001$ with the lowest being Ethics ($p = .244$) thus indicating no significant difference between SCM discipline groups for all concepts.

Table 46
Analysis of Variance Results: General Skills for SCM by SCM Responsibility

General Skills		*SS*	*df*	*MS*	*F*	*p*
Cross-Functional Teams	Between Groups	1.852	3	0.617	1.021	0.384
	Within Groups	113.059	187	0.605		
	Total	114.911	190			
Six Sigma	Between Groups	0.922	3	0.307	0.472	0.702
	Within Groups	122.448	188	0.651		
	Total	123.370	191			
Lean	Between Groups	0.366	3	0.122	0.195	0.899
	Within Groups	116.827	187	0.625		
	Total	117.194	190			
Process Mapping	Between Groups	0.651	3	0.217	0.303	0.823
	Within Groups	133.160	186	0.716		
	Total	133.811	189			
Project Management	Between Groups	0.136	3	0.045	0.058	0.982
	Within Groups	147.234	188	0.783		
	Total	147.370	191			
Simulation Modeling	Between Groups	0.450	3	0.150	0.183	0.908
	Within Groups	153.497	187	0.821		
	Total	153.948	190			
Communications	Between Groups	0.996	3	0.332	0.664	0.575
	Within Groups	93.983	188	0.500		
	Total	94.979	191			
Problem Solving & Decision Making	Between Groups	0.991	3	0.330	0.726	0.537
	Within Groups	85.488	188	0.455		
	Total	86.479	191			
Ethics	Between Groups	2.772	3	0.924	1.402	0.244
	Within Groups	123.895	188	0.659		
	Total	126.667	191			
Negotiations	Between Groups	1.067	3	0.356	0.495	0.686
	Within Groups	135.053	188	0.718		
	Total	136.120	191			
Computer PC Office	Between Groups	3.696	3	1.232	2.741	0.045
	Within Groups	84.063	187	0.450		
	Total	87.759	190			

* significant at $\alpha = .001$.

SCM Discipline Ranking

The descriptive statistics from the SCM Responsibility group responses to the question of the ranking of importance for each of the previously assessed SCM disciplines resulted in a great deal of variety within groups. Table 47 provides the descriptive results and recognizing the nine point scale rather than the previous five point scale, the standard deviations indicate greater disparity among respondents in each group. The greatest agreement is found in the Material group on the ranking of Transportation (*SD* = 1.246) and Supply Management (*SD* = 1.496), while the greatest disparity is in the Other group on the ranking of Material Handling and Packaging (*SD* = 3.480) and Total SCM on the ranking of Customer Service (*SD* = 3.006). As mentioned earlier, the forced ranking of SCM disciplines has produced a wide variety of responses when looking at all respondents, and the SCM Responsibility groups analysis uncovered some areas of stronger agreement and some areas of wider disparity of responses.

Table 47
SCM Discipline Ranking by SCM Responsibility

SCM Ranking	Total SCM	Material	Physical Dist	Other	Total
Forecasting					
n	103	14	51	9	177
M	4.437	3.571	4.627	4.222	4.412
SD	2.492	2.409	2.416	2.438	2.455
Production Inventory Planning					
n	105	15	54	9	183
M	4.333	3.333	4.407	4.000	4.257
SD	2.601	1.759	2.327	2.398	2.453
Supply Management					
n	104	15	51	9	179
M	4.510	2.333	4.118	3.778	4.179
SD	2.208	1.496	2.286	2.333	2.251
Manufacturing					
n	103	15	52	9	179
M	5.058	5.200	5.596	5.444	5.246
SD	2.187	2.274	2.225	2.698	2.225
Transportation					
n	103	15	51	9	178
M	5.087	5.467	4.784	4.556	5.006
SD	2.170	1.246	2.318	2.007	2.141
Distribution Management - Warehousing					
n	105	15	51	9	180
M	5.343	7.000	5.706	6.556	5.644
SD	2.209	1.512	2.326	1.740	2.216
Material Handling & Packaging					
n	105	15	52	9	181
M	6.343	7.667	6.462	6.111	6.475
SD	2.928	2.289	2.776	3.480	2.867
Customer Service					
n	110	15	53	9	187
M	4.891	5.800	4.321	4.111	4.765
SD	3.006	2.704	2.687	2.522	2.883
Information Systems & Technology					
n	110	15	53	9	187
M	5.391	4.267	4.981	6.222	5.225
SD	2.560	2.187	2.938	2.635	2.658

A review of the between group responses for the SCM discipline ranking by SCM discipline groups produced the strongest indication of disagreement (see Table 48). While most of the *p* values are well above α = .001, the Warehousing discipline has *p* = .026 and Supply Management a *p* = .005. To avoid the risk of Type I error in stating these two disciplines have no significant differences in responses between SCM Responsibility groups, a Scheffe posttest was run for each. Despite the very low *p* values the Scheffe test results indicate no significant differences between groups for Warehousing (*p* = .137) with the greatest disparity between Material and Physical Distribution (*p* = .059) both greater than α = .001. While there appears to me more disparity with between group responses for Supply Management the Scheffe results again indicate no significant differences between groups (*p* = .097) with the greatest difference between Material and Physical Distribution (*p* = .006).

Table 48

Analysis of Variance Results: SCM Discipline Ranking by SCM Responsibility

Discipline Ranking		*SS*	*df*	*MS*	*F*	*p*
Forecasting	Between Groups	12.647	3	4.216	0.696	0.556
	Within Groups	1048.246	173	6.059		
	Total	1060.893	176			
Production Inventory Planning	Between Groups	15.225	3	5.075	0.841	0.473
	Within Groups	1079.704	179	6.032		
	Total	1094.929	182			
Supply Management	Between Groups	64.106	3	21.369	4.462	0.005
	Within Groups	838.173	175	4.790		
	Total	902.279	178			
Manufacturing	Between Groups	10.392	3	3.464	0.696	0.556
	Within Groups	870.792	175	4.976		
	Total	881.184	178			
Transportation	Between Groups	8.198	3	2.733	0.592	0.621
	Within Groups	802.797	174	4.614		
	Total	810.994	177			
Distribution Management - Warehousing	Between Groups	44.777	3	14.926	3.148	0.026
	Within Groups	834.468	176	4.741		
	Total	879.244	179			
Material Handling & Packaging	Between Groups	24.336	3	8.112	0.987	0.400
	Within Groups	1454.802	177	8.219		
	Total	1479.138	180			
Customer Service	Between Groups	32.120	3	10.707	1.295	0.278
	Within Groups	1513.527	183	8.271		
	Total	1545.647	186			
Information Systems & Technology	Between Groups	28.906	3	9.635	1.371	0.253
	Within Groups	1285.661	183	7.025		
	Total	1314.567	186			

* significant at $\alpha = .001$.

Dissertation Question 3

H3: SCM majors are expected to possess the same knowledge, skills, and abilities by all industries.

The final question focuses on determining if there are any differences in expectations of the knowledge, skills, and abilities of SCM higher education graduates based on industries. Specifically, do the respondents place different values on the disciplines, or the concepts in each discipline, because of industry affiliation?

In the demographics segment of the survey the respondents were asked to identify the industry in which they work. The input of the respondents from the three resulting aggregation groups, Manufacturing, Wholesale-Distribution-Retail (WDR), and Service were compared and the results presented below. The descriptive statistics and Analysis of Variance (ANOVA) with appropriate post-hoc test of the data for each of the 12 question categories are reviewed below to assess the level of agreement between industry leaders on the SCM knowledge, skills, and abilities required for success.

Given that each respondent was asked a total of 78 questions and a desire to establish an 95% confidence level, the level of significance that is used to assess each question is an $\alpha = .001$ (.05/78 = .000641).

General SCM Knowledge

A review of the descriptive statistics for the responses to the General SCM Knowledge questions from the perspective of the three Industry groups is provided in Table 49. With most of the standard deviations below .9 there is general agreement within each industry group for all concepts except the WDR group with SCM Strategy

(*SD* = .950) and the Service group for SCM Integration (*SD* = .935). A review of the means identifies that the Service industry has a slightly higher level of mastery expectation for all concepts compared to the other groups, except for SCM Abbreviations (*SD* = 2.892) and SCM in the Value Chain (*SD* = 2.778).

Table 49
General SCM Knowledge Comparison by Industry

General SCM Knowledge	Manufacturing	WDR	Service	Total
SCM Scope				
n	74	35	82	191
M	3.149	2.943	3.159	3.115
SD	0.734	0.639	0.761	0.731
SCM Abbreviations				
n	75	35	83	193
M	2.907	2.686	2.892	2.860
SD	0.791	0.676	0.716	0.740
Corporate Profitability				
n	75	35	82	192
M	2.707	2.714	2.841	2.766
SD	0.818	0.667	0.777	0.774
SCM Strategy				
n	75	35	83	193
M	2.467	2.457	2.627	2.534
SD	0.875	0.950	0.879	0.890
SCM Metrics				
n	74	35	83	192
M	2.919	2.943	3.036	2.974
SD	0.790	0.765	0.740	0.762
SCM Integration				
n	74	35	82	191
M	2.595	2.686	2.646	2.634
SD	0.792	0.832	0.935	0.859
SCM in Value Chain				
n	75	35	81	191
M	2.827	2.743	2.778	2.791
SD	0.760	0.780	0.742	0.753

Note: SCM = Supply Chain Management

The results of an ANOVA comparing the means of the three Industry groups for the six General Knowledge questions are presented in Table 50. The results indicate limited variability in the average responses for each group for all concepts with the mean square (*MS*) results closely aligned. The resulting *p* values are significantly greater than α = .001, therefore there is no evidence that any difference exists between the General SCM Knowledge requirements based on industry needs.

Table 50
Analysis of Variance Results: General SCM Knowledge by Industry

SCM General Knowledge		*SS*	*df*	*MS*	*F*	*p*
SCM Scope	Between Groups	1.276	2	0.638	1.198	0.304
	Within Groups	100.190	188	0.533		
	Total	101.466	190			
SCM Abbreviations	Between Groups	1.309	2	0.655	1.197	0.304
	Within Groups	103.914	190	0.547		
	Total	105.223	192			
Corp Profitability	Between Groups	0.825	2	0.412	0.686	0.505
	Within Groups	113.629	189	0.601		
	Total	114.453	191			
SCM Strategy	Between Groups	1.257	2	0.629	0.792	0.454
	Within Groups	150.774	190	0.794		
	Total	152.031	192			
SCM Metrics	Between Groups	0.579	2	0.289	0.496	0.610
	Within Groups	110.291	189	0.584		
	Total	110.870	191			
SCM Integration	Between Groups	0.221	2	0.110	0.148	0.862
	Within Groups	140.125	188	0.745		
	Total	140.346	190			
SCM in Value Chain	Between Groups	0.191	2	0.095	0.167	0.846
	Within Groups	107.432	188	0.571		
	Total	107.623	190			

* significant at α = .001. Note: SCM = Supply Chain Management

Forecasting

A summary of the descriptive statistics for the six forecasting concepts by the three Industry groups shows general agreement within industries given most standard

deviations below .9 (see Table 51). The standard deviation indicates some level of disagreement with the WDR group on Model Development (*SD* = .900) and Model Execution (*SD* = .950), and the Service group responses varied for CPFR (*SD* = .902). While group means are close for each concept, the manufacturing sector has the highest level of mastery expectations for all Forecasting concepts.

Table 51
Forecasting Comparison by Industry

Forecasting	Manufacturing	WDR	Service	Total
Role in SCM				
n	75	35	82	192
M	2.787	2.714	2.695	2.734
SD	0.741	0.825	0.697	0.736
Data sources				
n	75	34	83	192
M	2.493	2.353	2.361	2.411
SD	0.760	0.734	0.774	0.761
Model development				
n	75	35	83	193
M	2.493	2.314	2.289	2.373
SD	0.876	0.900	0.863	0.875
Model execution				
n	74	35	82	191
M	2.432	2.257	2.268	2.330
SD	0.877	0.950	0.890	0.895
APS				
n	74	35	83	192
M	2.378	2.286	2.120	2.250
SD	0.789	0.825	0.802	0.806
CPFR				
n	75	35	83	193
M	2.333	2.314	2.229	2.285
SD	0.723	0.832	0.902	0.821

Note: SCM = Supply Chain Management. APS = Advanced Planning and Scheduling. CPFR = Collaborative Planning Forecasting and Replenishment.

Comparing the means of the three industry segments for each of the six Forecasting concept with analysis of variance, there is no indication of significant differences as all *p* values are much greater than α = .001 (see Table 52).

Table 52
Analysis of Variance Results: Forecasting by Industry

Forecasting		*SS*	*df*	*MS*	*F*	*p*
Role in SCM	Between Groups	0.346	2	0.173	0.317	0.729
	Within Groups	103.108	189	0.546		
	Total	103.453	191			
Data sources	Between Groups	0.827	2	0.413	0.712	0.492
	Within Groups	109.668	189	0.580		
	Total	110.495	191			
Model development	Between Groups	1.790	2	0.895	1.170	0.313
	Within Groups	145.350	190	0.765		
	Total	147.140	192			
Model execution	Between Groups	1.274	2	0.637	0.794	0.454
	Within Groups	150.945	188	0.803		
	Total	152.220	190			
APS	Between Groups	2.657	2	1.328	2.069	0.129
	Within Groups	121.343	189	0.642		
	Total	124.000	191			
CPFR	Between Groups	0.466	2	0.233	0.344	0.710
	Within Groups	128.860	190	0.678		
	Total	129.326	192			

* significant at α = .001

Production and Inventory Planning

Comparing the survey results by Industry group for the six concepts that are part of Production and Inventory Planning, it is evident that there is general agreement within the groups as the standard deviations are all below .889 (see Table 53). While the means are close for all concepts, Manufacturing respondents have slightly higher expectations of concept mastery for all but Inventory Costing by the Service group (*M* = 2.691) and DRP by the WDR group (*M* = 2.571).

Table 53

Production & Inventory Planning Comparison by Industry

Production Planning & Inventory Planning	Manufacturing	WDR	Service	Total
Production Planning Models				
n	75	35	82	192
M	2.640	2.486	2.415	2.516
SD	0.729	0.702	0.628	0.686
Inventory Techniques				
n	74	34	82	190
M	2.959	2.882	2.756	2.858
SD	0.691	0.686	0.746	0.717
Inventory Costing				
n	74	35	81	190
M	2.527	2.543	2.691	2.600
SD	0.744	0.817	0.769	0.768
SOP				
n	75	35	81	191
M	2.560	2.543	2.407	2.492
SD	0.826	0.886	0.787	0.820
DRP				
n	75	35	81	191
M	2.480	2.571	2.444	2.482
SD	0.777	0.778	0.837	0.800
Inventory Collaboration -VMI				
n	75	35	81	191
M	2.427	2.143	2.321	2.330
SD	0.756	0.772	0.819	0.789

The results of an ANOVA comparing the means of the Industry groups for the Production and Inventory Planning concepts are presented in Table 54. The most variability between group responses was found in Production Planning Models (p = .116), however with all concept comparison p values well above $\alpha = .001$, there is no indication that a difference exists between the industry groups regarding the level of mastery expected for the Production and Inventory Planning concepts.

Table 54
Analysis of Variance Results: Production & Inventory Planning by Industry

Production & Inventory Planning		*SS*	*df*	*MS*	*F*	*p*
Production Planning Models	Between Groups	2.028	2	1.014	2.179	0.116
	Within Groups	87.925	189	0.465		
	Total	89.953	191			
Inventory Techniques	Between Groups	1.633	2	0.817	1.599	0.205
	Within Groups	95.530	187	0.511		
	Total	97.163	189			
Inventory Costing	Between Groups	1.184	2	0.592	1.003	0.369
	Within Groups	110.416	187	0.590		
	Total	111.600	189			
SOP	Between Groups	1.017	2	0.508	0.754	0.472
	Within Groups	126.721	188	0.674		
	Total	127.738	190			
DRP	Between Groups	0.394	2	0.197	0.306	0.737
	Within Groups	121.291	188	0.645		
	Total	121.686	190			
Inventory Collaboration -VMI	Between Groups	1.933	2	0.967	1.563	0.212
	Within Groups	116.287	188	0.619		
	Total	118.220	190			

* significant at $\alpha = .001$

Supply Management

The Industry group comparison of descriptive statistics for the nine concepts identified in Supply Management provided insight into the general agreement within the groups (see Table 55). However, of the 27 within group comparisons, 17 had standard deviations between *SD* = .803 and *SD* = .895. The Service group results for Master Scheduling had the least variability with *SD* = .699 and WDR displayed the greatest variability with responses related to Supplier Assessment *SD* = .910.

Table 55

Supply Management Comparison by Industry

Supply Management	Manufacturing	WDR	Service	Total
Master Scheduling				
n	75	35	82	192
M	2.440	2.286	2.256	2.333
SD	0.758	0.893	0.699	0.761
Purchasing				
n	73	35	83	191
M	2.301	1.943	2.337	2.251
SD	0.828	0.765	0.769	0.801
Supplier Assessment				
n	75	35	81	191
M	2.467	2.229	2.358	2.377
SD	0.890	0.910	0.780	0.849
Procurement Strategy				
n	74	34	83	191
M	2.473	2.147	2.325	2.351
SD	0.895	0.857	0.798	0.851
Contract Law				
n	75	35	83	193
M	1.893	1.686	2.012	1.907
SD	0.847	0.758	0.804	0.818
Spend Analysis & TCO				
n	75	35	83	193
M	2.573	2.486	2.530	2.539
SD	0.756	0.887	0.846	0.816
Strategic Sourcing				
n	75	35	83	193
M	2.520	2.171	2.349	2.383
SD	0.875	0.891	0.803	0.853
Supplier Collaboration				
n	75	35	82	192
M	2.320	2.286	2.244	2.281
SD	0.808	0.825	0.883	0.840
Profitability Impact				
n	75	33	83	191
M	2.613	2.545	2.843	2.702
SD	0.820	0.869	0.773	0.814

Note: TCO = Total Cost of Ownership

The analysis of variance for Supply Management responses between Industry groups produced *p* values exceeding α = .001, therefore indicating no significant differences (see Table 56). Two concepts, Purchasing and Profitability Impact, have low *p* values of *p* = .039 and *p* = 099 and a Scheffe posttest was run to reduce the risk of Type I error. The overall Purchasing concept Scheffe test results were not significant (*p* = .061), and the greatest variability was found between WDR and Service (*p* = .049). The Profitability Impact concept Scheffe results were stronger with total concept *p* = .164.

Table 56
Analysis of Variance Results: Supply Management by Industry Segment

Supply Management		*SS*	*df*	*MS*	*F*	*p*
Master Scheduling	Between Groups	1.422	2	0.711	1.230	0.295
	Within Groups	109.245	189	0.578		
	Total	110.667	191			
Purchasing	Between Groups	4.127	2	2.064	3.293	0.039
	Within Groups	117.810	188	0.627		
	Total	121.937	190			
Supplier Assessment	Between Groups	1.403	2	0.702	0.974	0.380
	Within Groups	135.455	188	0.721		
	Total	136.859	190			
Procurement Strategy	Between Groups	2.570	2	1.285	1.790	0.170
	Within Groups	134.928	188	0.718		
	Total	137.497	190			
Contract Law	Between Groups	2.644	2	1.322	1.998	0.138
	Within Groups	125.677	190	0.661		
	Total	128.321	192			
Spend Analysis & TCO	Between Groups	0.194	2	0.097	0.144	0.866
	Within Groups	127.764	190	0.672		
	Total	127.959	192			
Strategic Sourcing	Between Groups	3.068	2	1.534	2.134	0.121
	Within Groups	136.559	190	0.719		
	Total	139.627	192			
Supplier Collaboration	Between Groups	0.228	2	0.114	0.160	0.852
	Within Groups	134.585	189	0.712		
	Total	134.813	191			
Profitability Impact	Between Groups	3.057	2	1.529	2.338	0.099
	Within Groups	122.932	188	0.654		
	Total	125.990	190			

* significant at $\alpha = .001$.

Manufacturing

The descriptive statistics for the Industry group assessment of the seven concepts of the Manufacturing discipline are provided in Table 57. The within Industry group responses are generally consistent with all standard deviations less than .9 except; the Service group responses to Plant Layout and Design (*SD* = .919) and the Manufacturing

responses to Manufacturing Resource Planning (*SD* = .919) and Lean Manufacturing (*SD* = .998) indicating a more widely distributed set of responses.

Table 57
Manufacturing Comparison by Industry

Manufacturing	Manufacturing	WDR	Service	Total
Production Scheduling				
n	74	35	83	192
M	2.338	2.200	2.265	2.281
SD	0.745	0.833	0.717	0.748
Total Quality Management				
n	74	34	83	191
M	2.297	2.265	2.277	2.283
SD	0.772	0.864	0.816	0.804
Lean Manufacturing				
n	73	35	83	191
M	2.397	2.343	2.373	2.377
SD	0.702	0.998	0.792	0.798
Six Sigma				
n	74	35	83	192
M	2.297	2.029	2.337	2.266
SD	0.823	0.747	0.816	0.810
Manufacturing Resource Planning				
n	73	35	83	191
M	2.370	2.257	2.265	2.304
SD	0.717	0.919	0.798	0.789
Plant Layout & Design				
n	74	35	83	192
M	1.662	1.429	1.759	1.661
SD	0.708	0.778	0.919	0.822
Strategies				
n	74	34	81	189
M	2.230	1.971	2.086	2.122
SD	0.803	0.797	0.825	0.813

The analysis of variance comparing the responses between the Industry groups for the Manufacturing concepts is provided in Table 58. The strong agreement between the groups is reflected in the *p* values all significantly larger than $\alpha = .001$, and with the

greatest differences evident in Six Sigma (p = .153) and Plant Layout and Design (p = .137).

Table 58
Analysis of Variance Results: Manufacturing by Industry

Manufacturing		*SS*	*df*	*MS*	*F*	*p*
Production Scheduling	Between Groups	0.490	2	0.245	0.435	0.648
	Within Groups	106.323	189	0.563		
	Total	106.813	191			
Total Quality Management	Between Groups	0.029	2	0.015	0.023	0.978
	Within Groups	122.704	188	0.653		
	Total	122.733	190			
Lean Manufacturing	Between Groups	0.072	2	0.036	0.056	0.946
	Within Groups	120.787	188	0.642		
	Total	120.859	190			
Six Sigma	Between Groups	2.468	2	1.234	1.896	0.153
	Within Groups	122.985	189	0.651		
	Total	125.453	191			
Manufacturing Resource Planning	Between Groups	0.519	2	0.260	0.414	0.661
	Within Groups	117.868	188	0.627		
	Total	118.387	190			
Plant Layout & Design	Between Groups	2.689	2	1.344	2.012	0.137
	Within Groups	126.306	189	0.668		
	Total	128.995	191			
Strategies	Between Groups	1.741	2	0.870	1.322	0.269
	Within Groups	122.460	186	0.658		
	Total	124.201	188			

* significant at $\alpha = .001$.

Transportation Management

The descriptive statistics for the Industry groups' responses to the nine Transportation Management concepts reflect a general agreement within the groups as to the level of mastery expected of an SCM graduate (see Table 59). The largest variability within a group is found in the Manufacturing group for the Domestic Documentation (*SD*

= .920) and International Documentation (*SD* = .963), and WDR group for the transportation Pricing concept (*SD* = .980). The strongest agreement is found in the relatively low mean score of *M* = 1.857 by the WDR group for Law and Regulations (*SD* = .692).

Table 59

Transportation Management Comparison by Industry

Transportation	Manufacturing	WDR	Service	Total
Mode & Carrier Selection				
n	75	35	82	192
M	2.413	2.543	2.512	2.479
SD	0.824	0.852	0.850	0.837
Law & Regulations				
n	75	35	83	193
M	2.000	1.857	1.952	1.953
SD	0.788	0.692	0.731	0.745
Indirect & Special Carrier				
n	75	35	81	191
M	1.827	1.829	1.914	1.864
SD	0.778	0.857	0.825	0.809
3PL & 4PL				
n	75	35	82	192
M	2.280	2.257	2.354	2.307
SD	0.798	0.886	0.709	0.776
Domestic Document				
n	75	35	83	193
M	2.067	1.971	2.241	2.124
SD	0.920	0.785	0.892	0.887
International Document				
n	75	34	83	192
M	2.067	2.059	2.133	2.094
SD	0.963	0.736	0.894	0.893
Pricing				
n	75	35	83	193
M	2.267	2.257	2.386	2.316
SD	0.827	0.980	0.867	0.871
Global Logistics				
n	75	35	82	192
M	2.400	2.400	2.451	2.422
SD	0.854	0.847	0.804	0.828
Transportation Management System				
n	75	35	83	193
M	2.013	2.257	2.337	2.197
SD	0.814	0.741	0.859	0.831

Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

A comparison of the means between the Industry groups for the Transportation Management concepts is provided in Table 60. Eight of the nine Transportation concept responses are generally constant between the Industry groups with *p* values ranging from $p = .249$ to $p = .915$, all well above $\alpha = .001$. Only the Transportation Management System concept has an $F = 3.179$ and a $p = .044$ and a Scheffe posttest was run to reduce the risk of Type I error. The results of the posttest indicate the greatest difference in responses between Manufacturing and Service ($p = .049$) and an overall Industry group comparison with a $p = .118$. With both well above $\alpha = .001$; there is no significant difference between the groups.

Table 60
Analysis of Variance Results: Transportation Management by Industry

Transportation		*SS*	*df*	*MS*	*F*	*p*
Mode & Carrier Select	Between Groups	0.556	2	0.278	0.394	0.675
	Within Groups	133.360	189	0.706		
	Total	133.917	191			
Law & Regulations	Between Groups	0.487	2	0.244	0.436	0.647
	Within Groups	106.093	190	0.558		
	Total	106.580	192			
Indirect & Special Carrier	Between Groups	0.348	2	0.174	0.263	0.769
	Within Groups	124.113	188	0.660		
	Total	124.461	190			
3PL & 4PL	Between Groups	0.320	2	0.160	0.264	0.768
	Within Groups	114.550	189	0.606		
	Total	114.870	191			
Domestic Document	Between Groups	2.197	2	1.098	1.402	0.249
	Within Groups	148.819	190	0.783		
	Total	151.016	192			
International Document	Between Groups	0.221	2	0.111	0.138	0.872
	Within Groups	152.091	189	0.805		
	Total	152.313	191			
Pricing	Between Groups	0.705	2	0.353	0.462	0.631
	Within Groups	145.015	190	0.763		
	Total	145.720	192			
Global Logistics	Between Groups	0.123	2	0.062	0.089	0.915
	Within Groups	130.705	189	0.692		
	Total	130.828	191			
Transportation Management System	Between Groups	4.292	2	2.146	3.179	0.044
	Within Groups	128.227	190	0.675		
	Total	132.518	192			

* significant at α = .001. Note: 3PL = Third Party Logistics. 4PL = Fourth Party Logistics

Distribution Management – Warehousing

A review of the descriptive statistics for the Industry groups' responses regarding the level of mastery for six Distribution Management concepts is provided in Table 61. Once again, within the Industry groups there is general agreement on for all concepts

except for the Manufacturing group regarding Warehouse Layout and Design (*SD* = .926). The strongest level of agreement is found for the Distribution Network Design concept by the Service group (*SD* = .686).

Table 61
Distribution Management - Warehousing Comparison by Industry

Distribution Management	Manufacturing	WDR	Service	Total
Whse. Purposes				
n	75	35	83	193
M	2.560	2.486	2.699	2.606
SD	0.758	0.853	0.761	0.778
Distribution Network Design				
n	75	35	83	193
M	2.493	2.600	2.663	2.585
SD	0.724	0.847	0.686	0.732
Whse. Specification & Selection				
n	75	35	83	193
M	1.933	2.057	2.169	2.057
SD	0.844	0.838	0.778	0.818
Whse. Layout & Design				
n	75	35	83	193
M	1.813	1.943	1.988	1.912
SD	0.926	0.873	0.848	0.882
Whse. Operations				
n	74	34	83	191
M	2.216	2.324	2.398	2.314
SD	0.763	0.878	0.811	0.805
Whse. Management System				
n	75	35	82	192
M	2.027	2.343	2.305	2.203
SD	0.838	0.838	0.812	0.835

Note: Whse. = Warehouse.

The analysis of variance for between Industry group responses for the Distribution Management concepts is provided in Table 62. All Distribution Management concept *p* values are greater than $\alpha = .001$ and therefore there is no difference in Industry group expectations. The lowest of the Distribution Management concept *p* values is

found with Warehouse Management System (p = .062). A Scheffe posttest comparing the three Industry groups finds the greatest difference between Manufacturing and Service (p = .112) well above α = .001and therefore little risk of Type I error.

Table 62
Analysis of Variance Results: Distribution Management - Warehousing by Industry

Distribution Management		*SS*	*df*	*MS*	*F*	*p*
Whse. Purposes	Between Groups	1.380	2	0.690	1.143	0.321
	Within Groups	114.693	190	0.604		
	Total	116.073	192			
Distribution Network Design	Between Groups	1.138	2	0.569	1.063	0.347
	Within Groups	101.701	190	0.535		
	Total	102.839	192			
Whse. Specifications & Selection	Between Groups	2.182	2	1.091	1.643	0.196
	Within Groups	126.191	190	0.664		
	Total	128.373	192			
Whse. Layout & Design	Between Groups	1.242	2	0.621	0.796	0.453
	Within Groups	148.260	190	0.780		
	Total	149.503	192			
Whse. Operations	Between Groups	1.291	2	0.645	0.996	0.371
	Within Groups	121.861	188	0.648		
	Total	123.152	190			
Whse. Management System	Between Groups	3.868	2	1.934	2.829	0.062
	Within Groups	129.210	189	0.684		
	Total	133.078	191			

* significant at α = .001. Note: Whse. = Warehouse.

Material Handling and Packaging

A statistical analysis of the responses of the Industry groups regarding the five Material Handling and Packaging concepts was conducted and the descriptive statistics are provided in Table 63. The distribution of responses within the Industry groups is fairly consistent for all Material Handling and Packaging concepts except for MH Principles concept for the Manufacturing group (SD = .915).

Table 63
Material Handling & Packaging Comparison by Industry

Material Handling & Packaging	Manufacturing	WDR	Service	Total
MH Equipment Selection				
n	73	35	83	191
M	1.644	1.600	1.771	1.691
SD	0.872	0.812	0.754	0.810
MH Principles				
n	75	35	83	193
M	2.200	2.143	2.205	2.192
SD	0.915	0.772	0.852	0.860
Packaging Types & Purpose				
n	75	35	83	193
M	1.920	1.829	2.072	1.969
SD	0.749	0.664	0.823	0.770
Packaging Materials				
n	75	35	83	193
M	1.720	1.571	1.723	1.694
SD	0.648	0.698	0.846	0.746
Auto Identification				
n	75	34	83	192
M	2.213	2.206	2.217	2.214
SD	0.810	0.808	0.797	0.800

Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

An assessment of the differences between the Industry group responses for the Material Handling and Packaging concepts is presented in Table 64. While the Industry groups' means for the Material Handling and Packaging discipline are generally lower than the other SCM disciplines, the Industry groups are in general agreement on the level of mastery with *p* values ranging from Packaging Types and Purposes ($p = .228$) to Auto Identification ($p = .998$).

Table 64
Analysis of Variance Results: Material Handling & Packaging by Industry

Material Handling & Packaging		*SS*	*df*	*MS*	*F*	*p*
MH Equipment Selection	Between Groups	0.985	2	0.492	0.748	0.475
	Within Groups	123.790	188	0.658		
	Total	124.775	190			
MH Principles	Between Groups	0.103	2	0.051	0.069	0.933
	Within Groups	141.804	190	0.746		
	Total	141.907	192			
Packaging Types & Purpose	Between Groups	1.756	2	0.878	1.489	0.228
	Within Groups	112.058	190	0.590		
	Total	113.813	192			
Packaging Materials	Between Groups	0.646	2	0.323	0.577	0.563
	Within Groups	106.318	190	0.560		
	Total	106.964	192			
Auto Identification	Between Groups	0.003	2	0.001	0.002	0.998
	Within Groups	122.242	189	0.647		
	Total	122.245	191			

* significant at α = .001. Note: MH = Material Handling. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc.

Customer Service

The Industry groups' responses regarding the level of mastery for Customer Service concepts were analyzed and the descriptive statistics are provided in Table 65. While the overall variability within Industry groups is relatively small, the WDR group has higher variability of responses in three areas; Customer Relationship Management (*SD* = .910), Reverse Logistics (*SD* = .938), and Customer Service Strategies (*SD* = 1.035).

Table 65

Customer Service Comparison by Industry

Customer Service	Manufacturing	WDR	Service	Total
Distribution Channels				
n	75	35	83	193
M	2.453	2.371	2.602	2.503
SD	0.776	0.770	0.697	0.744
Customer Service Strategies				
n	75	35	83	193
M	2.560	2.400	2.542	2.523
SD	0.809	1.035	0.770	0.836
Role in SCM				
n	75	35	82	192
M	2.627	2.457	2.732	2.641
SD	0.785	0.886	0.754	0.793
Customer Relationship Management				
n	75	35	83	193
M	2.333	2.229	2.265	2.285
SD	0.844	0.910	0.842	0.852
Reverse Logistics				
n	75	35	83	193
M	2.120	2.057	2.361	2.212
SD	0.805	0.938	0.758	0.817

The analysis of variance by Industry groups for the five Customer Service concepts confirms there is no significant difference between the groups' results (see Table 66). The *p* values for the between group comparison for all concepts are greater than $\alpha = .001$.

Table 66
Analysis of Variance Results: Customer Service by Industry Segment

Customer Service		*SS*	*df*	*MS*	*F*	*p*
Distribution Channels	Between Groups	1.611	2	0.806	1.463	0.234
	Within Groups	104.638	190	0.551		
	Total	106.249	192			
Customer Service Strategies	Between Groups	0.663	2	0.331	0.472	0.625
	Within Groups	133.482	190	0.703		
	Total	134.145	192			
Role in SCM	Between Groups	1.873	2	0.937	1.496	0.227
	Within Groups	118.330	189	0.626		
	Total	120.203	191			
Customer Relationship Management	Between Groups	0.320	2	0.160	0.218	0.804
	Within Groups	139.007	190	0.732		
	Total	139.326	192			
Reverse Logistics	Between Groups	3.328	2	1.664	2.530	0.082
	Within Groups	124.962	190	0.658		
	Total	128.290	192			

* significant at $\alpha = .001$.

Information Systems and Technology

The descriptive statistics for the seven SCM Information Systems and Technology concepts assessed by the Industry groups provides insight into variability of response within the three groups (see Table 67). The Manufacturing groups concept responses are relatively consistent with standard deviations ranging from .726 to .850 for all concepts except SCM Data Collection (*SD* = .902), indicating some variability in expected content mastery. While the Service group results indicate a slightly higher inconsistency within the group with standard deviations for five concepts between .823 and .893, two concepts have standard deviations that identify some differences in respondent views; IS and IT Assessment and Selection (*SD* = 9.01) and Systems Analysis and Design (*SD* = .924). It is the WDR group that displays the greatest amount of within group variability. While

ERP (*SD* = .868) and E-Business (*SD* = .785) have a fair level of within group agreement, the remainder of the concepts have standard deviations ranging from .912 to 1.008, or differences in the group's views on the level of mastery for the respective concepts.

Table 67
Information Systems & Technology Comparison by Industry

Information Systems & Technology	Manufacturing	WDR	Service	Total
ERP				
n	75	35	81	191
M	2.347	2.200	2.407	2.346
SD	0.726	0.868	0.863	0.812
Decision Support Systems				
n	75	35	83	193
M	2.133	1.914	2.145	2.098
SD	0.723	0.919	0.843	0.814
E-Business				
n	75	35	82	192
M	2.067	2.029	2.159	2.099
SD	0.794	0.785	0.824	0.803
SCM Data Collection				
n	75	35	83	193
M	2.253	2.000	2.373	2.259
SD	0.902	0.970	0.893	0.916
Auto ID & Voice				
n	75	35	83	193
M	1.960	2.057	2.133	2.052
SD	0.796	0.998	0.823	0.846
Systems Analysis & Design				
n	75	34	83	192
M	1.920	1.882	2.024	1.958
SD	0.850	1.008	0.924	0.909
IS & IT Assessment & Selection				
n	74	34	82	190
M	1.878	1.676	1.951	1.874
SD	0.843	0.912	0.901	0.882

Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

The between group comparison of the Industry groups' responses for the Information Systems and Technology concepts is presented in the analysis of variance in Table 68. The *p* values for all Information Systems and Technology concepts range from $p = .129$ for SCM Data Collection to $p=.671$ for Systems Analysis and Design confirming that the Industry groups agree on the level of master for each of the concepts.

Table 68
Analysis of Variance Results: Information Systems & Technology by Industry

Information Systems & Technology		*SS*	*df*	*MS*	*F*	*p*
ERP	Between Groups	1.051	2	0.526	0.796	0.453
	Within Groups	124.142	188	0.660		
	Total	125.194	190			
Decision Support Systems	Between Groups	1.455	2	0.727	1.100	0.335
	Within Groups	125.675	190	0.661		
	Total	127.130	192			
E-Business	Between Groups	0.543	2	0.271	0.418	0.659
	Within Groups	122.577	189	0.649		
	Total	123.120	191			
SCM Data Collection	Between Groups	3.438	2	1.719	2.072	0.129
	Within Groups	157.608	190	0.830		
	Total	161.047	192			
Auto ID & Voice	Between Groups	1.174	2	0.587	0.818	0.443
	Within Groups	136.308	190	0.717		
	Total	137.482	192			
Systems Analysis & Design	Between Groups	0.665	2	0.333	0.401	0.671
	Within Groups	157.001	189	0.831		
	Total	157.667	191			
IS & IT Assessment & Selection	Between Groups	1.817	2	0.908	1.170	0.313
	Within Groups	145.151	187	0.776		
	Total	146.968	189			

* significant at $\alpha = .001$. Note: E-Business = Electronic Business. SCM = Supply Chain Management. Auto Identification includes bar coding, Radio Frequency Identification, character recognition, voice recognition, etc. IS & IT = Information Systems and Information Technology.

General Skills for SCM

The Industry groups are in general agreement within the groups on the level of mastery of the General Skills for SCM concepts identified (see Table 69). There are four potential exceptions and three involve the WDR group; Process Mapping (*SD* = .942), Simulation Modeling (*SD* = .963) and Negotiations (*SD* = 1.003) these indicate some disparity of desired level of mastery within the group. In addition, the Manufacturing group has some variety in responses for Project Management (*SD* = .905).

Table 69
General SCM Skills for SCM Comparison by Industry

General Skills	Manufacturing	WDR	Service	Total
Cross Functional Teams				
n	74	35	83	192
M	2.878	2.714	2.614	2.734
SD	0.721	0.893	0.762	0.777
Six Sigma				
n	75	35	83	193
M	2.267	1.886	2.325	2.223
SD	0.777	0.796	0.798	0.802
Lean				
n	75	35	82	192
M	2.373	2.114	2.415	2.344
SD	0.712	0.867	0.800	0.784
Process Mapping				
n	74	35	82	191
M	2.784	2.629	2.817	2.770
SD	0.763	0.942	0.862	0.839
Project Management				
n	75	35	83	193
M	2.733	2.714	2.831	2.772
SD	0.905	0.825	0.881	0.878
Simulation Modeling				
n	75	35	82	192
M	2.267	1.886	2.232	2.182
SD	0.859	0.963	0.893	0.900
Communications				
n	75	35	83	193
M	3.293	3.171	3.253	3.254
SD	0.712	0.664	0.730	0.709

Table 60 (continued)
General SCM Skills for SCM Comparison by Industry

General Skills	Manufacturing	WDR	Service	Total
Problem Solving & Decision Making				
n	75	35	83	193
M	3.173	3.143	3.229	3.192
SD	0.645	0.692	0.704	0.677
Ethics				
n	75	35	83	193
M	3.373	3.286	3.313	3.332
SD	0.767	0.860	0.840	0.813
Negotiations				
n	75	35	83	193
M	2.667	2.629	2.518	2.596
SD	0.794	1.003	0.817	0.843
Computer PC Office				
n	74	35	83	192
M	3.203	3.457	3.542	3.396
SD	0.740	0.611	0.611	0.678

The analysis of variance for the Industry groups' responses to the General Skills for SCM concepts provides insight into the level of agreement between the groups (see Table 70). While there is general agreement among all three Industry groups for nine of the concepts reflected in *p* values well over $\alpha = .001$, there are two concepts; Six Sigma ($p = .020$) and Computer PC Office ($p = .006$) that are marginal. To further confirm the ANOVA findings, Scheffe posttests were run for each. The test of Six Sigma indicated the Service to WDR comparison ($p = .024$) and the Service to Manufacturing comparison ($p = .065$) as well as the overall comparison ($p = 1.00$) were not significantly different. Likewise, the Scheffe tests for Computer PC Office resulted in Manufacturing to Service ($p = .007$) and Manufacturing to WDR ($p = .117$), with the overall group ($p = .133$), again with no significant difference between the Industry groups.

Table 70
Analysis of Variance Results: General Skills for SCM by Industry

General Skills		*SS*	*df*	*MS*	*F*	*p*
Cross Functional Teams	Between Groups	2.742	2	1.371	2.299	0.103
	Within Groups	112.711	189	0.596		
	Total	115.453	191			
Six Sigma	Between Groups	4.993	2	2.497	4.006	0.020
	Within Groups	118.426	190	0.623		
	Total	123.420	192			
Lean	Between Groups	2.321	2	1.160	1.907	0.151
	Within Groups	114.992	189	0.608		
	Total	117.313	191			
Process Mapping	Between Groups	0.896	2	0.448	0.633	0.532
	Within Groups	132.968	188	0.707		
	Total	133.864	190			
Project Management	Between Groups	0.521	2	0.260	0.336	0.715
	Within Groups	147.448	190	0.776		
	Total	147.969	192			
Simulation Modeling	Between Groups	3.813	2	1.906	2.389	0.094
	Within Groups	150.807	189	0.798		
	Total	154.620	191			
Communications	Between Groups	0.355	2	0.177	0.350	0.705
	Within Groups	96.205	190	0.506		
	Total	96.560	192			
Problem Solving & Decision Making	Between Groups	0.224	2	0.112	0.242	0.785
	Within Groups	87.683	190	0.461		
	Total	87.907	192			
Ethics	Between Groups	0.232	2	0.116	0.174	0.840
	Within Groups	126.545	190	0.666		
	Total	126.777	192			
Negotiations	Between Groups	0.916	2	0.458	0.642	0.528
	Within Groups	135.561	190	0.713		
	Total	136.477	192			
Computer PC Office	Between Groups	4.669	2	2.335	5.300	0.006
	Within Groups	83.248	189	0.440		
	Total	87.917	191			

* significant at $\alpha = .001$.

SCM Discipline Ranking

The final segment to assess for the Industry group analysis includes the overall ranking of the nine SCM disciplines. Once again the forced ranking has resulted in a lot of disparity in the views of the Industry group members (see Table 71). The most agreement within a group is found with the ranking of the Distribution Management by the WDR group (*SD* = 1.966) followed closely by Manufacturing group assessment of Transportation (*SD* = 1.993). The most disparity within a group was found in the WDR group positioning of Customer Service (*SD* = 3.145).

Table 71

SCM Discipline Ranking Comparison by Industry

Discipline Ranking	Manufacturing	WDR	Service	Total
Forecasting				
n	71	32	75	178
M	4.183	3.906	4.907	4.438
SD	2.582	2.291	2.389	2.472
Production Inventory Planning				
n	71	34	79	184
M	4.141	3.735	4.633	4.277
SD	2.497	2.179	2.518	2.462
Supply Management				
n	70	34	76	180
M	3.871	4.324	4.434	4.194
SD	2.265	2.212	2.259	2.255
Manufacturing				
n	69	35	76	180
M	5.029	5.429	5.316	5.228
SD	2.216	2.132	2.305	2.232
Transportation				
n	71	33	75	179
M	4.972	5.303	4.907	5.006
SD	1.993	2.338	2.188	2.135
Distribution Management - Warehousing				
n	71	34	76	181
M	5.873	6.118	5.197	5.635
SD	2.184	1.966	2.292	2.214
Material Handling & Packaging				
n	71	33	78	182
M	6.887	6.606	6.000	6.456
SD	2.676	2.499	3.142	2.870
Customer Service				
n	72	34	82	188
M	4.722	4.529	4.854	4.745
SD	2.744	3.145	2.932	2.888
Information Systems & Technology				
n	72	35	81	188
M	5.028	5.257	5.395	5.229
SD	2.562	2.822	2.677	2.652

The analysis of variance for the Industry groups' responses to ranking the SCM Disciplines is presented in Table 72. Despite the variability within the groups there is a general overall agreement between the groups with all p values over $\alpha = .001$. The most disparity in group responses is with the Forecasting discipline ($p = .084$) and a Scheffe posttest indicates a low risk of Type I error with overall significance at .122 and the least between group significance .158 for WDR and Service.

Table 72
Analysis of Variance Results: SCM Discipline Ranking by Industry Segment

Discipline Ranking		*SS*	*df*	*MS*	*F*	*p*
Forecasting	Between Groups	30.135	2	15.068	2.507	0.084
	Within Groups	1051.685	175	6.010		
	Total	1081.820	177			
Production Inventory Plan	Between Groups	21.301	2	10.650	1.772	0.173
	Within Groups	1087.564	181	6.009		
	Total	1108.864	183			
Supply Management	Between Groups	12.239	2	6.120	1.206	0.302
	Within Groups	897.955	177	5.073		
	Total	910.194	179			
Manufacturing	Between Groups	4.727	2	2.363	0.472	0.625
	Within Groups	886.935	177	5.011		
	Total	891.661	179			
Transportation	Between Groups	3.734	2	1.867	0.407	0.666
	Within Groups	807.260	176	4.587		
	Total	810.994	178			
Distribution Management - Warehousing	Between Groups	26.506	2	13.253	2.758	0.066
	Within Groups	855.428	178	4.806		
	Total	881.934	180			
Material Handling & Packaging	Between Groups	30.171	2	15.085	1.848	0.161
	Within Groups	1460.977	179	8.162		
	Total	1491.148	181			
Customer Service	Between Groups	2.586	2	1.293	0.154	0.858
	Within Groups	1557.159	185	8.417		
	Total	1559.745	187			
Information Systems & Technology	Between Groups	5.177	2	2.588	0.366	0.694
	Within Groups	1309.988	185	7.081		
	Total	1315.165	187			

* significant at $\alpha = .001$.

Conclusion

The above review of the descriptive statistics including frequency distribution for the overall responses addressed in question 1, along with the descriptive statistics and

ANOVA for the data assessed by groups for questions 2 and 3, provide great insight into the expectations of the respondents. The specific findings that resulted from this statistical analysis are provided in Chapter V.

CHAPTER V

DISCUSSION

Summary of Study

This study was designed to lay the foundation for answering the question: *How can higher education faculty ensure that students completing a Supply Chain Management program have acquired and can demonstrate the knowledge, skills, and abilities needed to be successful in an SCM career and/or graduate studies in the field?*

While five need sets were identified in Chapter I as required to completely address this question, the first and foundational need involves the outcomes expected by the organizational stakeholders who hire graduates of a four year SCM higher education program. A number of studies have identified the general business and leadership skills and abilities required of SCM professionals (Gammengaard & Larson, 2001; P. R. Murphy & Poist, 2006; Myers et al., 2004; van Hoek et al., 2002), yet there has been little done in the area of specific SCM knowledge, skills, and abilities expected.

To gain insight into these outcome requirements the Supply Chain Management Higher Education Survey was developed to answer three questions. The first question has two elements in that it involves what level of mastery should an SCM higher education four year graduate achieve for the various concepts involved with each of the SCM disciplines, and do the SCM executives that direct hiring of such graduates agree on these levels of mastery. A five point Likert scale was developed to permit respondents to identify, for each SCM concept selected, if that concept is "not required for SCM graduates" (None) up to "proficient application and able to instruct others" (Mastery). In

addition respondents were asked to provide a forced ranking of the nine major SCM discipline processes to assess relative value of each. Finally, the demographics collected from each completed survey provided insight into the respondents industry and specific SCM scope of responsibilities. The second and third questions were addressed with these two pieces of data to assess if there is agreement among SCM executives across industries and across SCM disciplines regarding the level of mastery expected of a four year SCM graduate.

The target population for the study included SCM executives (Chief Supply Chain Officers, SCM Vice Presidents, and SCM Directors) from all industries. The survey strategy included hard copy mailing of an introduction to the survey followed by a series of email communications. The survey was administered using SurveyMonkey through a web link from Duquesne University. A total of 2124 SCM executives from the CSCMP membership were solicited for the survey with 218 (10.26%) responding. The result is a rich database to not only effectively address the three questions of this dissertation, but in addition provide input for a number of other SCM program development issues.

Summary of Results

The survey respondents provided both qualitative and quantitative input. In addition to the Likert scale choices the respondents were offered the opportunity to provide open-ended input in the form of comments in each of the content assessment sections of the survey. While a number of the comments early in the survey process were related to concepts that were covered later in the survey, there were two primary themes that were uncovered. The first issue is a pedagogical concern and certainly of great value in program development, specifically the inclusion of experiential learning. Respondents

expressed the value of hands on experience through internships or on-site case projects as important to transition from the classroom to the marketplace.

The second qualitative comment was the concern for differentiating between the five Likert scale options and provides some potential insight into the statistical distribution of results. While the "none" option is very definitive, the definitions of the remaining four scale options required interpretation on the part of the respondent. Some respondents stated that mastery of a specific concept is impossible in an academic environment, while others responded that mastery was required for the same concept. These comments provide valuable qualitative insight into the respondents' views when assessing the level of mastery and agreement of all respondents.

The following provides an assessment of the specific findings developed from the results presented in Chapter IV. Each dissertation question and related hypothesis is addressed through a summary of selected related survey results and a review of the conclusions drawn from those results. The statistical references and summaries are extracted from data provided in Chapter IV and are presented as examples to support the conclusions the study.

Research Question One

The scope and complexity of SCM is extensive and ever changing. If a higher education program expects to prepare a graduate of a four year undergraduate program to successfully enter such an environment it is important to understand the knowledge, skills, and abilities required by those who lead and manage the supply chains. Therefore, understanding the critical outcomes both in concept and level of mastery is essential to SCM program development. This leads to the question of what knowledge skills and

abilities should a graduate possess, and to what ability level? Also, imbedded in this question is some expectation that despite the complexity of SCM, there is agreement among SCM leaders on these concepts and the level of mastery of each.

From this multi-faceted question the first research hypothesis was proposed with two elements to it.

> *H1: All SCM business leaders (managers, directors, vice presidents, and chief supply chain officers) agree on the level and scope of SCM knowledge, skills, and abilities required of graduates from a higher education SCM four year program.*

To determine if the SCM executives agree on SCM knowledge, skills, and abilities required, the level of mastery of each critical SCM concept must be assessed. By calculating the mean, standard deviation, and frequency distribution of all responses to each of the 78 SCM concepts surveyed, a picture of both the level of mastery and level of agreement among the 218 respondents was uncovered.

Total Survey Findings

From the descriptive data reported in Chapter IV, the minimum and maximum response for each concept provides insight into the level of variety in the responses. Of the 78 SCM concepts presented for assessment, 55 of the concepts received a 0 - None response indicating the concept is not important to an SCM program while the remaining 23 concepts had a minimum response of 1 – Some Exposure, and at the same time every concept received a maximum response of 4 – Mastery. However, a summary of the Likert scale responses in Table 73 identifies that of the 55 concepts receiving a None response, there were only a total of 133 None responses with 25 concepts only receiving one “0”

response and 15 had two. The concept with the highest None responses, a total of 11, was the concept of Manufacturing – Plant Layout and Design.

While all 78 concepts received at least three Mastery response the number of respondents selecting Mastery for the SCM concepts was significantly higher with a total of 1625 Mastery responses. Manufacturing – Plant Layout and Design was the concept with the lowest number of Mastery votes (three), while the highest was General Skills for SCM – Ethics with 101 Mastery responses.

Table 73
Distribution of None and Mastery Responses

Number of Responses	0 - 9	10 -19	20 - 49	50 - 99	100 +	Total
None						
Number of Concepts	53	2				55
Total Responses	110	21				131
Mastery						
Number of Concepts	19	33	20	5	1	78
Total Responses	128	447	590	359	101	1625

This provides valuable insight into the SCM concepts selected for assessment. While 55 concepts did receive a None response indicating some respondents felt the concepts are not a necessary part of a four year SCM higher education curriculum, 40 of those concepts received only one or two votes, and the highest None response for a concept represented less than 6% of the respondents. At the same time all concepts received at least three mastery responses and the concept with the highest number of mastery responses exceeded 50% of the responses to that concept. Therefore, the survey has confirmed that all of the concepts selected are of some importance to a graduate of an SMC program. This is farther validated by the limited number of additional concepts recommended by the respondents in the open ended “Other” option.

From these findings it can be concluded that to meet the current needs of the SCM marketplace a best in class higher education SCM program must address at a minimum the concepts identified in the survey. This does not imply that a successful SCM program should be limited to these concepts, rather that these are the foundational requirements upon which a program should build. In addition, many of the concepts chosen for the survey, such as Collaborative Planning Forecasting and Replenishment (CPFR) and Sales and Operations Planning (SOP), exemplify SCM strategies that are gaining popularity in business and require a significant amount of additional content matter in order to successfully understand and execute. The value placed on these strategic concepts confirms the nature of the need in industry for SCM graduates to bring a holistic view of integrated SCM to the marketplace. This study has answered the question regarding what SCM executives expect graduates from a higher education SCM program to bring to the job.

Given the confirmation of stakeholder value for each of the survey SCM concepts, it then becomes important to determine how well a graduate must perform in each area. This is required to establish the goals for outcomes assessment, which is the next critical step in developing an effective higher education curriculum with the technique of backward design (Wiggins & McTighe, 2001). Many of the SCM concepts assessed are very complex due to their quantitative or integrative nature, or both. Researchers spend years studying and analyzing these methods and business professionals focus significant amount of their career implementing and administering the concepts. Therefore, how well should graduate from a four year higher education program be expected to perform in each of these concepts based on an academic

experience, even if supplemented with experiential learning? To address this portion of the curriculum development plan, the survey respondents were asked to identify their expectations on the degree of mastery for each SCM concept.

The survey results provide valuable information regarding the level of mastery expected of an SCM program graduate by identifying the average score of responses for each SCM concept. When taken in concert with the standard deviation, the strength of the mean as an indicator of mastery becomes evident. The range of the means for all 78 SCM concepts is from the highest mean for General SCM Skills Computer- PC Office (*M* = 3.395) to the lowest mean for Manufacturing – Plant Layout and Design (*M* = 1.642) or a difference of 1.753 or 35% of the five point scale. Setting the range for each level of mastery at plus or minus .5, the highest level of mastery expected from a graduate is *working knowledge* (Able to apply and analyze) for 25 of the SCM concepts with means between 3.5 and 2.5 and the lowest level of mastery is *general knowledge* (Able to discuss the topic and research solutions) for 53 concepts with means between 2.5 and 1.5. No SCM concept means fell in the Mastery range (3.5 to 4.0), the Some Exposure range (.5 to 1.5) or the None range (0 to .5). However, it is also necessary to factor in the variability of responses to establish strength of the mean as the indicator of the desired level of mastery.

The highest 20 concept means range from General SCM Skills Computer- PC Office (*M* = 3.395) number one, to Distribution Management – Distribution Network Design (*M* = 2.59) number 20 (see Table 74). With all means between 2.5 and 3.5, graduates are expected to perform at a level of Working Knowledge for these concepts. These top 20 mean concepts also have 13 of the 20 lowest standard deviations which are

identified in bold in Table 74, and for these concepts the respondents had the highest level of agreement. It is interesting to note that while Computer PC Office, Communications, and Problem Solving & Decision Making produced three of the four highest means and three of the four lowest standard deviations, Ethics ranked second in highest means but 49th in standard deviations indicating some variability in responses but at *SD* = .8302 there is still strong consistency. The greatest variability in the top 20 concepts is with number 12, Project Management (*M* = 2.7653) with the 69th largest standard deviation (*SD* = .8806) indicating some disparity in the responses.

Table 74
Highest Twenty SCM Concept Means

SCM Concepts	*M*	*M* Rank	*SD*	*SD* Rank
General Skills - Computer PC Office	3.3949	1	0.6834	**2**
General Skills – Ethics	3.3163	2	0.8302	49
General Skills – Communications	3.2449	3	0.7098	**4**
General Skills - Problem Solving & Decision Making	3.1837	4	0.6771	**1**
General Knowledge - SCM Scope	3.1075	5	0.7333	**6**
General Knowledge - SCM Metrics	2.9767	6	0.7639	**16**
General Knowledge - SCM Abbreviations	2.8710	7	0.7589	**14**
Production & Inventory Planning - Inventory Techniques	2.8683	8	0.7325	**5**
General Knowledge- SCM in Value Chain	2.7850	9	0.7572	**13**
General Knowledge - Corporate Profitability	2.7721	10	0.7729	**17**
General Skills - Process Mapping	2.7680	11	0.8473	59
General Skills - Project Management	2.7653	12	0.8806	69
Forecasting - Role in SCM	2.7464	13	0.7389	**8**
General Skills – Cross-Functional Teams	2.7231	14	0.7834	23
Supply Management - Profitability Impact	2.6897	15	0.8128	33
General Knowledge- SCM Integration	2.6495	16	0.8523	62
Customer Service - Role in SCM	2.6313	17	0.7936	26
Distribution Management - Whse. Purposes	2.6050	18	0.7759	**19**
Production & Inventory Planning - Inventory Costing	2.6029	19	0.7779	**20**
Distribution Management - Distribution Network Design	2.5850	20	0.7454	**10**

Note: SCM = Supply Chain Management. Whse. = Warehouse

Other revealing information from the descriptive data in Table 74 includes the fact that six of the seven SCM General Knowledge concepts are included in the top 20 means, only SCM Strategy is not, but was ranked 22nd. Also, seven of the 11 SCM General Skills concepts are included in the top 20, therefore 13 of the top 20 highest level of mastery concepts are general in nature and not focused SCM discipline techniques.

This provides support to earlier research indicating the value of general business knowledge and skills for SCM career success (Gammengaard & Larson, 2001; P. R. Murphy & Poist, 2006; Myers et al., 2004; van Hoek et al., 2002).

Also revealing are the set of concepts that comprise the lowest 20 mean scores. Table 75 identifies the lowest 20 SCM concept means and the respective standard deviations and standard deviation ranking. Of interest is the fact that many of the lowest mean concepts also had the higher standard deviations indicating some disparity in responses for the lower scored concepts. Specifically, 14 of the 20 lowest mean concepts had standard deviations in the upper 50 percentile of the concepts studied. However, there are three concepts that drew a higher level of agreement among respondents. Packaging Types & Purpose (*SD* = .7790) was the 21 lowest standard deviation, Packaging Materials (*SD* = .7569) was 12th lowest, and Transportation - Law & Regulations (*SD* = .7430) was the ninth lowest standard deviation. This indicates a higher level of agreement for these three concepts to be developed at the *general knowledge* level of mastery, and establishes a solid position for each in the SCM program development.

Table 75
Lowest Twenty SCM Concept Means

SCM Concepts	*M*	*M* Rank	*SD*	*SD* Rank
Material Handling & Packaging - MH Principles	2.1950	59	0.8664	66
Transportation - Transportation Management System	2.1841	60	0.8312	50
General Skills - Simulation Modeling	2.1795	61	0.9102	77
Transportation - Domestic Documentation	2.1343	62	0.8927	74
Transportation - International Documentation	2.1000	63	0.8910	73
IS & IT - E-Business	2.0969	64	0.8011	27
IS & IT - Decision Support Systems	2.0909	65	0.8135	34
Manufacturing - Strategies	2.0909	66	0.8259	45
Distribution Management - Whse. Specification & Selection	2.0650	67	0.8272	48
IS & IT - Auto ID & Voice	2.0404	68	0.8480	60
Material Handling & Packaging - Packaging Types & Purpose	1.9650	69	0.7790	21
IS & IT - System Analysis & Design	1.9492	70	0.9077	76
Transportation - Law & Regulations	1.9453	71	0.7430	**9**
Distribution Management - Whse. Layout & Design	1.9200	72	0.8874	71
Supply Management - Contract Law	1.9073	73	0.8262	47
IS & IT - Assess & Selection	1.8763	74	0.8787	67
Transportation - Indirect & Special Carrier	1.8643	75	0.8144	35
Material Handling & Packaging - MH Equipment Selection	1.7020	76	0.8230	43
Material Handling & Packaging - Packaging Materials	1.7000	77	0.7569	**12**
Manufacturing - Plant Layout & Design	1.6418	78	0.8192	41

Note: MH = Material Handling. IS & IT = Information Systems and Technology. Whse. = Warehouse. E-Business = Electronic Business. Auto ID & Voice includes bar coding, Radio Frequency Identification, and voice recognition.

A review of the SCM concept frequency distributions uncovered that by far the most popular response to the level of mastery for the SCM concepts assessed was *general knowledge* which was the highest response for 50 of the 78 concepts (see Table 76). The second most frequent selection was *working knowledge* being the dominant response for

25 of the SCM concepts. Also, the General Skills for SCM – Lean concept received 79 votes for both *general knowledge* and *working knowledge* tying for the top response. The only other level of ability to receive the highest number of responses for any of the 78 SCM concept is *mastery* which dominated the votes for two concepts; General Skills for SCM – Computer PC Office (98 responses) and Ethics (101 responses).

For all but 12 concepts, whenever *general knowledge* received the highest responses, *working knowledge* had the second highest number of responses, and whenever *working knowledge* received the highest votes, *general knowledge* earned the second highest number of responses. This may be explained by the earlier observation regarding respondents interpretation of the level of mastery with *general knowledge* and *working knowledge* closely aligned. It can also be inferred that with over 97% of the concepts having *general knowledge* and *working knowledge* as the most frequent response there is in fact agreement among respondents on the level of ability required of an SCM graduate. In addition, there were a total of 15,747 responses to the 78 SCM concepts and *general knowledge* and *working knowledge* accounted for 74.12% of all responses confirming the overall value of the concepts to an SCM higher education program and the general agreement among executive respondents.

Table 76
Response Frequency Distribution SCM Concept Summary

SCM Concepts	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Number of Highest Responses	0	0	50	25	2
Ties for Highest Responses	0	0	1	1	0
Number of Second Highest Responses	0	10	48	18	2
Percent of Total Responses	0.84	14.71	39.34	34.78	10.32

These findings are significant for setting the outcomes expectations of an SCM program and guiding the methods of assessment required to achieve each. Once again, the lack of responses to the lowest two and highest levels of mastery options confirms the appropriateness of the concepts and their value to SCM education. It also establishes the level of academic performance of both students and faculty to be designed into a successful program. In other words, these results will set the goals for outcomes assessment and identify the ability level of instructors in each of the SCM concepts. The ever changing nature of many of these concepts also mandates a lifelong learning philosophy for students and faculty alike.

Total Respondent SCM Discipline Ranking Findings

One area where the respondents did not have a high level of agreement is the overall relationship of the nine SCM discipline processes. The forced ranking of the disciplines did not provide a strong consensus. A review of the averages provides little information other than Supply Management (M = 4.2) is the highest ranked but Material Handling and Packaging (M = 6.5) is the lowest ranked, or all nine disciplines are within 2.5 points on a nine point scale. The frequency distribution provides a bit more insight into the tendencies of the respondents but still does not provide a definitive answer to the relative importance of each discipline as can be seen in Table 77 where the highest percentage for each ranking is in bold. Customer Service received the highest percentage of first place responses with 20.53% but also received the second highest percentage of 9th place responses with 15.26%. Likewise, Material Handling & Packaging got the highest number of 9th place responses with 34.43% and the 4th highest 1st place responses (12.02%). Forecasting got the highest percentage of 2nd and 3rd place responses and the

third highest 7th place percentage (13.41%). Production & Inventory Planning did not dominate the responses in any ranking but got 15.05% responses to 1st, 2nd and 4th place. Supply Management, which has the highest overall mean, was the dominate 4th place response recipient at 17.13% and had the third highest 1st place responses (14.02%). Manufacturing did not dominate any group in the voting, but responses were concentrated with the 5th and 6th rankings. Transportation topped the voting for 5th and 6th place with 19.89% and 17.13% respectively, with relatively lower percentages in the other rankings. Warehousing held the highest percentage for 7th place (18.68%) and a strong response for 8th (17.03%). Information Systems and Technology had the highest percentage of 8th place votes but was second highest for 2nd place (15.26%), fourth for 4th place (12.63%), and third highest percentage for 9th place (10.53%).

Table 77
Frequency Distribution for Ranking of SCM Disciplines

SCM Disciplines	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Forecasting									
Percent	10.61	**16.20**	**17.32**	12.29	10.06	5.59	13.41	7.26	7.26
Production & Inventory Planning									
Percent	15.05	15.05	13.98	15.05	8.06	10.22	9.14	7.53	5.91
Supply Management									
Percent	14.92	12.71	12.71	**17.13**	12.71	10.50	9.94	7.73	1.66
Manufacturing									
Percent	6.08	5.52	11.60	13.81	18.78	15.47	10.50	8.29	9.94
Transportation									
Percent	6.63	9.94	9.94	9.94	**19.89**	**17.13**	13.81	9.39	3.31
Warehousing									
Percent	2.75	9.34	8.79	9.89	12.09	14.29	**18.68**	17.03	7.14
Material Handling & Packaging									
Percent	12.02	4.37	6.56	2.73	2.19	8.74	10.93	18.03	**34.43**
Customer Service									
Percent	**20.53**	10.00	10.53	6.84	11.05	8.42	8.95	8.42	15.26
Information Systems & Technology									
Percent	8.95	15.26	5.79	12.63	7.37	12.11	8.95	**18.42**	10.53

Note: Bold items represent the highest percentage for each ranking.

This analysis uncovers some patterns to the responses that lead to consideration of the following ranking:

1. Customer Service
2. Production & Inventory Planning
3. Forecasting
4. Supply Management
5. Manufacturing
6. Transportation
7. Warehousing
8. Information Systems & Technology
9. Material Handling & Packaging

However, the review also uncovers a number of differences that make the strength of any ranking questionable. This may lend support to the SCM theory that all disciplines are integrated and of equal importance. Therefore, a forced ranking results in personal interests or random responding.

Conclusion

The analysis of the Supply Chain Higher Education Survey responses has provided great insight into the views of SCM executives regarding the knowledge, skills, and abilities they expect a graduate of a SCM higher education program to possess. A review of the averages and variability of responses to the 78 SCM concepts presented confirms the level of mastery expected and identifies those topics where the SCM executives may have some disagreement. The consensus of the respondents is that all 78 concepts are of some importance and that they should be mastered at either the *general knowledge* or *working knowledge* level. Also, while there does exist variability of responses to any one concept, overall the respondents were in general agreement regarding the level of mastery.

Therefore the hypothesis is accepted: All SCM business leaders (managers, directors, vice presidents, and chief supply chain officers) agree on the level and scope of SCM knowledge, skills, and abilities required of graduates from a higher education SCM four year program. This provides a solid foundation upon which to build a best in class SCM higher education curriculum. Understanding the expected outcomes of a program both in terms of content and level of mastery is an important step to program development. When combined with current state self assessment it will provide priorities for correcting gaps in program outcome needs (Holcomb, 2001). This level of detail is also critical for the development of courses to support curriculum goals and the associated outcomes assessment (Angelo & Cross, 1993).

Research Question Two

While the review of the expectations for SCM program graduates from all respondents is of value to understanding the needs of the marketplace, there is some concern that disciplines within SCM may have differing requirements. More specifically, graduates of SCM higher education programs generally secure entry level positions with titles such as buyer, transportation analyst, production coordinator, materials planner, inventory specialist, operations planner, etc. (CSCMP, 2009). Given the extensive scope of the SCM disciplines these positions represent, it raises the question; should a graduate bring a different set of capabilities to the job depending on the entry level position?

This concern led to the second dissertation hypothesis:

> *H2: SCM majors are expected to possess the same level of knowledge, skills, and abilities for career success in any of the disciplines that make up SCM.*

As mentioned in Chapter III, the distribution of discipline responsibilities of respondents to the SCM Higher Education Survey required aggregation into four categories. With many respondents identifying their scope of responsibility as Total SCM and others selecting the majority or all of the SCM disciplines as under their purview, a large number of respondents were categorized as Total SCM (113). Those who identified multiple responsibilities in the "front end" of the supply chain were classified as members of the traditional discipline of Materials Management (15), while the balance of the SCM responsibilities were grouped under Physical Distribution (55). Finally, a small group of respondents did not fit into any of these categories and were labeled as Other (9). This lack of differentiation of SCM responsibilities places some limits on the effectiveness of this analysis in that more than half of the respondents are in one category, and two others groups have only 15 and nine samples. However, there are some interesting findings from the statistical analysis.

Responsibility Group Findings

All 78 SCM concept means for the SCM Discipline Group analysis were ranked based on the Total mean for each SCM concept and the highest 20 were compared to the highest 20 means for each of the four SCM Responsibility groups (see Table 78). The top 20 means for each Responsibility group do not align perfectly for example Computer PC Office is ranked number one for Total, Material, and Physical Dist, it is 2nd for Total SCM and 3rd for Other. However, there is consistency in the SCM techniques included in each top 20 grouping, in fact there are only eight concepts across all four Responsibility groups that do not rank in the top 20, these are noted in bold in Table 78. Given the fact that the Total SCM group accounts from more than 50% of the respondents it may be

expected to have the best alignment with the Total means. However, two of the outliers are found in the Total SCM group; Warehouse Purposes and Negotiations were ranked 26 and 21 respectively. There were also two for the Material group; SCM Integration and Inventory Costing were ranked 21 and 38 respectively. For the Physical Distribution group only the Customer Service Role in SCM is ranked 23. Finally, the Other group had three concept means that did not align with the Total: Cross-Functional Teams ranked 24th, Inventory Costing 25th, and Negotiations 33rd.

Table 78
Comparison of Highest 20 Total Means of SCM Responsibility Groups

	Total SCM		Material		Physical Dist.		Other		Total	
	M	Rank	*M*	Rank	*M*	Rank	*M*	Rank	*M*	Rank
Computer PC Office	3.29	2	3.50	1	3.60	1	3.33	3	3.40	1
Ethics	3.30	1	3.40	3	3.45	2	2.89	7	3.33	2
Communications	3.20	3	3.33	4	3.33	3	3.44	1	3.26	3
Problem Solving & Decision Making	3.16	4	3.33	5	3.20	5	3.44	2	3.20	4
SCM Scope	3.02	5	3.47	2	3.20	4	3.22	5	3.12	5
SCM Metrics	2.98	6	3.00	7	3.00	6	2.89	8	2.98	6
Inventory Techniques	2.91	7	3.07	6	2.74	11	2.67	13	2.86	7
SCM Abbreviations	2.77	10	3.00	8	2.93	7	3.33	4	2.86	8
SCM in Value Chain	2.76	12	2.93	10	2.83	9	2.78	12	2.79	9
Project Management	2.77	11	2.80	14	2.76	10	2.89	10	2.78	10
Corp Profitability	2.69	14	2.87	11	2.89	8	2.89	9	2.77	11
Process Mapping	2.78	9	2.71	17	2.72	13	3.00	6	2.77	12
Forecasting Role in SCM	2.79	8	2.73	15	2.65	19	2.67	16	2.74	13
Cross-Functional Teams	2.74	13	3.00	9	2.71	14	**2.44**	**24**	2.74	14
Profitability Impact	2.69	15	2.87	12	2.70	15	2.67	15	2.71	15
Customer Service Role in SCM	2.66	16	2.60	20	**2.57**	**23**	2.89	11	2.64	16
SCM Integration	2.63	18	**2.60**	**21**	2.70	16	2.56	19	2.64	17
Whse. Purposes	**2.51**	**26**	2.87	13	2.73	12	2.67	14	2.61	18
Inventory Costing	2.65	17	**2.33**	**38**	2.60	20	**2.44**	**25**	2.60	19
Negotiations	**2.58**	**21**	2.67	18	2.67	17	**2.33**	**33**	2.60	20

Note: Dist. = Distribution. Whse. = Warehouse. Bold entries represent items that do not align with the Total highest 20 means.

Therefore, while the priorities as expressed by the largest means for each SCM concept do not exactly aligned by each responsibility group, overall the highest means in each group identify some commonality in the levels of mastery expected. Also of interest, is the fact that within the two specialized groups; Material and Physical Distribution, those concepts not aligning with the Total highest 20 are very specific to each group. For

example, 16th highest concept for the Material group is Supplier Selection and the 19th is Spend Analysis and TCO which are both the responsibility of the supply management - purchasing discipline in Material Management. Likewise, the missing concept for Physical Distribution is Mode and Carrier Selection, number 18, which is the responsibility of transportation management from the Physical Distribution group. However, while these outliers have some special interest to only one Responsibility group, they were in fact identified as important SCM concepts by all groups.

Also of interest is the fact that as stated earlier under the discussion of hypothesis one, the averages for all respondents did not place any concepts in the *mastery* level of ability. However, in the Responsibility group analysis, using the plus and minus .5 assessment, Computer PC Office is in the *mastery* level for the Physical Distribution group (M = 3.6) and borderline for the Material group (M = 3.5).

While there are some minor differences between SCM discipline groups in the expected performance of graduates for the concepts that display the highest level of mastery, the differences are negligible when it comes to establishing outcome goals. This level of consistency is also encouraging to those universities focused on developing a comprehensive SCM program, in that graduates will possess the knowledge, skills, and abilities to be successful in entry level positions for any SCM discipline.

A similar review of the smallest 20 Total means for the Responsibility groups; those ranked 59 through 78, identifies those concepts that were rated as the lowest level of mastery (see Table 79). Once again there is a general agreement regarding the lowest 20 means across all Responsibility groups, however there are 16 means across the four groups that do not fit in the lowest 20 category. As would be expected the largest group,

Total SCM, aligns the best with the overall Total means with only one out of the category. The Material and Physical Distribution groups each have four means that do not fall into the Total lowest 20, while the Other group has seven.

While the average for all SCM concepts for the total sample did not result in any concept with an expected level of mastery below *general knowledge*, the Material group's mean for Material Handling Equipment Selection (M = 1.40) puts the level of mastery at *some exposure* or the fact that "familiarity with the topic" would be sufficient for an SCM graduate. This indicates a very limited level of Material Handling Equipment Selection knowledge required for those working in the Materials Management segment of SCM.

It is important to reiterate that the means for each concept provide an indicator of the level of mastery expected by the Responsibility group and that highest and lowest do not infer a level of quality, rather how accomplished a graduate should be in each concept.

Table 79
Comparison of Lowest 20 Total Means of SCM Disciplines

	Total SCM		Material		Physical Distrib.		Other		Total	
	M	Rank	*M*	Rank	*M*	Rank	*M*	Rank	*M*	Rank
TMS	**2.21**	**57**	2.00	63	**2.24**	**56**	2.11	63	2.20	59
MH Principles	2.12	61	**2.20**	**53**	**2.35**	**42**	**2.22**	**50**	2.20	60
Simulation Modeling	2.18	60	**2.33**	**45**	2.15	63	2.11	66	2.18	61
Domestic Document Strategies	2.07	65	1.93	67	**2.31**	**49**	**2.11**	**58**	2.13	62
International Document	2.09	64	**2.33**	**46**	2.12	64	**2.22**	**52**	2.12	63
E-Business	2.05	66	1.93	68	**2.24**	**57**	2.11	64	2.10	64
Decision Support Systems	2.11	63	1.93	66	2.09	65	**2.33**	**44**	2.10	65
Whse. Specifications & Selection	2.12	62	**2.20**	**54**	1.98	71	**2.44**	**32**	2.10	66
Auto ID & Voice	2.02	68	1.80	72	2.16	62	**2.33**	**43**	2.06	67
Packaging Types & Purpose	2.05	67	2.00	64	2.05	68	2.11	68	2.05	68
Systems Analysis & Design	1.95	71	1.93	69	2.04	70	2.00	75	1.97	69
Law & Regulations	1.98	69	1.80	73	1.93	73	2.11	70	1.96	70
Whse. Layout & Design	1.95	70	1.87	71	1.96	72	2.11	69	1.95	71
Contract Law	1.84	74	1.73	74	2.07	66	**2.22**	**53**	1.92	72
IS & IT Assessment & Selection	1.89	72	1.93	70	1.89	74	2.11	71	1.91	73
Indirect & Special Carrier	1.85	73	2.00	65	1.85	75	2.11	72	1.87	74
Packaging Materials	1.80	75	1.67	75	2.04	69	2.00	74	1.87	75
MH Equipment Selection	1.68	76	1.60	76	1.76	78	1.67	78	1.70	76
Plant Layout & Design	1.68	77	1.40	78	1.80	76	1.78	77	1.69	77
	1.60	78	1.60	77	1.78	77	1.89	76	1.66	78

Note: Dist. = Distribution. Whse. = Warehouse. E-Business = Electronic Business. Auto ID & Voice = Automated Identification such as bar codes and radio frequency identification, and voice recognition. IS & IT = Information Systems and Information Technology. Bold entries represent items that do not align with the Total lowest 20 means.

The final review of the Responsibility group means looked at those concepts that were clustered around the 2.5 range which differentiates between *general knowledge* and *working knowledge*. As might be expected from the review above, there is very little difference between the groups concerning where the break should take place. In fact there are only three Total SCM, two Material, and two Physical Distribution concept means that do not align with the Total mean break between *general knowledge* and *working knowledge*. The Other group, which tended to score the midrange concepts lower than the rest of the groups, had six concepts that did not align with the Total mean mastery break. Overall, this is a strong indication of the agreement among the Responsibility group respondents on the level of mastery expected of an SCM program graduate.

Level of Agreement Within Responsibility Groups

A review of the distribution of standard deviations identifies the variability in levels of agreement with Responsibility groups for the same SCM concepts. While the comparison in standard deviation rankings across all four Responsibility groups and the Total for the groups is exploratory in nature, it does provide some insight into the level of agreement on the required mastery of the selected SCM concepts. For example the concept of SCM Abbreviations had the 9^{th} lowest standard deviation for the Total of the Responsibility groups (*SD* = .742) yet for the Material group it was 69^{th} (*SD* = .845) indicating a higher level of disagreement on the level of mastery of this concept by the Material group respondents. In fact, for the lowest 20 standard deviations of the Total for Responsibility groups, only eight of the Material group's lowest 20 standard deviations were included, with four concept standard deviations in the highest 20 of the Material group.

There were similar differences when reviewing the 20 highest standard deviations for the Total of the Responsibility groups. The Total highest 20 standard deviation concepts included three of the lowest standard deviation concepts for the Material group and four of the lowest for the Other group. At the same time, the lowest overall standard deviation for an SCM concept was from the Material group for Inventory Techniques (SD = .475) and the highest was from the Other group for Ethics (SD = 1.453). It is important to note that the differences in standard deviation rankings and the extremes, high and low, may be the result of the small sample size of the Material and Other groups. These data points may be indicators of some differences in the level of agreement within the groups or they could be the result of only few outliers or agreements. Regardless, these results are of interest for future studies to determine if these responsibility groups truly disagree with the rest of the SCM leaders.

Level of Agreement Between Responsibility Groups

Perhaps the most revealing statistics from Chapter IV regarding the Responsibility groups' level of agreement on the mastery of SCM concepts by SCM program graduates comes from the analysis of variance. For all 78 SCM concepts assessed in the survey all p values were greater than $\alpha = .001$, with the smallest Computer PC Office ($p = .045$) and the largest Auto Identification and Voice Recognition ($p = .992$). Therefore, while the level of agreement varied from concept to concept between the Responsibility groups, there are no statistically significant differences. The Responsibility groups agree on the level of mastery expected of an SCM program graduate and there is no difference in the groups' expectations.

Responsibility Group SCM Discipline Ranking Findings

Once again the ranking of importance of the SCM disciplines resulted in little differentiation based on the means for each Responsibility. Table 80 lists the SCM disciplines in order based on the Total mean, again given the most important was to be rated 1, the lowest mean represents the most important discipline. The range of means for the Total SCM group is only 1.83 from 1st ranked to 9th ranked discipline, while the Physical Distribution group range is 2.34 and Other group range is 2.3. Only the Materials group produced any significant difference between the highest and lowest means with a range of 5.34. This is due in part to the small sample size combined with the fact that the highest ranked discipline; Supply Management, is a significant element in Material Management. Likewise, the Material group responses ranked Material Handling and Packaging the lowest with a mean significantly higher than any other 9th ranked disciplines.

While not all Responsibility groups completely align on the ranking of each discipline, there is general agreement in that each Responsibility group ranking is within a two point range, except for Customer Service and Information Systems and Technology. With three of the four groups in general agreement on the ranking of Customer Service the Material group is three to five points lower than the rest of the groups. This may be due to the fact that the Material group is often organizationally removed from the customer and places higher priority on the SCM disciplines more closely aligned. The variability of rankings for Information Systems and Technology is very interesting; with the Material group ranking it high at four, while the Physical

Distribution group ranks it as a six and the remaining groups rank it at eight. These results require additional research before any conclusion can be reached.

Except for the couple differences noted, there is a general consensus on the ranking relationship between the SCM disciplines based on the means that is consistent across Responsibility groups. Once again, The forced ranking has not provided a very strong differentiation between discipline priorities, indicating the overall importance of viewing SCM as a series of integrated processes.

Table 80
SCM Discipline Ranking by SCM Responsibility

SCM Disciplines	Total SCM		Material		Physical Dist		Other		Total	
	M	Rank	*M*	Rank	*M*	Rank	*M*	Rank	*M*	Rank
Supply Management	4.51	3	2.33	1	4.12	1	3.78	1	4.18	1
Production & Inventory Planning	4.33	1	3.33	2	4.41	3	4.00	2	4.26	2
Forecasting	4.44	2	3.57	3	4.63	4	4.22	4	4.41	3
Customer Service	4.89	4	5.80	7	4.32	2	4.11	3	4.76	4
Transportation	5.09	6	5.47	6	4.78	5	4.56	5	5.01	5
Information Systems & Technology	5.39	8	4.27	4	4.98	6	6.22	8	5.22	6
Manufacturing	5.06	5	5.20	5	5.60	7	5.44	6	5.25	7
Distribution Management	5.34	7	7.00	8	5.71	8	6.56	9	5.64	8
Material Handling & Packaging	6.34	9	7.67	9	6.46	9	6.11	7	6.48	9

The analysis of variance comparison of the Responsibility groups' ranking of the SCM disciplines identifies the strong agreement between the groups on the ranking of Transportation ($p = .621$) and the weakest level of agreement for Supply Management ($p = .005$). With all the p values greater than $\alpha = .001$, and as noted in Chapter IV a Sheffe test confirmed there are no significant differences in the between group data for Supply Management. Therefore, while some differences exist between Responsibility groups in

the ranking of SCM disciplines, there are no significant differences, therefore the groups agree.

Conclusion

A review of the survey responses aggregated by Responsibility groups provides no indication of significant differences in SCM concept mastery expectations of graduates from an SCM higher education program. There is evidence of a desire by some responsibility groups for a higher level of mastery for specific discipline concept knowledge and skills unique to that group such as Supplier Selection by the Material group and Mode and Carrier Selection by the Physical Distribution group. Yet while some of these discipline specific concepts displayed slight variability in mastery level expected, results from all Responsibility groups indicate a general range of agreement. Any differences uncovered will be beneficial in structuring discipline specific courses to include the highest level of mastery concepts in the course strategy.

Therefore the hypothesis is accepted that: SCM majors are expected to possess the same level of knowledge, skills, and abilities for career success in any of the disciplines that make up SCM. The acceptance of this hypothesis is a significant linchpin in the higher education SCM program development. Confirming the overall common set of concepts important to all SCM disciplines establishes a solid foundation of expected outcomes upon which to build a program. It also indicates that the integration of SCM disciplines has progressed to the point where synergy of techniques is recognized. While depth of concept for specific SCM disciplines is still an academic strategic option in program development, it is not required for program success. The solid agreement among discipline leaders on the importance of the survey concepts indicates an acceptance of

graduates who have achieved the designated levels of mastery in each concept, into any discipline of SCM. The few concept mastery level mismatches that were uncovered are specific to identified disciplines and will prove beneficial in the development of discipline specific courses. The lack of strong differences in discipline requirements enhances the viability of successfully developing and administering a comprehensive higher education SCM program.

Research Question Three

The final review of the survey results involves analysis of responses based on the industry in which the respondent works. Specifically, while all businesses have a supply chain, how the supply chain is managed may vary depending on the strategy, output, and the customers of the organization. Is the business for profit or non-profit, is the output a product or a service, is the customer another business or a consumer, etc? These factors may have an impact on the knowledge, skills, and abilities required of an SCM program graduate. It is essential in SCM curriculum development to take into consideration the needs of the stakeholders, in this case those who will hire graduates from an SCM program and it is necessary to determine if different industries require different knowledge, skills and abilities.

To answer this question the third and final segment of this study is focused on the assessment of the following hypothesis:

H3: SCM majors are expected to possess the same knowledge, skills, and abilities for all industries.

The result of the responses to the demographic data pertaining to industry identification resulted in a large number of industry groups with a small sample size for

many of them. The aggregation by NAIC classifications into three groups resulted in 75 respondents in manufacturing, 35 respondents in Wholesale, Distributor, Retail (WDR), and 83 respondents in the service industry. While still not an equal number of respondents by segment, the groups are much more evenly represented than the SCM Responsibilities groups.

Industry Group Mastery Expectations

A review of the overall alignment of the average responses for each Industry group provides some insight into both the level of expected mastery and the agreement between the groups. Table 81 presents the highest 20 Total Industry group means along with the corresponding means and ranking for the three individual Industry groups. In addition, in bold are the means for any SCM concept that did not fall in the highest 20 for the group. While the top five concept means, and therefore the concepts with the highest level of mastery expected, do not align perfectly for all groups, they are the same highest five concepts. Not only do the rankings align well, but the means are closely aligned.

A review of the balance of Table 81 uncovers the fact that overall there is an agreement among the three Industry groups' rankings of the highest 20 concepts level of mastery. Each group has only two concepts that do not align in the top 20 and all cases these are within the top 26 highest concept means. Once again the differences, while not shown on Table 81, can in part be tracked to concepts that are uniquely important to the specific group. For example, while the Manufacturing group mean for Production Planning Models (M = 2.64) placed it 16th highest on their mean list, it was ranked 25th for the Total mean (M = 2.52). This would appear logical as production planning models are used by, and most important to, manufacturers. Likewise the WDR group mean for

Distribution Resource Planning (DRP) (*M* = 2.57) placed it 18th on their list, while it was 28th on the Total group list (M = 2.48). DRP is intended to improve the planning for the Wholesale, Distributor, and Retailer channel.

One exception to the ranking comparison found on Table 81 is the fact that the Service group mean for Computer PC Office (*M* = 3.54) is in the *mastery* range of level of knowledge, skills, and abilities. This is not in strong conflict with the other Industry groups or the results from the total sample review from question 1 as all critiques have placed this concept on the high end of *working knowledge* or the low end of the *mastery* range.

Table 81
Comparison of Highest 20 Total Means of Industry Groups

SCM Concepts	Manufact.		WDR		Service		Total	
	M	Rank	M	Rank	M	Rank	M	Rank
Computer PC Office	3.20	3	3.46	1	3.54	1	3.40	1
Ethics	3.37	1	3.29	2	3.31	2	3.33	2
Communications	3.29	2	3.17	3	3.25	3	3.25	3
Problem Solving & Decision Making	3.17	4	3.14	4	3.23	4	3.19	4
SCM Scope	3.15	5	2.94	5	3.16	5	3.12	5
SCM Metrics	2.92	7	2.94	6	3.04	6	2.97	6
SCM Abbreviations	2.91	8	2.69	13	2.89	7	2.86	7
Inventory Techniques	2.96	6	2.88	7	2.76	13	2.86	8
SCM in Value Chain	2.83	10	2.74	8	2.78	12	2.79	9
Project Management	2.73	13	2.71	9	2.83	10	2.77	10
Process Mapping	2.78	12	2.63	15	2.82	11	2.77	11
Corporate Profitability	2.71	14	2.71	10	2.84	9	2.77	12
Forecasting Role in SCM	2.79	11	2.71	11	2.70	16	2.73	13
Cross Functional Teams	2.88	9	2.71	12	**2.61**	**21**	2.73	14
Profitability Impact	2.61	18	2.55	19	2.84	8	2.70	15
Customer Service Role in SCM	2.63	17	**2.46**	**26**	2.73	14	2.64	16
SCM Integration	2.59	19	2.69	14	2.65	19	2.63	17
Whse. Purposes	**2.56**	**22**	**2.49**	**23**	2.70	15	2.61	18
Inventory Costing	**2.53**	**24**	2.54	20	2.69	17	2.60	19
Negotiations	2.67	15	2.63	16	**2.52**	**25**	2.60	20

Note: Manufact. = Manufacturing. WDR = Wholesale, Distributor, Retail. Whse. = Warehouse. SCM = Supply Chain Management.

The 20 SCM concepts with the lowest Total averages are presented in Table 82 and the lowest three means are common for all Industry groups. There is a general agreement on the 20 SCM concepts with the lowest Total averages. the lowest 20 means with the exceptions in bold; Manufacturing with two, WDR with four, and Service with three. One noted difference is the WDR groups' mean for Plant Layout and Design (M = 1.43) places it in the *some exposure* level of mastery indicating limited knowledge of this

concept is necessary for SCM success in this group, and indicates a difference from the total survey population as reviewed under hypothesis one.

Table 82
Comparison of Lowest 20 Total Means of Industry Groups

SCM Concepts	Manufact.		WDR		Service		Total	
	M	Rank	M	Rank	M	Rank	M	Rank
Transportation Management System	2.01	66	**2.26**	**45**	**2.34**	**44**	2.20	59
MH Principles	2.20	59	**2.14**	**54**	2.20	61	2.19	60
Simulation Modeling	**2.27**	**54**	1.89	69	**2.23**	**58**	2.18	61
Domestic Document	2.07	64	1.97	63	**2.24**	**57**	2.12	62
Manufacturing Strategies	**2.23**	**56**	1.97	64	2.09	68	2.12	63
E-Business	2.07	63	2.03	61	2.16	63	2.10	64
Decision Support Systems	2.13	60	1.91	67	2.14	64	2.10	65
International Document	2.07	62	**2.06**	**56**	2.13	65	2.09	66
Whse. Specification & Selection	1.93	69	**2.06**	**58**	2.17	62	2.06	67
Auto ID & Voice	1.96	68	2.06	59	2.13	66	2.05	68
Packaging Types & Purpose	1.92	71	1.83	72	2.07	69	1.97	69
Systems Analysis & Design	1.92	70	1.88	70	2.02	70	1.96	70
Law & Regulations	2.00	67	1.86	71	1.95	73	1.95	71
Whse. Layout & Design	1.81	75	1.94	66	1.99	72	1.91	72
Contract Law	1.89	72	1.69	74	2.01	71	1.91	73
IS & IT Assessment & Selection	1.88	73	1.68	75	1.95	74	1.87	74
Indirect & Special Carrier	1.83	74	1.83	73	1.91	75	1.86	75
Packaging Materials	1.72	76	1.57	77	1.72	78	1.69	76
MH Equipment Selection	1.64	78	1.60	76	1.77	76	1.69	77
Plant Layout & Design	1.66	77	1.43	78	1.76	77	1.66	78

Note: Manufact. = Manufacturing. WDR = Wholesale, Distributor, Retail. MH = Material Handling. E-Business = Electronic Business. Whse. = Warehouse. IS & IT = Information Systems and Information Technology. Auto ID & Voice = Automated Identification such as bar codes and radio frequency identification, and voice recognition.

Of great interest is how well the Industry groups' ratings of the concepts align with the Total mean split between *general knowledge* and *working knowledge*. While there is not perfect agreement, the number of SCM concepts that do not align with the Total mean divide of 2.5 is relatively small. The Manufacturing group has five concepts that do not align with the Total and the Service group has only two. The WDR group has 10 concepts that do not align as the group ranked the mid range concepts overall lower than the other Industry groups. However, even with these differences, the groups are in general agreement on the level of mastery expected for each SCM concept.

Level of Agreement Within Industry Groups

A review of the standard deviations for the 78 SCM concepts assessed by the three Industry groups provided some insight into the level of agreement within the Industry groups regarding each concept. While the group standard deviations do not address the question of agreement between the groups, it does provide an indication of the level of agreement of the members within each group. This is ultimately important in confirming the strength of a concept mean and hence the level of mastery expected.

The standard deviations for the concepts indicate a general level of agreement as the vast majority is less than *SD* = .900. The Manufacturing group had six concepts with standard deviations ranging from .90 to .96. The Service group had five concepts with standard deviations ranging from .90 to .93. However, the WDR group had 18 concepts with standard deviations ranging from .90 to 1.03 indicating a greater level of disagreement within this group than the other two. There are potentially a couple explanations for these differences including the fact that the WDR group was the smallest sample group at 35 respondents therefore outliers would have a stronger impact. Another

is the risk of combining the wholesale and distributor businesses with the retail businesses in one group. It may be that their supply chain perspectives differ enough to impact their expectations of SCM program graduates. Additional survey work will be necessary to determine if the differences are significant.

This overall level of agreement within the Industry groups also provides opportunities in SCM program development to target industries if deemed of strategic value. Due to geographic location and proximity to industry concentrations, some universities may design programs to respond to specific regional industry needs, and the strength of the survey results by industry would support such a program strategy.

Level of Agreement Between Industry Groups

Once again the analysis of variance provides some of the most revealing data to address the dissertation hypothesis; SCM majors are expected to possess the same knowledge, skills, and abilities for all industries. A comparison of data for the 78 SCM concepts between groups produced the highest *p* value for Material Handling and Packaging concept of Auto Identification ($p = .998$) with all three Industry group means equal to 2.21 or 2.22. Computer PC Office the concept with the highest Total Industry group mean is also the concept with the greatest variance ($p = .006$) indicating some limited degree of differences in expectations but it still exceeds $\alpha = .001$.

Therefore, with the focus of this section on the level of agreement between industry groups, the ANOVA comparing the between group data supports the hypothesis H3; there are no significant differences between industry executive expectation of SCM higher education outcomes, both in content and mastery.

The lack of differentiation on concept level of mastery between industry groups provides a great opportunity for development of an integrated SCM higher education program that will prepare graduates for any industry. The overall agreement on the level of mastery for each concept across the industry groups provides a fairly level playing field on which to design SCM curriculum. The few differences allow for program developers to customize programs if an industry specific strategy is selected.

Industry Group SCM Discipline Ranking Finding

A review of the central tendency statistics for the SCM discipline rankings of the Industry groups was conducted and is presented in Table 83. While all groups are in agreement that the lowest ranking SCM discipline is Material Handling and Packaging, there is some disagreement on the highest ranking discipline. With the Manufacturing and Service Industry groups supporting the Total group ranking of 1st for Supply Management, the WDR mean ranking places it 3rd. Interestingly, the WDR mean (*M* = 4.32) is lower than Service (*M* 4.43) , but the WDR group means for Production and Inventory Planning (M = 3.74) and Forecasting (M = 3.91) are even lower and therefore result in higher rankings for both.

Table 83
SCM Discipline Ranking Comparison by Industry

SCM Discipline	Manuf.		WDR		Service		Total	
	M	Rank	*M*	Rank	*M*	Rank	*M*	Rank
Supply Management	3.87	1	4.32	3	4.43	1	4.19	1
Production	4.14	2	3.74	1	4.63	2	4.28	2
Inventory Planning Forecasting	4.18	3	3.91	2	4.91	4	4.44	3
Customer Service	4.72	4	4.53	4	4.85	3	4.74	4
Transportation	4.97	5	5.30	6	4.91	5	5.01	5
Manufacturing	5.03	7	5.43	7	5.32	7	5.23	6
Information Systems & Technology	5.03	6	5.26	5	5.40	8	5.23	7
Distribution Management	5.87	8	6.12	8	5.20	6	5.64	8
Material Handling & Packaging	6.89	9	6.61	9	6.00	9	6.46	9

Note: Manuf. = Manufacturing. WDR = Wholesale, Distributor, Retail.

The ANOVA for the Industry group SCM discipline ranking confirms the agreement between the groups. With *p* values ranging from Distribution Management (*p* = .066) to Customer Service (*p* = .858), all p values exceed $\alpha = .001$ confirming the hypothesis that there is agreement among SCM industry leaders on the ranking of SCM disciplines.

Once again, while the rankings lack strong definition of the nine positions of the SCM disciplines, the trend indicates a higher value for the planning and supplier/customer interface disciplines, followed by the operations and physical distribution disciplines. The clustering of all the disciplines by each Industry group within a 3.02 spread on a nine point scale may also support the theory that the integrated value of the disciplines makes a forced ranking difficult if not somewhat arbitrary. This pattern is of great importance to the strategy of SCM program development. It indicates a higher value placed on the importance of a graduate's quantitative and analytical abilities to plan and analyze. At the same time these results confirm the importance of those

disciplines that have the greatest impact on profitability and competitiveness and provide guidelines for curriculum development. Of interest is the indication that the physical disciplines of material handling and packaging are of less importance to the SCM program graduate. This may be due to the engineering nature of the work, or it may be that these concepts are best learned on the job. Additional study in this area is necessary.

Conclusion

The Supply Chain Management Higher Education Survey has provided insight into both the needs and level of agreement of the three Industry groups into which respondents were aggregated. Despite what on the surface may appear to be significant differences in the strategic initiatives of differing industries, the survey results indicate that there is general agreement between all Industry groups on the level of SCM knowledge, skill, and abilities expected of higher education SCM program graduates.

While the results of all responses to 78 SCM concepts reviewed in section one of this chapter indicated that all concepts should be assessed at either the *general knowledge* or *working knowledge* level of mastery, select Industry groups identified a few disciplines that should be *some exposure* level and a few at *mastery*. In all cases, the concepts were found to be statistically only marginally into the different level of mastery ranges. Once again, no concepts were determined to be "not required for SCM graduates".

The overall agreement among the Industry groups on the level of mastery for each of the SCM concepts assessed confirms the practicality of an integrated SCM approach to curriculum development. The challenges of addressing all 78 concepts to the level of mastery indicated by the respondents are still a critical curriculum and pedagogical issues. However, the fact that the industry groups agree on what knowledge, skills, and

abilities a graduate of a higher education SCM program should bring to the marketplace is of great benefit to SCM program development. With the wide variety of industries found in any geographic region, the fact that those industries are seeking the same foundational level of concept mastery allows for the development an SCM program whose graduates will be sought by multiple industries.

Implications of This Study

This study confirms that there currently exists a finite set of SCM knowledge, skills, and abilities that will prepare the graduate from a four year higher education SCM program for success in the marketplace. It is essential to reiterate that SCM education alone will not prepare a graduate for a career in SCM. In addition, a solid foundation of business leadership and management knowledge, skills, and abilities are required. The corporate SCM leader respondents to the Supply Chain Management Higher Education Survey confirmed both these assertions by agreeing on a common set of SCM concepts and the level of mastery expected of a higher education SCM program graduate. In addition, the respondents rated highest many of the general SCM and business concepts presented. Confirming the appropriateness of the SCM concepts presented in the survey as critical components of an SCM higher education program. It is also significant that in all of the response assessments conducted none of the 78 SCM concepts presented were considered "not required for SCM graduates", and in fact very few respondents selected this option as an indicator of expected mastery of a concept. With only a few exceptions, the multiple views of this study provided the same level of mastery results, specifically that graduates of SCM programs should enter the marketplace possessing *general knowledge* or *working knowledge* of the 78 concepts assessed (see Appendix I). Even the

concepts presented that are engineering in nature; packaging, material handling, and plant layout and design, which were scored lower, still were identified as expecting a *general knowledge* level of mastery. This confirms their value as components of a higher education SCM program.

This study also asserts that while there are some differences in priority and comprehensiveness of the concepts expected by SCM leaders in differing segments of SCM or differing industries, the concepts surveyed provide the foundation for career success in SCM. The results of the study confirm that the 78 concepts evaluated are significant to all SCM discipline careers and all industries. At the same time it provides insight into some of the variability of expectations based on SCM discipline responsibility or industry needs. Should an SCM program curriculum strategy be to support a specific industry or prepare a graduate to focus on an SCM discipline, this information would be valuable in program development.

Therefore, this study implies that all of the concepts surveyed should make up the core of any higher education comprehensive SCM program. The study results provide insight into the priority the respondents placed on each concept by the positioning of the concept within the level of mastery range and in relationship to each other. The results of this study can be used as a guideline to establish the desired outcomes of an SCM higher education program from which curriculum development can take direction. Likewise, establishing electives or advanced options of study to support student interest in an industry or SCM discipline could be offered to supplement the SCM core and permit students to develop a higher level of mastery in select concepts.

Finally, the results of this study imply that the traditional business disciplines that now comprise the functional infrastructure and strategic model for SCM have become integrated to the point where prioritization of each is not feasible. While the intent of the SCM discipline ranking question was to provide another level of granularity to critique the importance of each SCM concept assessed, the results indicate a lack of firm agreement on a specific priority of the traditional SCM concepts. A review of the response data provides only some indication of a trend to higher priorities in SCM planning and customer/supplier relationship disciplines followed by operations and distribution. The one discipline group that was consistently ranked the lowest is Material Handling and Packaging. This is understandable as much of the specific work in these areas is done by industrial and packaging engineers. Therefore, while SCM business programs need to raise student awareness and understanding of these disciplines, the details of designing and implementing each are generally not considered content matter for a business student.

It is important to note that these findings do not imply or propose there are no differences in the knowledge, skills, and abilities required for long-term career success in a particular SCM responsibility group or industry. Rather, that SCM executives are looking for talented professionals possessing a prescribed level of mastery of the SCM concepts presented, along with strong leadership and business skills. Therefore, these results do imply that the differences and nuances of SCM responsibility and industry knowledge, skills, and abilities will be part of the graduate's lifelong learning both on the job and through additional focused training and education.

As a result of these findings a model was created to aid higher education SCM curriculum program assessment and development, and to establish the outcomes and confirming assessments to enhance a graduate's potential for success in the marketplace (see Figure 3). Research has shown that SCM programs must be built on a foundation of general business knowledge and a solid set of management, analytical, and leadership skills (Gammengaard & Larson, 2001; P. R. Murphy & Poist, 2006; Myers et al., 2004; van Hoek et al., 2002). These skill sets do not have to be mature and well developed at the time of graduation, but strong building blocks for long-term development must be in place.

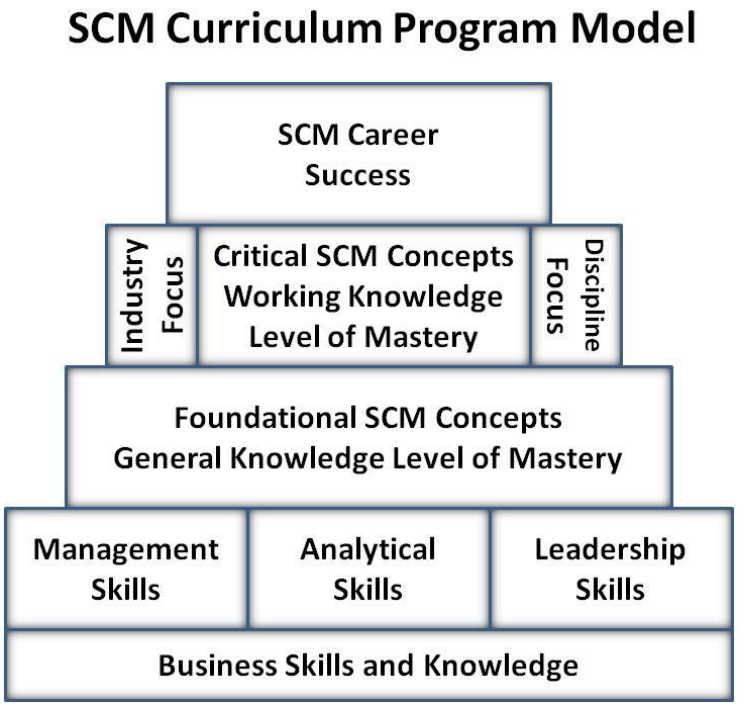

Figure 3. SCM Curriculum Model

Upon this foundation of general business knowledge and skills the SCM curriculum can be built to provide the SCM specific knowledge, skills, and abilities critical to career success. The SCM Higher Education Survey has confirmed that all 78

concepts evaluated are of importance to the success of a program graduate. Given no significant differences were found based on SCM responsibility or industry needs, the overall average rating for each concept provides a good indicator of the level of mastery expected of an SCM program graduate. Therefore, it can be inferred that the curriculum of an SCM program must develop all 78 concepts beyond the level of *some exposure* to a minimum of *general knowledge* in both content and outcomes assessment.

With this level of content and mastery in place those concepts identified as valued enough to require a mastery level of *working knowledge* can then be enhanced in the program to achieve this goal. Specific pedagogical methods may vary by program strategy and faculty preferences, however, students must gain a higher level of mastery and self efficacy in those concepts rated highest by SCM executives. In addition, program strategy may focus on industry or SCM discipline requirements by elevating the level of mastery for select concepts identified by the subgroups as requiring *working knowledge* or perhaps even *mastery*.

The intent of the SCM Curriculum Program Model is not to limit the scope and content of an SCM program, rather it is designed to provide visibility to the knowledge, skills, and abilities a program wishes to promote. In fact, the model provides a format by which program developers can strategically direct the programs content to target specific market needs.

It is also important to point out that the model is a shell with each level including many business and SCM concepts, techniques, and skills. For example, in assessing or developing an SCM program the Foundational SCM Concepts level of the model would in fact include all 78 concepts from the survey or more. It provides a structure by which

the content and level of mastery can be strategically decided setting the groundwork for outcomes assessment.

Finally, the model can be used in concert with Bloom's Taxonomy (Schultz, 2007) to formally build a hierarchy of knowledge and skill development. Working knowledge requires the more advanced abilities of analysis and creativity, and program improvements must focus on pedagogical methods to develop learning to these levels.

Limitations

Limitations to the study include issues of dealing with the scope of SCM. Specifically, while the definition of SCM continues to evolve and industry adapts organizationally, operationally, and strategically, the scope of SCM is a very large and moving target (Gibson, Mentzer, & Cook, 2005). The goal to develop and administer a comprehensive SCM survey containing less than 90 content question plus demographics required the aggregation of concepts and the presentation of techniques to assess SCM principles. Discipline experts who critiqued the survey often complained about the limits on the number of concepts included. While the results of the study provide a good view of SCM executive expectations regarding the concepts provided, and the fact that few respondents offered additional concepts, each discipline could be assessed in a more comprehensive manner.

The decision to use a five point Likert scale was intended to reduce respondent stress and improve the response rate. The five point scale results reduced the granularity of responses and limited the differentiation. Some respondents also expressed concern regarding the definition of the five point scale, except for "none". The requirement on the part of the respondent to interpret the levels of mastery was stressful for some and may

have resulted in the loss differentiation due to interpretation and may have limited the response rate.

The 218 sample size provided a good indication of the expectations of mastery for the responding group and SCM executive population they represent. However, the distribution detail for the SCM discipline and industry analysis did not provide the depth expected. The SCM discipline responses were revealing in the fact that such a major portion of the respondents oversee all or a significant portion of their company's SCM operations. While this was informative, it did not permit the desired assessment of the nine SCM disciplines that were the focal point of the study. The necessary aggregation into four Responsibility groups did not result in a good distribution of sample sizes and therefore the results have limitations. The two greatest limitations include the dominance of the Total SCM group and the insufficient sample size of the Material and Other groups.

The industry segmentation likewise suffered from many categories and skewed samples. The aggregation by NAIC did produce a stronger sample set than the discipline segmentation. One area for additional analysis is the decomposition of the Wholesale, Distributor, and Retail group to see if there were any differences that were lost in the combination.

Finally the length of the survey may have affected responses. While most respondents completed the entire survey there were some who did not provide the demographic data and others that elected to answer only segments of the survey. The survey strategy allowed for skipping discipline segments that the respondent did not feel qualified to address. It is not clear if that was the only reason the segments were not

completed. The lack of definition in the SCM discipline ranking segment may be attributable to the integration priorities that exist in SCM or it may be due in part to survey fatigue and encountering a nine point ranking as the final assessment.

While these limitations, some understood at the time of the study, others learned through the study process, provide insight to improving future work, they are not considered significant detractors to this study. The results of this study provide a solid foundation for development of an SCM program curriculum. These limitations are noted as issues to consider if this work is input to more specific outcomes development such as courses.

Future Research

Future research in the area of SCM higher education can take a number of different tracks. As identified in Chapter I, there are four additional curriculum and pedagogical based questions to be addressed related to developing a comprehensive and effective SCM program. These include:

- How does one assess that the industry and graduate program outcome requirements for undergraduate SCM majors have been met?
- How does one ensure the program and its courses provide students the opportunity to gain the knowledge, skills, and abilities identified in the SCM program outcomes and remain up to date?
- How does one ensure that the SCM courses and program meet the university/school vision, mission, and goals?
- What teaching techniques and skills best support the SCM program outcomes?

Of great concern for both student and program success is the development of outcomes assessments to ensure the level of mastery identified in this study for each concept is in fact achieved by a graduate of an SCM program. This will be a logical next research step and the course of action I will take toward the goal of addressing the SCM higher education curriculum effectiveness with a focus on the continuing enhancement of the Duquesne University SCM program.

Another area for future research includes focused studies into the detailed academic outcomes for each of the SCM disciplines. A migration of the work done by Giunipero and Handfield (2004) in the supply management area to the other SCM disciplines would provide insight into specific learning goals important to each discipline. This would help to validate or refute the claims of this study that there are no differences in expectations of SCM program graduates based on the business hiring SCM discipline.

There would be value in a similar study focused on specific industry requirements of SCM graduates. Once again to validate or refute the claims of this study that there are no differences in expectations of SCM program graduates based on the hiring industry.

There are at least two comparative studies that would be both informative and constructive to the future of SCM education. One opportunity is to compare the results of this study with the current content of the SCM professional society certification programs. While a number of the SCM professional society certification programs were critiqued to validate discipline concept content for the Supply Chain Management Higher Education Survey, it would be informative to compare the results of this study with the examination content. This would be of special interest as some of the professional societies are updating their certification programs.

Also of interest would be a study of SCM faculty to see if there is agreement between the industry responses to this study and those who are preparing the graduate to enter the marketplace. Recognizing that all higher education SCM programs are not comprehensive and that some strategically focus on segments of SCM, this study would require additional demographic information of the academic institution's program strategy.

Finally, there would be benefit to continuing this work as a longitudinal study to monitor changes in overall, discipline, and industry expectation of the SCM knowledge, skills, and abilities of a graduate from a higher education SCM program. It is my plan to continue the research both at the macro-level of the Supply Chain Management Higher Education Survey and in greater depth into the expectations of discipline specific curriculum development.

Conclusion

The new and rapidly changing business concept that has become known as supply chain management is providing the marketplace with new-found opportunities and challenges to improve cost, quality, flexibility, and responsiveness and thus enhanced business competitiveness. In its infancy, the SCM evolution is integrating a number of traditional business disciplines with enhanced processes that are linked by information systems and technology to enable previously unconsidered strategic initiatives. These rapid and continuous changes require SCM professionals to have a focus on lifelong learning in order to keep up-to-date and competitive. It is for this environment that the higher education SCM programs must prepare graduates for career success. These factors were the motivation behind this study.

Specifically, SCM faculty and administrators struggle with content to be included in SCM programs, strategies for keeping programs current, the view that integrated SCM cannot be learned in the time allotted by four year SCM programs, and the perception that differences in industry and discipline requirements surpass program flexibility. Research into standard outcomes assessment for SCM concepts produced limited results, in fact there did not exist a single body of information on what SCM concept outcomes should be assessed. Therefore, it was necessary to conduct a study to determine if there currently exists agreement among SCM executives on the knowledge, skills, and abilities entry level SCM program graduates should possess for career success. It was important that not only were the primary SCM concepts assessed, but in addition the level of mastery determined. With such information the Duquesne University, as well as higher education SCM programs globally, can build a solid strategic SCM curriculum development model to ensure both current and future program effectiveness. The 218 corporate executives who contributed to the study provided data to establish a body of knowledge upon which SCM programs can mature and flourish.

This study provides insight into the expectations of corporate SCM executives regarding the knowledge, skills, and abilities of entry level SCM professionals graduating from a four year higher education SCM program. The study confirms the existence of a foundational set of concepts that are critical to SCM career success. In addition, it confirms that while there may be differences in approaches to SCM based on discipline or industry perspectives, these same foundational concepts are of value to all SCM program graduates regardless of their career starting point.

After discussions with SCM leaders, review of professional society goals, and years of personal experience in the field, I expected a significant difference between disciplines and some differences between industries on the importance of the SCM concepts assessed and the level of mastery expected. The overwhelming agreement across both groups was both surprising and encouraging. Without such agreement SCM higher education programs would continuously struggle to meet disparate needs in the marketplace. Significant disagreements on concept importance by discipline would also indicate the lack of SCM integration in industry. While there are still those who hold to the value of purity in discipline content or limited integration with strategies such as logistics, this research clearly points to a strong gestalt view of SCM. It was also surprising to find such a large portion of the respondents identifying the scope of their responsibilities to include all of SCM. The fact that CSCMP has over 2100 members with titles of director, vice president, or chief supply chain officer reveals the continued recognition of the value of SCM to corporate success.

This study is the first step in establishing a comprehensive SCM higher education program. It lays the foundation for the development of outcomes assessment, strategic curriculum development, and alignment of pedagogical best practices, intended to create a dynamic SCM program that will meet current stakeholder expectations and keep aligned with and drive the continued evolution of SCM.

The timeliness and value of this study is evident in the continued research and discussion of the subject as of late. The Supply Chain Council (SCC) recently organized an online SCM higher education interest group titled the Supply Chain Talent Academic Initiative (SCTAI). The group's primary focus is "The partnership being developed

between industry, the universities, and the professional associations to define supply chain skill requirements and to assist the universities in meeting the growing and changing demands of industry" (Supply-Chain-Council, 2009a). The group being supported by Linkedin.com has drawn 193 industry and academic members in less than two months showing the value and interest surrounding the topic of SCM higher education.

Also, the SCC, in concert with AMR Research, recently conducted a survey of 300 companies to identify the critical skill sets for the next generation supply chain manager, what skill set gaps exist today, and what universities can do to better prepare graduates for a career in SCM (Supply-Chain-Council, 2009b). While the results of the SCC/AMR study are not available at this time for referencing in this study, the fact that these two prestigious organizations invested in such a project confirms the importance of the topic.

The immediate benefit of this research will come from the assessment and enhancement of the Duquesne University SCM program. Application of the SCM Program Curriculum Model through mapping of current course and program content and level of mastery to that of the study results will provide insight into the strengths and areas for improvement in the current program. These results will provide strategic direction for curriculum development including course revisions and additions. It will also set the framework for instituting a formal hierarchical outcomes assessment program that integrates course and program level assessment.

As identified in the introduction to this study, there are five critical steps to complete before an SCM program can truly address the question of:

"*How can higher education faculty ensure that students completing a Supply Chain Management program have acquired and can demonstrate the knowledge, skills, and abilities needed to be successful in a career in supply chain management and/or graduate studies in the field?"*

This research has focused on the first step and provides the expected SCM program outcomes of industry leaders. While the remaining steps are not easy, they cannot be effectively accomplished without the results of this study. Given the scope and depth of potential SCM academic content it is recognized that this research begins the process of truly understanding the potential and expected higher education SCM outcomes.

Finally, it is hoped that the results of this study will be of benefit as a starting point for additional research to advance the understanding of the knowledge, skills, and abilities required of SCM graduates and those seeking to focus on lifelong learning. Specifically, it will be of benefit to the SCM professional societies that currently maintain, or those planning on developing, professional certifications that address the full scope of SCM. The SCM professional societies have been active in keeping their organizations current in this rapidly changing environment. This work can provide a foundation for certification enhancement and a process by which to keep the professional programs up-to-date.

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APPENDICES

Appendix A

Supply Chain Management Higher Education Survey

Supply Chain Management Higher Education Survey

Welcome to the Supply Chain Management Higher Education Survey
It will take you less than 15 minutes to complete this survey.

-- Instructions

You can skip the introduction and begin the survey at anytime by selecting the "next" button at the bottom of the page.

Completing this survey implies your consent to participate in this research.

This is an anonymous survey. Your responses will not be linked to your email or any other method of identification.

Survey questions are grouped into 13 sections each containing from 5 to 10 related questions focused on a specific discipline for ease of answering.

You are also encouraged to add any SCM concepts, techniques, or skill sets that you feel essential and that are not included in the question set.

Your time and attention to completing this survey is deeply appreciated. While it is hoped that you would respond to all questions, feel free to skip any sections or concepts about which you do not feel qualified to respond.

If you feel a given discipline section or concept is not important for SCM graduates, please indicate so by providing the lowest score (None) for each concept in that section.

Upon completion of the survey a separate on line page will be presented to provide you with an opportunity to submit your name and address or email address to receive a copy of the research results for your review.

Thank you in advance for investing in this effort to gain stronger insight into the needs of the stakeholders of the academic process. Once the SCM needs of the marketplace are identified, then outcomes assessments and program enhancements can be implemented to better prepare graduates from a four year SCM undergraduate program to be rapid contributors in the SCM marketplace.

-- The following describes the survey goals and processes.

This survey is intended to assess the needs of the Supply Chain Management (SCM) marketplace regarding the SCM knowledge, skills, and abilities required of a graduate from a four year SCM higher education program to begin a successful career in the field. Recognizing that SCM encompasses a number of traditional business disciplines and that mastery of all concepts, techniques, and skills is not possible in the four years of an undergraduate SCM program, this survey is designed to identify both the important factors and the degree of accomplishment expected of a graduate.

It is important to note that there are a number of other general business and management skills that are critical for success in an SCM career. However, graduates from a four year SCM program will be expected to learn these skills from the general business core curriculum that all business school students are required to complete for graduation. If there are any business or management skills you deem uniquely essential for success in SCM please add them to Section 11 as appropriate.

-- Supply Chain Management Defined

The Supply Chain can be viewed as a series of repeating links that involve the processes of Plan (forecasting, production planning, and inventory planning), Source (supply management and purchasing), Make (production scheduling and manufacturing), Deliver (transportation, warehousing, material handling, packaging, and customer service), and Return (reverse logistics), linked by information systems and technology, and coordinated through SCM strategic planning. Management of the supply chain can be described as the integrative management of the sequential flow of logistical, conversion and service activities from the supplier's supplier to ultimate consumers,

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Supply Chain Management Higher Education Survey

General SCM Knowledge

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

1. What level of mastery of "General SCM Knowledge" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Definition and scope of SCM	○	○	○	○	○
SCM abbreviations and acronyms (e.g. JIT, MRP, VMI, SOP, etc.)	○	○	○	○	○
SCM role in corporate profitability and competitiveness	○	○	○	○	○
SCM strategic planning	○	○	○	○	○
SCM performance measurements	○	○	○	○	○
SCM integration cost/service optimization	○	○	○	○	○
Role of SCM in the Value Chain	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

Forecasting

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

2. What level of mastery of "Forecasting" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Role of forecasting in SCM	○	○	○	○	○
Forecasting data sources	○	○	○	○	○
Forecast model development	○	○	○	○	○
Forecast model execution	○	○	○	○	○
Advanced Planning & Scheduling (APS) functionality	○	○	○	○	○
Collaborative Planning Forecasting & Replenishment (CPFR)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Page 4

Supply Chain Management Higher Education Survey

Production and Inventory Planning

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

3. What level of mastery of "Production and Inventory Planning" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Production planning models	○	○	○	○	○
Inventory management techniques (i.e. JIT, MRP, Re-order point, EOQ, etc.)	○	○	○	○	○
Inventory costing	○	○	○	○	○
Sales and Operations Planning (SOP)	○	○	○	○	○
Distribution Resource Planning (DRP)	○	○	○	○	○
Inventory collaboration (i.e. Vendor Managed Inventory - VMI)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

Production and Inventory Planning

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

3. What level of mastery of "Production and Inventory Planning" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Production planning models	○	○	○	○	○
Inventory management techniques (i.e. JIT, MRP, Re-order point, EOQ, etc.)	○	○	○	○	○
Inventory costing	○	○	○	○	○
Sales and Operations Planning (SOP)	○	○	○	○	○
Distribution Resource Planning (DRP)	○	○	○	○	○
Inventory collaboration (i.e. Vendor Managed Inventory - VMI)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

Supply Management - Purchasing

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

4. What level of mastery of "Supply Management - Purchasing" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Master scheduling	○	○	○	○	○
Types of purchasing (MRO, Commodities, etc.)	○	○	○	○	○
Supplier selection and assessment	○	○	○	○	○
Procurement strategies (e.g. Purchasing portfolio matrix)	○	○	○	○	○
Contract law	○	○	○	○	○
Spend analysis & Total Cost of Ownership	○	○	○	○	○
Strategic sourcing	○	○	○	○	○
Supplier collaboration (e.g. Early Supplier Involvement - ESI)	○	○	○	○	○
Impact of Supply Management on profitability	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Page 6

Supply Chain Management Higher Education Survey

Manufacturing

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

5. What level of mastery of "Manufacturing" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Production scheduling techniques	○	○	○	○	○
Total Quality Management	○	○	○	○	○
Lean Manufacturing	○	○	○	○	○
Six Sigma	○	○	○	○	○
Manufacturing Resource Planning (MRPII)	○	○	○	○	○
Plant layout design and automation	○	○	○	○	○
Manufacturing strategies (e.g. Postponement)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

Transportation Management

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

6. What level of mastery of "Transportation Management" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Mode and carrier selection	○	○	○	○	○
Contract law and regulations	○	○	○	○	○
Indirect and specialized carriers	○	○	○	○	○
Third/Fourth Party Logistics (3PL/4PL)	○	○	○	○	○
Domestic transport documentation	○	○	○	○	○
International transport documentation	○	○	○	○	○
Transportation pricing	○	○	○	○	○
Global logistics	○	○	○	○	○
Transportation Management Systems (TMS)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

Distribution Management - Warehousing

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

7. What level of mastery of "Distribution Management - Warehousing" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Warehouse purposes	○	○	○	○	○
Distribution network strategies & design	○	○	○	○	○
Warehouse specifications & selection	○	○	○	○	○
Warehouse layout & design	○	○	○	○	○
Warehouse operations	○	○	○	○	○
Warehouse Management Systems (WMS)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

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Supply Chain Management Higher Education Survey

Material Handling and Packaging

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

8. What level of mastery of "Material Handling and Packaging" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Selection of material handling equipment	○	○	○	○	○
Material handling principles	○	○	○	○	○
Types & purposes of packaging	○	○	○	○	○
Packaging materials	○	○	○	○	○
Auto Identification integration (bar code, RFID, etc.)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

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Supply Chain Management Higher Education Survey

Customer Service

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

9. What level of mastery of "Customer Service" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Distribution channels	○	○	○	○	○
Customer service strategies	○	○	○	○	○
Role of customer service in SCM	○	○	○	○	○
Customer Relationship Management (CRM)	○	○	○	○	○
Reverse logistics strategies & operations	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

Supply Chain Management Higher Education Survey

SCM Information Systems and Technology

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

10. What level of mastery of "Information Systems and Technology" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Enterprise Resource Planning (ERP)	○	○	○	○	○
SCM Decision Support Systems (DSS)	○	○	○	○	○
E-Business concepts & techniques	○	○	○	○	○
SCM data collection & integration	○	○	○	○	○
Auto ID - Bar codes, RFID, Voice Recognition, etc.	○	○	○	○	○
SCM systems specification, analysis, & design	○	○	○	○	○
IS & IT assessment & selection	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

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Supply Chain Management Higher Education Survey

General Skills for SCM

Identify the level of mastery expected of SCM graduates for each topic in the following section.

Select one button for each of the concepts listed in the left hand column using the following scale:
- None = Not required of SCM graduates
- Some Exposure = Familiarity with the topic is sufficient
- General Knowledge = Able to discuss topic and research solutions
- Working Knowledge = Able to apply and analyze topic
- Mastery = Proficient application and able to instruct others

11. What level of mastery of "General Skills for SCM" do you expect SCM college graduates to attain for each of the following?

	None	Some Exposure	General Knowledge	Working Knowledge	Mastery
Cross-functional teams	○	○	○	○	○
Six Sigma	○	○	○	○	○
Lean	○	○	○	○	○
Process mapping	○	○	○	○	○
Project management	○	○	○	○	○
Simulation modeling	○	○	○	○	○
Communication skills	○	○	○	○	○
Problem solving & decision making skills	○	○	○	○	○
Ethics	○	○	○	○	○
Negotiation skills	○	○	○	○	○
PC skills (e.g. Word, Excel, etc.)	○	○	○	○	○
Other (specify in comments)	○	○	○	○	○

Comments

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Supply Chain Management Higher Education Survey

SCM Discipline Ranking

Thank you for rating the level of mastery for the various concepts from each SCM discipline.

Please now rank each discipline based on the level of importance to you.

This is a forced ranking and while it is recognized that more than one may be significantly important (1) or un-important (9) please provide a 1 through 9 ranking for each. Each ranking number can only be used once.

12. Rank the following disciplines based on their importance to SCM.

	1	2	3	4	5	6	7	8	9
Forecasting	○	○	○	○	○	○	○	○	○
Production & Inventory Planning	○	○	○	○	○	○	○	○	○
Supply Management	○	○	○	○	○	○	○	○	○
Manufacturing	○	○	○	○	○	○	○	○	○
Transportation	○	○	○	○	○	○	○	○	○
Warehousing	○	○	○	○	○	○	○	○	○
Material handling & Packaging	○	○	○	○	○	○	○	○	○
Customer service	○	○	○	○	○	○	○	○	○
SCM information systems & technology	○	○	○	○	○	○	○	○	○

Supply Chain Management Higher Education Survey

About you and your business

Please provide the following demographic information.

13. Please identify title that most closely describes your organizational position (select only one).

- ○ Chief Supply Chain Officer
- ○ Vice President
- ○ Director
- ○ Manager
- ○ Supervisor
- ○ Other (please specify)

14. Select the area of SCM that best describes the scope of your responsibilities (select as many as appropriate).

- ☐ Total Supply Chain Management
- ☐ Materials Management
- ☐ Physical Distribution
- ☐ Forecasting
- ☐ Production & Inventory Planning
- ☐ Supply Management
- ☐ Manufacturing
- ☐ Transportation
- ☐ Warehousing, Material handling, & packaging
- ☐ Customer service & Order management
- ☐ SCM System & Technology
- ☐ Other (please specify)

Supply Chain Management Higher Education Survey

15. Select the industry category that best describes your business (select only one).

- ○ Aerospace & Defense
- ○ Automotive
- ○ Computers
- ○ Industrial
- ○ Electricals & Electronics
- ○ Chemicals
- ○ Package Goods
- ○ Grocery
- ○ Apparel
- ○ Healthcare
- ○ Financial Serices
- ○ Supply chain service provider
- ○ Other (please specify)

16. What was your company's revenue for the last complete fiscal year?

- ○ Less than $1 million
- ○ $1 million to less than $10 million
- ○ $10 million to less than $100 million
- ○ $100 million to less than $1 billion
- ○ $1 billion to less than $10 billion
- ○ Greater than $10 billion
- ○ Other (please specify)

17. Does your company have a Supply Chain Management organizational structure?

- ○ Yes
- ○ No

Supply Chain Management Higher Education Survey

18. If you answered "Yes" to question 17, which of the following disciplines are included in your SCM organization (select all that apply)?

- ☐ Forecasting
- ☐ Production & Inventory Planning
- ☐ Supply Managment - Purchasing
- ☐ Manufacturing
- ☐ Transportation
- ☐ Warehousing, Material handling, & Packaging
- ☐ Customer service & Order management
- ☐ SCM Systems & Technology
- ☐ Other (please specify)

19. Please indicate your years of SCM work experience.

	Years of experience
In the workforce	
In your current position	

20. Please indicate your gender.

- ○ Female
- ○ Male

21. What is your age?

- ○ 20 - 29
- ○ 30 - 39
- ○ 40 - 49
- ○ 50 - 59
- ○ 60 - 69
- ○ Greater than 70

Supply Chain Management Higher Education Survey

Thank You

Thank you for completing the SCM Higher Education survey.

Your input will be combined with that of other SCM executives to identify the critical outcomes for higher education SCM programs.

If you would like a copy of the survey results, please click the following link that will take you to another site to input your mailing or email address. This link is to protect the confidentiality of your responses.

Addresses submitted will not be used for any other purpose than forwarding the survey results.

Thank you again.

Click here to access a separate site to provide contact information to receive study results. Click Here.

Or

Select "Done" to leave the survey without requesting results.

Thank You

Appendix B

John R. Mawhinney
Executive Assistant Professor

T 412.396.1774
F 412.396.4764

Duquesne University
600 Forbes Avenue
Pittsburgh PA 15282

www.business.duq.edu
mawhinney@duq.edu

DUQUESNE BUSINESS SCHOOL
A.J. PALUMBO SCHOOL OF BUSINESS ADMINISTRATION

October 27, 2008

Name
Title
Company
Address
Address
City, State Zip

Dear ,

The rapidly changing field of Supply Chain Management (SCM) creates a challenge for universities offering SCM degrees to keep current on critical concepts and methods. You can help assure future graduates will be prepared to start successful careers and contribute quickly to hiring organizations by identifying the critical knowledge, skills, and abilities they require.

In a Supply & Demand Chain Executive reader survey respondents cited that one of the most critical business issues facing their supply organizations was "lack of expertise in global supply chain management"1. This year's APICS, Michigan State University, and SAP sponsored study "Supply Chain Management 2010 and Beyond", identified six significant gaps including "Talent management and leadership" specifically stating "An insufficient supply of competent cross-functionally trained supply chain professionals exists"2.

You have been identified as an SCM strategic decision maker in your organization and your input regarding the outcomes of SCM higher education programs is of great value to the future of SCM education, and potentially future candidates for positions in your company.

Within the next few days you will receive an email with a link to an online Supply Chain Management Higher Education survey through which you can provide insight into the factors you deem critical to SCM career success. The survey can be completed in less than 15 minutes and the results will be anonymously compiled with the responses of other SCM executives for analysis and publication.

If you would like to complete the survey now, log on to http://www.business.duq.edu/survey at your convenience and select the "Supply Chain Management Higher Education Survey". Also, if you are interested in the results you can request a copy upon completion of the survey.

With 26 years of corporate SCM experience I am working toward a doctoral degree in supply chain management education with a focus on SCM program outcomes. Keeping current on the needs of industry is critical to SCM higher education program success, and with your help we can meet that goal.

Thank you in advance for participating in this research.

Respectfully,

John R. Mawhinney
Executive Assistant Professor
Supply Chain Management
Duquesne University

1. Supply & Demand Chain Executive, Executive Memo: Warning signs, June/July 2006,
2. APICS Educational & Research Foundation, 2008, Supply Chain Management 2010 and Beyond: Mapping the Future of the Strategic Supply Chain

Appendix C

Supply Chain Management Higher Education Study Request for

1. Contact Information

If you wish to receive a copy of the final results of the Supply Chain Management Higher Education study, please provide your contact information below.

This information will be used only to provide study results and will not be used or shared for any other purposes.

1. Please provide mail or email information to which you would like the survey results sent.

Name:

Company:

Address:

Address 2:

City/Town:

State:

ZIP/Postal Code:

Country:

Email Address:

Page 1

Appendix D

PALUMBO ▪ DONAHUE
School of Business
DUQUESNE UNIVERSITY

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934 ROCKWELL HALL

600 FORBES AVENUE
PITTSBURGH, PA 15282
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mawhinney@duq.edu
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This email is follow-up to the letter you received a couple days ago regarding the Supply Chain Management Higher Education Survey designed to assess what knowledge, skills, and abilities are most important to you for SCM university graduates to possess.

In the time it takes to drink a cup of coffee, you could cast your vote and provide valuable input for the future direction of SCM education.

You have been identified as an SCM strategic decision maker in your organization and your input regarding the outcomes of SCM higher education programs is of great value to the future of SCM education, and potentially future candidates for positions in your company.

The survey can be completed in less than 15 minutes and the results will be anonymously compiled with the responses of other SCM executives for analysis and publication. Also, if you are interested in the results you can request a copy upon completion of the survey.

Access the survey through the following link: http://www.business.duq.edu/survey and select the "Supply Chain Management Higher Education Survey".

If you are one of the many who have already completed the survey; thank you for your contribution to the future of SCM education. If not, your investment in this project would be deeply appreciated.

John Mawhinney – Doctoral Student
Executive Assistant Professor
Supply Chain Management

Appendix E

PALUMBO • DONAHUE
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If you are one of the many who completed the Supply Chain Management Higher Education Survey, thank you! The time you invested is deeply appreciated and your contribution will strengthen the results of the study.

If you have not completed the survey but would like to have your views included in the study there is still time. It will take less than 15 minutes for you to provide valuable information regarding your opinion on the level of mastery of various disciplines that a graduate from a four year SCM program should possess upon graduation.

Please invest in the future of SCM education by accessing and anonymously completing the survey through the following link: http://www.business.duq.edu/survey and selecting the "Supply Chain Management Higher Education Survey".

Upon completion of the survey you will be given an opportunity to request a copy of the results.

Thank you in advance for participating in this project to assist university faculty and administrators gain a better understanding of your expectations of an SCM graduate.

The survey link will be closed on November 29.

John Mawhinney – Doctoral Student
Executive Assistant Professor
Supply Chain Management

Appendix F

PALUMBO • DONAHUE
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Thank you to all who completed the Supply Chain Management Higher Education Survey.

If you have not taken the survey, I am writing to ask a favor, I need your help.

Statistical significance for survey results is dependent on the number of surveys completed by those asked to take the survey, and while nearly 200 have responded so far, this leaves the pending results in question.

Please consider an investment of 15 minutes to contribute to the future direction of SCM education by completing the Supply Chain Management Higher Education Survey.

The survey has been reopened and is accessible through http://www.business.duq.edu/survey and by selecting the "Supply Chain Management Higher Education Survey".

If you would like to see the views of hundreds of other SCM executives regarding SCM education, you will be given an opportunity to request a copy of the results upon completion of the survey.

Thank you in advance for participating in this project to assist university faculty and administrators gain a better understanding of your expectations of an SCM graduate.

The survey link will be closed on December 31.

Happy Holidays

John Mawhinney – Doctoral Student
Executive Assistant Professor
Supply Chain Management

Appendix G

Supply Chain Managment Textbook Review																											
Author(s)	**Title**	**Ed**	**Year**	**Type**	**Scope**	**IS & IT**	**Frcst**	**Agg Pln**	**Invent**	**Mtl Pln**	**Purch**	**Ops**	**Trans**	**Whse**	**Mtl Hnd**	**Pkg**	**Cus Ser**	**Rev Log**	**Dist Pln**	**Metrics**	**Qual**	**Coolab**	**Pln/Proj Mgt**	**BPM/ BPR**	**Model**	**Global**
Arnold, J. T. Tony, Chapman, Stephen, N., Clive, Lloyd, M.	Introduction to Materials Management	6th	2008	Op / Tact	MatM	1	1	1	1	1	1	1	1	1	1	1				1	1	1				
Ballou, Ronald H.	Business Logistics/ Supply Chain Management: Planning, Organizing, and Controlling the Supply Chain	5th	2004	Op / Tact	Log	1			1	1	1		1	1	1		1		1	1						
Benton, Jr, W. C.	Purchasing and Supply Management		2007	Op / Tact	Pur	1			1	1	1		1							1	1	1				1
Blanchard, David	Supply Chain Management Best Practices		2007	Op / Tact	SCM	1	1	1			1	1	1	1			1		1	1	1	1				1
Bloomberg, David J., LeMay, Stephen, Hanna, Joe B.	Logistics		2002	Op / Tact	Log	1		1	1	1	1	1	1	1	1	1	1	1			1	1	1				1
Bowersox, Donald J., Closs, David J., Cooper, M. Bixby	Supply Chian Logistics Management	2nd	2007	Op / Tact	Log	1	1		1		1	1	1	1	1	1	1		1			1	1				1
Bozarth, Cecil C., Handfield, Robert B.	Introduction to Operations and Supply Chain Management	2nd	2008	Op / Tact	Ops	1	1	1	1	1	1	1							1		1		1	1		
Burt, David N., Dobler, Donald W., Starling, Stephen L.	World Class Supply Management: The Key to Supply Chain Management	7th	2003	Op / Tact	Pur	1	1		1	1	1										1	1	1		1	1
Cachon, Gerard Terwiesch, Christian	Matching Supply with Demand: An Introduction to Operations Management		2006	Op / Tact	Ops	1	1	1	1			1											1		1	
Chapman, Stephen N.	The Fundamentals of Production Planning and Control		2006	Op / Tact	Inv/PrP	1	1	1	1	1	1	1														
Chase, Ricard B., Aquilano, Nicholas J., Jacobs, F. Robert	Operations Management for Competitive Advantage	9th	2001	Op / Tact	Ops	1	1	1	1	1		1							1		1		1		1	
Chopra, Sunil, Meindl, Peter	Supply Chain Management: Strategy, Planning, and Operation	3rd	2007	Strat	SCM	1	1	1	1		1		1						1	1		1			1	
Christopher, Martin	Logistics and Supply Chain Management: Creating Value-Adding Networks	3rd	2005	Strat	SCM														1	1		1	1			1
Cohen, Shoshanah, Roussel, Joseph	Management: The Five Disciplines of Top Performance		2005	Strat	SCM							1								1	1	1	1			
Copacino, William C.	Supply Chain Management: The Basics and Beyond		1997	Op / Tact	SCM		1		1		1		1	1						1		1	1	1		
Coyle, John J., Bardi, Edward J., Novack, Robert A.	Transportation	6th	2006	Op / Tact	Trans	1							1				1					1				1
Coyle, John J., Bardi, Edward J., Langley Jr., C. John	The Management of Business Logistics: A Supply Chain Perspective	7th	2003	Op / Tact	SCM	1			1	1	1		1	1	1	1	1		1	1	1	1				1
Fawcett, Stanley E., Ellram, Lisa M., Ogden, Jeffrey A.	Supply Chain Management: From Vision to Implementation		2007	Strat	SCM	1					1		1	1			1			1	1	1	1	1	1	1

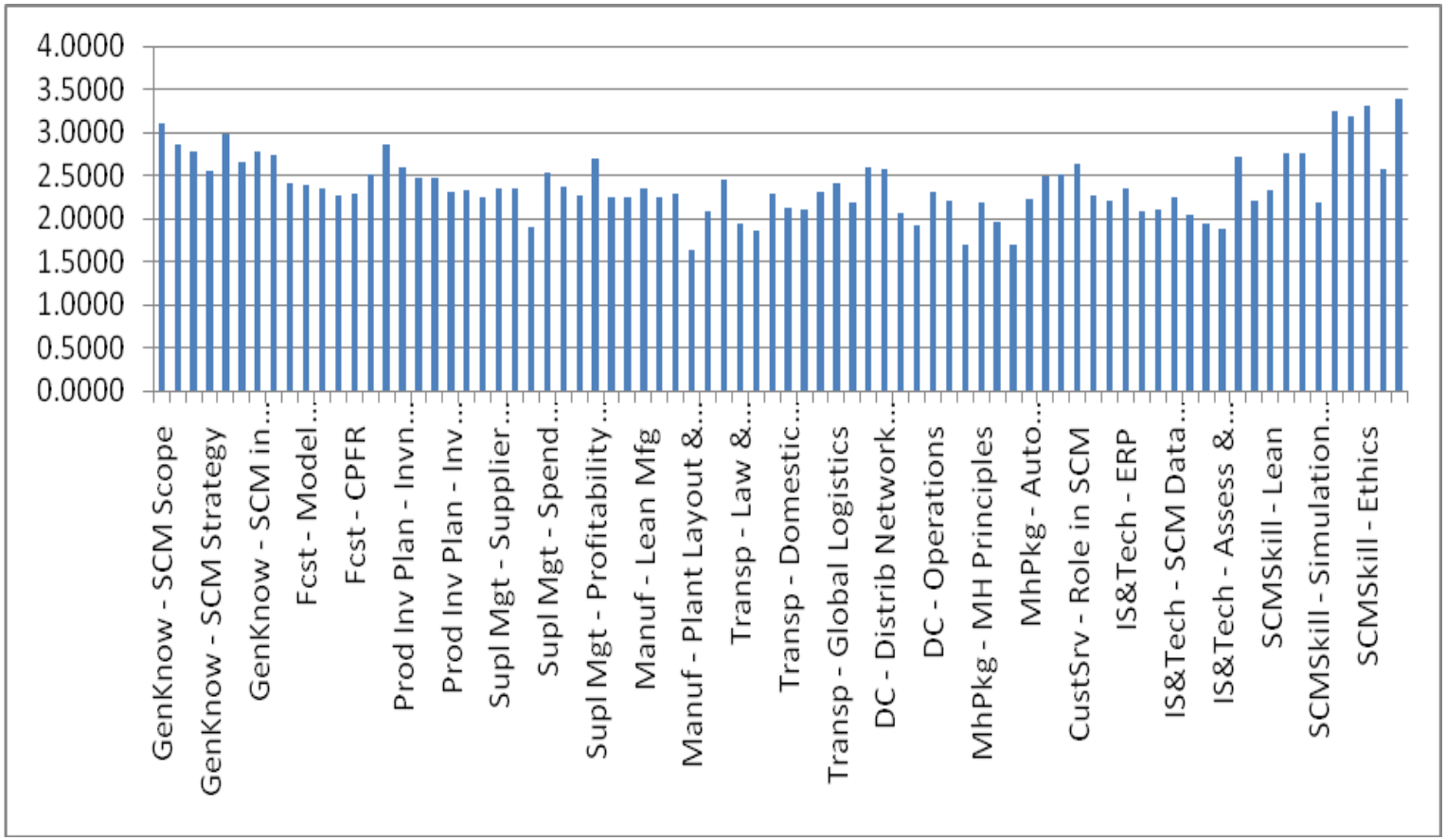
Fitzsimmons, James A., Fitzsimmons, Mona J.	Service Management: Operations, Strategy, and Information Technology	5th	2006	Op / Tact	Ops	1	1	1	1			1							1		1	1	1			1
Gattorna, John	Strategic Supply Chain Allignment:Best Practices in Supply Chain Management		1998	Strat	SCM	1	1	1	1		1		1				1	1	1	1	1	1	1		1	
Ghiani, Gianpaolo, Laporte, Gilbert, Musmanno, Roberto	Introduction to Logistics Systems Planning and Control		2004	Op / Tact	Log	1	1		1				1	1	1		1		1						1	
Handfield, Robert B., Nichols Jr., Ernest L.	Introdution to Supply Chain Management		1999	Op / Tact	SCM	1														1		1				
Hanna, Mark D., Newman, W. Rocky	Integrated Operations Management: Addign Value for Customers		2001	Strat	Ops	1	1	1	1			1					1				1	1	1		1	
Heizer, Jay, Render, Barry	Operations Management	9th	2008	Op / Tact	Ops	1	1	1	1	1		1	1						1	1	1	1	1		1	1
Hopp, Wallace, J.	Supply Chain Science		2008	Op / Tact	SCM				1			1									1	1				
Hugos, Michael	Essentials of Supply Chain Management	2nd	2006	Strat	SCM	1		1			1	1	1	1			1			1		1				
Jacobs, Robert F. Chase, Richard B.	Operations and Supply Chian Management: The Core		2008	Op / Tact	Ops		1	1	1	1	1	1							1				1			
Krajewski, Lee J., Ritzman, Larry P., Malhotra,, Manoj K.	Operations Management Processes and Value Chains	8th	2007	Op / Tact	Ops		1	1	1	1	1	1					1		1	1	1		1	1	1	
Lambert, Douglas M.	Supply Chain Management: Process, Partnerships, Performance	2nd	2006	Strat	SCM	1	1				1	1					1	1		1	1	1	1	1	1	
Johnson, P. Fraser, Flynn, Anna E., Fearon, Harold, E.	Purchasing and Supply Management	13th	2006	Op / Tact	Pur	1	1		1	1	1		1							1	1	1	1	1		1
Monczka, Robert M., Trent, Robert J., Handfield, Robert B.	Purchasing and SupplyChain Management	2nd	2002	Op / Tact	Pur	1			1		1		1							1	1	1	1			1
Murphy Jr., Paul R., Wood, Donald F.	Contemporary Logistics	9th	2008	Op / Tact	Log	1	1		1	1	1		1	1	1	1	1		1			1	1	1	1	1
Russell, Roberta S., Tayleo III, Bernard W.	Operations Management: Quality and Competitiveness in a Global Environment	5th	2006	Op / Tact	Ops	1	1	1	1	1		1							1		1	1	1		1	
Semchi-Levi, David, Kaminsky, Philip, Simchi- Levi, Edith	Desinging & Managing the Supply Chain: Concepts, Strategies & Case Studies	3rd	2008	Strat	SCM	1	1		1		1						1	1		1		1	1	1	1	1
Shafer, Scott M., Meredith, Jack R.	Operations Management		2003	Op / Tact	Ops	1	1	1	1	1		1									1		1		1	
Silver, Edward A., Pyke, David F., Peterson, Rein	Inventory Mangement and Production Planning and Scheduling	3rd	1998	Op / Tact	Inv/PrP		1	1	1	1															1	
Waters, Donald	Inventory Control and Management		2003	Op / Tact	Inv/PrP	1	1	1	1	1															1	
Webster, Scott	Principles and Tools for Supply Chain Management		2008	Op / Tact	SCM	1	1	1	1	1			1								1			1		1
Wisner, Joel D. Stanley, Linda L.	Process Management: Creating Value along the Supply Chain		2008	Op / Tact	SCM	1	1		1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	
Wisner, Joel D., Leong, G. Keong., Tan, Keah-Choon	Principles of Supply Chain Mangagement: A Balanced Approach		2005	Strat	SCM	1	1	1	1		1		1	1			1		1	1		1		1		1

Appendix H

Supply Chain Management Professional Society Certification Program Review																						
Organization	**Certification**	**IS & IT**	**Frcst**	**Agg Pln**	**Invent**	**Mtl Pln**	**Purch**	**Ops**	**Trans**	**Whse**	**Mtl Hnd**	**Pkg**	**Cus Ser**	**Rev Log**	**Dist Pln**	**Metrics**	**Qual**	**Coolab**	**Pln/Proj Mgt**	**BPM/ BPR**	**Model**	**Global**
APICS - The Association for Operations Management (APICS)	Certified Production & Invnetory Management (CPIM)	1		1	1	1		1								1	1		1			
APICS - The Association for Operations Management (APICS)	Certified Supply Chain Professional (CSCP)	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1		1
American Society of Transportation and Logistics (AST&L)	Certified in Transportation and Logistics (CTL)	1	1		1				1	1						1		1			1	1
Institute for Supply Management (ISM)	Certified Purchasing Manager (CPM)	1	1		1	1	1	1	1					1		1	1	1	1		1	1
Institute for Supply Management (ISM)	Certified Professional in Supply Management (CPSM)	1	1	1	1	1	1		1	1	1					1	1	1	1			1
International Supply Chain Education Alliance (ISCEA)	Certified Supply Chain Manager (CSCM)	1	1	1	1	1	1	1	1						1	1	1	1	1		1	
		6	5	4	6	5	4	4	5	3	1	0	1	2	2	6	5	5	5	1	3	4

Appendix I

SCM Higher Education Survey Concept Averages



GLOSSARY

- Aggregate Planning is the process of developing tactical plans to support the organization's business plan. Aggregate planning usually includes the development, analysis, and maintenance of plans for total sales, total production, targeted inventory, and targeted customer backlog for families of products (A.-A. f. O. M. APICS, 2008).

- Assessment is any method used to better understand the current knowledge that a student possesses (R.J. Dietel, J.L. Herman, & R.A. Knuth, 1991).

- Customer Service includes the Activities between the buyer and seller that enhance or facilitate the sale or use of the seller's products or services (CSCMP, 2006).

- Distribution Planning is the planning activities associated with transportation, warehousing, inventory levels, materials handling, order administration, site and location planning, industrial packaging, data processing, and communications networks to support distribution (CSCMP, 2006).

- Forecasting is the business function that attempts to predict sales and use of products so that they can be purchased or manufactured in appropriate quantities in advance (A.-A. f. O. M. APICS, 2008).

- Infrastructure the underlying foundation or basic framework as of a system or organization including the resources required for an activity (Merriam-Webster, 2008).

- Inventory Planning includes the activities and techniques of determining the desired levels of items, whether raw materials, work in process, or finished products including order quantities and safety stock levels (A.-A. f. O. M. APICS, 2008).

- Material Handling is the movement of materials going to, through, and from warehousing, storage, service facility, and shipping areas. Materials can be finished goods, semi-finished goods, components, scrap, WIP, or raw stock for manufacturing (WERC, 2008).

- Operations Management is the planning, scheduling, and control of the activities that transform inputs into finished goods and services (A.-A. f. O. M. APICS, 2008).

- Packaging includes all tasks associated with the "make ready" of an item or items for shipment. May include weighing, wrapping, labeling for shipment, and so on

(WERC, 2008). Also, includes the design and selection of materials to preserve and present products.

- Production Planning is a process to develop tactical plans based on setting the overall level of manufacturing output (production plan) and the other activities to best satisfy the current planned levels of sales (sales plan or forecasts), while meeting general business objectives of profitability, productivity, competitive customer lead times, and so on, as expressed in the overall business plan (A.-A. f. O. M. APICS, 2008).

- SCM Information Systems and Technology are a set of electronic tools used by world-class (supply chain managers) to generate, process, transfer, interpret and utilize information. These tools include state-of-the-art hardware, software, databases and networks (I. f. S. M. ISM, 2008).

- Supply Management is the identification, acquisition, access, positioning, management of resources and related capabilities the organization needs or potentially needs in the attainment of its strategic objectives (I. f. S. M. ISM, 2008).

- Transportation Planning is the process of defining an integrated supply chain transportation plan and maintaining the information which characterizes total supply chain transportation requirements, and the management of transporters both inter and intra company (CSCMP, 2006).

- Warehouse Management is the management of the movement and storage of materials throughout the warehouse (Tech-Target, 2008).