

# Identifying Desirable Competencies for Supply Chain Management Professionals

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**Abstract**— As the human dimension becomes increasingly critical to overall success of supply chain management (SCM), practitioners, researchers, and educators face the daunting task of identifying requisite competencies for SCM professionals. By using a large, frequently-updated, publicly-available archive – O\*NET, this research contrasts SCM and other business professionals to highlight the unique competencies that define the SCM profession. Our findings indicate that SCM professionals need greater functional knowledge about operations (e.g., transportation, production), higher general knowledge in geography and foreign language, extensive interpersonal skills, and a person-oriented management style. Furthermore, while limited differences exist between purchasing and logistic managers in the SCM profession, they exhibit certain competencies that distinguish them from operation managers. Such results inform efforts at curriculum design, recruitment, career development, and corporate training by suggesting areas where it may well be advantageous to customize efforts toward ensuring that requisite competencies are addressed. To our knowledge, this is the first study to utilize the US Department of Labor O\*NET database to compare and identify desired competencies for Supply Chain Management Professionals.

**Keywords**— *Supply Chain Management, Knowledge, Competencies, Skills, O\*NET*

## 1. Introduction

During the past few decades, researchers and practitioners have dedicated countless hours to advance and understand the field of supply chain management (SCM). There are many perspectives regarding the nature and composition of the broader SCM discipline, but it is widely recognized that SCM has emerged as a response to competitive

forces generated by a dynamic global marketplace. This response has involved integrating formerly standalone disciplines (e.g., logistics, operations, purchasing) within and across a network of firms to create stakeholder value [1]. It also involves incorporating issues and perspectives from other disciplines such as marketing, operations management, information systems, accounting, finance, and strategy.

Industry-leading organizations tend to view supply chain management as a formal business discipline and have embraced the SCM revolution by transforming their various existing functions (typically purchasing, operations, and logistics) into a single supply chain organization [2]. More aptly, this combination of purchasing, production/operations, and logistics might better be described as Supply Chain Operations (SCO) than SCM. As ref. [3] points out, all business functions should be involved in the management of supply chain relationships; therefore, managing relationships across the supply chain can be characterized as supply chain management.

Universities have reacted to meet needs of shifting organizational structures by reorganizing business curricula to include core supply chain management fundamentals, in addition to the creation of distinguished SCM programs in order to prepare the future crop of supply chain leaders [4], [5]. Likewise, professional associations have responded to the trend by realigning their scopes and missions to embrace the broader view afforded by supply chain management (e.g., the Council of Logistics Management has become the Council of Supply Chain Management Professionals).

Unfortunately, however, many organizations still fail to realize the true value of SCM. They merely rename their existing logistics and/or other functions as being SCM, rather than fully dedicating the resources necessary to achieve a successful transition to an integrated supply chain management strategy. Typically, managers within these organizations adapt as well, by adding “supply chain” to their titles, yet their overall job responsibilities remain largely unchanged [3], [6]. This phenomenon may trickle down to the expectations firms have for their SCM professionals. Even in academia, it has not been uncommon to see departments (such as those traditionally focused on operations management or quantitative methods fields) being renamed as SCM departments, with little or no change in faculty member orientation or curriculum designs. Similarly, some professors who have been productive in such fields are called SCM professors, while having done little research in SCM per se. This phenomenon may spread to the training of SCM professionals.

Despite lackluster SCM strategies employed by some, there is growing consensus that effective SCM strategy centers on populating an organization with SCM professionals. Ref. [2] contend that many advanced supply chain organizations seek competitive advantage by leveraging skills and knowledge of their supply chain leaders. They posit that growing responsibilities and influence of supply chain leaders in the global economy necessitate establishment of a supply chain talent model to define core skills and knowledge requirements for SCM professional development.

As the human dimension becomes increasingly critical to overall SCM success, scholars and industry practitioners face the daunting issues of identifying requisite capabilities of SCM professionals and attracting a cadre of individuals possessing those capabilities [7]. A stream of SCM literature focuses on the knowledge, skills, and abilities requirements and develops a long and ever-growing list of requisite competencies. Such a long list raises the question: What are the defining competencies that differentiate SCM professionals from other business professionals? The answer has practical significance to executives responsible for designing and staffing an organization’s supply chain work; is relevant to practitioners who train or

develop employees’ SCM skill set, as well as to educators as they strive to build and sustain programs for training budding SCM professionals.

By surveying various respondent groups or contrasting respondent groups’ opinions, prior literature has developed lists of desirable competencies for individual SCM functions. However, these do not give insights for answering the two key questions. To identify the defining competencies for SCM professionals, we examine occupations in supply chain management as a single unit of analysis and compare it with other business professionals (OBP) by scrutinizing a large, public, frequently-updated archive, The Occupational Information Network (O\*NET).

In addition to identifying defining characteristics of SCM professionals, this research makes several contributions to the practice of SCM and to extant literature. First, instead of focusing on a single specific SCM function, it sheds new light on requisite competencies for multiple SCM professionals through two levels of analysis, in the spirit of helping unify an appreciation of prior research. Second, through multiple comparisons, we show the importance of core competencies and highlight the functional competencies that distinguish SCM professionals from other business professionals, yielding implications for curriculum design, corporate training, and career development. Third, our findings stem from analysis of a large archival dataset available from an independent source sponsored by the U.S. Department of Labor. Although widely applied in other disciplines, use of this archival-based research is somewhat unusual in the SCM field. Lastly, prior empirical studies survey practitioners, students, professors, or other related parties in efforts intended to enumerate requisite competencies for SCM professionals. By utilizing O\*NET, we supplement extant literature by concentrating on identifying the defining competencies of specific importance to the SCM profession – distinguishing it from OBP.

The review of SCM and related literature shows few, if any, prior studies that examine the relative importance of various competencies by using other business professionals as benchmarks. Accordingly, we regard it as necessary/appropriate to posit a proposition, instead of hypothesis, as numerous requisite SCM competencies are also deemed important for other professions. For

example, various professional accounting organizations have released several statements that emphasize the importance of communication, interpersonal, problem-solving, leadership, and IT skills, as well as appropriate attitude and professionalism. Even accounting knowledge is also identified by the SCM literature as important [8]. Positing propositions, instead of hypotheses, better reflects the exploratory nature of this study.

To position this study relative to preceding research, the next section examines prior investigation related to our research questions. We then detail the methodology used for our study, including an overview of the O\*NET database. Results are then presented, followed by theoretical and practical implications and limitations.

## 2. Background

Education, training, and development designed to improve skills and knowledge of the firm's human resources is perhaps the most critical dimension of human capital [9]. Consequently, identifying the skills and knowledge required by a position inevitably plays an important role in achieving organization success. Becoming widespread in many organizations since the end of the 1990s [10], [11], Competence-Based Management (CBM) integrates human capital with business strategies, emphasizes the identification of competencies needed to carry out any job, and stresses the alignment of human resources and corporate strategies, so as to improve work performance and foster competitive advantages [12], [13]. In addition, CBM identifies a set of core competencies that apply to all employees and job-specific (functional) competencies mandated by individual occupations [10].

A recent analysis of investments in organizations forming Gartner (formerly AMR) Research's Supply Chain Top-25 reveals that average returns of this group outperformed returns of the Dow Jones Industrial Average and the S&P 500 by more than 10%, suggesting the contribution of superior SCM practices to organizational performance [2]. Recognizing the importance of supply chain superiority, it is becoming increasingly clear that optimizing human elements, particularly the competencies of organizations' supply chain professionals, is a key aspect for an overall supply chain strategy. Indeed, some studies suggest that

managers of supply chains are the "critical dimension" that adds strategic value and enables organizations to accomplish supply chain objectives [7], [14]. By leveraging the competencies of supply chain managers, an organization can boost employee performance and enhance its ability to achieve objectives in pursuing long-term competitive advantages [15].

### 2.1. Prior Studies on Competencies for SCM professionals

Considering the importance of supply chain human capital, a stream of literature highlights factors influencing SCM performance or identifies requisite competencies to effectively manage supply chains [12], [16]. Since the 1960s, conceptual studies by thought leaders have proposed various knowledge and skills that are required for SCM professionals [17]. For example, ref. [18] suggests that supply chain managers must possess technological expertise, an adaptive and open mind, soft skills in leadership and team orientation, and "supply chain thinking" to integrate with their counterparts. Ref. [19] indicate that supply chain managers must have domain knowledge, cross-functional expertise, cross-cultural skills (e.g., international experience, foreign language), and soft skills to lead and collaborate. Moreover, practitioners and researchers have empirically tested the importance of various competencies through multiple methods. Table 1 shows a non-exhaustive list of these studies as many of the prevailing SCM competency studies were published more than 10 years ago.

As shown in Table 1, research methods used to explore requisite competencies for SCM professionals include content analyses, interviews, and mostly surveys. Survey respondents include students, educators, headhunters, purchasing professionals, and logistic managers. Regions of survey include Australia, Asia, Europe, and the U.S. Due to the nature of research objectives or questions, all of these empirical studies are exploratory without proposing any hypothesis.

Although multiple methods, regions, and respondent types are employed, nearly all competencies proposed in these empirical studies are found to be important for SCM professionals. For example, ref. [34] propose a Business-Logistics-Management (BLM) framework with 83

skills, ranging from functional knowledge to personal grooming/dress habits.

**Table 1. Empirical Studies on Requisite Competencies for SCM professionals**

Ref.	Methods	Skills	Analyses
[14]	<b>Interview</b> educators from U.S., U.K., and Netherland schools; <b>survey</b> graduate students from 10 universities in Europe, Asia, and USA; <b>interview</b> corporates on the knowledge and skills required by logistics and supply chain managers	13	Ranking Academics vs. students vs. corporate
[16]	<b>Survey</b> U.S. recruiting firms on skill requirements for senior- and entry-level logistics mangers	80	Means and ranking logistics managers
[20]	<b>Content analysis</b> of employment pages in an Australian newspaper on employers' desired attributes for log. managers	13	Ranking and categorization
[21]	<b>Survey</b> U.S. practitioners on skill requirements for logisticians	83	Means and ranking
[22]	<b>Survey</b> U.S. headhunters on knowledge prerequisites for senior-level logistics executives	83	Means and ranking
[23]	<b>Comparisons of surveys</b> of U.S. headhunters and practitioners on skill requirements for senior-level logisticians	83	Means and ranking Headhunters vs. practitioners
[24]	<b>Survey</b> U.S. educators on skill requirements for senior-level transportation and logistics executives	83	Means and ranking
[25]	<b>Survey</b> U.S. purchasing professionals on required skills of a world-class purchasing/supply chain professional	30	Means and categorization
[26]	<b>Survey</b> students and logistics practitioners; and interview logistics and SC managers on skills required by logisticians	45	Means, ranking, and categorization
[27]	<b>Survey</b> of Irish logistic managers on skills currently required	8	Means and ranking
[28]	<b>Survey</b> U.S. and European logistic managers on skill preferences for logistics managers	13	Means and ranking EU vs. US
[29]	<b>Survey</b> Singapore and Malaysian logistics managers on skill requirements for senior-level logistics executives	83	Means, ranking, and categorization
[30]	<b>Consult</b> four focus groups of top executives on skills required to attain purchasing and supply chain flexibility	7	Means, ranking, and categorization
[31]	<b>Comparisons of surveys</b> of U.S. headhunters on knowledge prerequisites for senior-level logistics executives -	90	Means and ranking Early 90s vs. Mid-2000s
[32]	<b>Survey and interview</b> Australian logistic professionals on skill requirements	68	Means and ranking Current vs. future
[33]	<b>Survey</b> Australian supply chain professionals on important competencies and skills, supply chain technologies, and future challenges for supply chains	19	Means

Adopting the BLM framework, Murphy and Poist survey practitioners [21], headhunters [23], and educators [24] and find that 33/35/31 skills are of great importance, 40/36/42 of moderate importance, and 11/12/11 of little importance, respectively. Ref. [32] modify the BLM framework and propose an updated model with 68 condensed skills, all of which are found to be important. Other empirical studies propose and examine a variety of important skills and knowledge.

Moreover, the number of requisite SCM competencies keeps growing. In response to the macro-environmental changes, ref. [16] added seven new skills into their BLM framework (e.g., electronic commerce, entrepreneurship). Ref. [35] emphasize the importance of strong verbal IQ, high need for achievement, and high adaptability. Ref. [32] find that knowing the impact of globalization,

developing environmentally sustainable logistic systems, and understanding the influences of

climate change are moderately important to logistics professionals.

On one hand, such a broad range of competencies reflects the ongoing trends of globalization, market turbulence, and the increasing role of SCM in firms' strategic planning. Supply chain professionals require numerous competencies to enable operational innovations and to manage complicated supply chain processes [35]-[37]. On the other hand, such a long list calls for additional analysis and refinement.

The relative importance of these competencies can be evaluated by comparing them with appropriate benchmarks. Nevertheless, as shown in Table 1, some studies compare perceptual differences

between respondent types – headhunters vs. practitioners [23]; students vs. practitioners [26]; U.S. vs. European [28]; Singapore vs. Malaysian [29]; and academics vs. students vs. corporate [14]. Others contrast requisite competencies for senior-level vs. entry-level logistics managers [16], early 1990s vs. mid-2000s, and current vs. future [32]. These comparisons reveal the evolutionary nature of SCM competencies and perceived gaps between various groups, but do not contribute to an understanding of the defining attributes of the SCM profession. To separate core from functional competencies and, more importantly, to identify competencies uniquely important to SCM professionals, we contend that comparisons between SCM professionals and other business professionals are necessary.

## 2.2. Competencies – Knowledge, Skills, and Abilities

To inform activities in workforce and career development, academic and policy research, and human resource management (HRM), practitioners and researchers have examined job characteristics and workers attributes essential to the performance of major occupational duties for several decades, resulting in many frameworks, models, or taxonomies [38]. The U.S. Department of Labor develops and maintains a multi-layer hierarchical taxonomy to synthesize and consolidate prior findings from education, psychology, labor economics, occupational analysis, career counseling, and HRM – The Content Model of Occupational Information Network (O\*NET).

Derived from extensive reviews of occupational analysis since the 1930s, the O\*NET Content Model captures worker- or job-oriented characteristics for over 1100 major U.S. occupations by using more than 250 “descriptors.” Built on strong theoretical and psychometric foundations [39], these descriptors assist in understanding day-to-day aspects and associated qualifications for specific jobs, plus allow comparison/contrast of selected occupations [40]. As shown in Figure 1, these descriptors are categorized into six content domains, based on their orientation and cross-occupational comparability. Worker-oriented and relatively comparable, subdomains in Worker Characteristics describe innate/enduring attributes (e.g., personality,

abilities) that may influence both performance and the capacity to acquire necessary knowledge and skills for effective work performance. The domain Worker Requirements reflects worker-oriented attributes that are acquired/developed through education and experience, whose subdomains include knowledge, skills, and education [41]. Recent development in Competence-Based Management generally classifies worker-related attributes as Knowledge, Skills, Abilities, and Other attributes (KSAOs). The former two are captured in the Worker Requirements domains, whereas the latter two are Worker Characteristics.

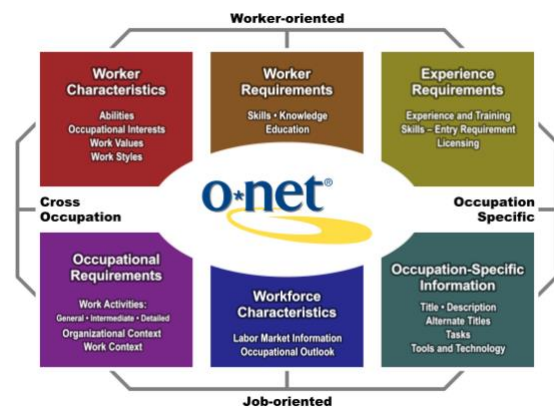


Figure 1. O\*NET Content Model [42]

## 2.3. Requisite Knowledge for SCM professionals

Knowledge, as used here, refers to a collection of discrete but interrelated facts and information about a particular domain related to the performance of an occupation. Knowledge, specifically the management of knowledge, can be leveraged as a strategic asset serving as a key source of competitive advantage [38]. As shown in Table 2, to successfully lead an organization toward supply chain excellence, SCM professionals must possess knowledge across a considerable range of domains.

Following ref. [29], we classify requisite knowledge for SCM professionals into seven categories and find that operational/functional knowledge (e.g., logistics, purchasing) and other business/management knowledge domains (e.g., HRM, economics, finance) demonstrate varied levels of importance for SCM professionals. Knowledge in communication and analytical skills, as well as general knowledge, are also found to be important. Recognizing that a central tenet of SCM

is the integration of business functions throughout a focal organization [45], it is insufficient for SCM professionals to merely possess a core

understanding of functional business disciplines alone. It requires expertise about interactions

**Table 2. Requisite Knowledge for SCM professionals**

Requisite Knowledge	[14]	[16]	[19]	[20]	[21]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[32]	[33]	[44]
<b>Functional Knowledge</b>											√					
• Transportation & Logistics		G	√	√	G	G	G					G		M		
• Production Management	√	M			M	M	M					M		G		
• Purchasing/Procurement		L			M	M	M					M		M		
• Marketing		L			M	M	M					M		M		
• Supply Chain Management	√	G														
<b>Business Knowledge</b>																
• Human Resource Management		L			G	M	M			√		G		G		
• General Business Administration		M	√		G	G	G					G		M		
• Strategic Management	√	L			M	M	G	√				M		G	√	
• International Business		L			M	L	M					M		M	√	√
• Logistics in Emerging Markets	√															
• Electronic Commerce		M														
• Entrepreneurship		L													√	
• Customer Focus								√								
<b>Economics and Finance Knowledge</b>																
• Microeconomics		L			M	M	M					M		M		
• Macroeconomics		L			M	M	M					M		M		
• Finance	√	M		√	M	M	M					M		G		
<b>Communication Skills</b>																
• Information Systems		M		√	G	M	M	√	√		√	M		M		√
• Business Writing		M			G	M	G					M		G		
• Foreign Language		L			L	L	L				√	L		L		
<b>Analytical Skills</b>																
• Computer Science/ IT	√	L		√	M	M	M	√	√		√	M		M	√	√
• Accounting & Cost Control		M		√	M	M	M	√				M		G	√	
• Business Statistics/ Quant. Methods		M			M	M	M	√			√	G		M	√	
<b>Ethics &amp; Legal Knowledge</b>	√															
• Business Ethics		G			M	G	G					G		G	√	
• Business Law		L			M	M	M					M		M	√	
• Risk Management/ Insurance		L			L	L	L					L	√	G	√	
• International Business Regulations	√													M		
<b>General Knowledge</b>																
• Economic Geography		L			L	L	L					L				
• Business and Government		L			M	M	M					M		M		
• The Impact of Globalization														M		
<b>Cross-Functional Knowledge</b>			√						√						√	

Note: G = Great, M = Moderate, L = Little

√ Denotes knowledge domains that are identified as important

among the various business functions and processes that can enhance relationship building in an effort to create successful partnerships for all members of the supply chain [46]. Such expertise requires an

integration of cross-functional knowledge, coinciding with refs. [18], [43], and many others. Nevertheless, a long list of requisite knowledge for SCM professionals necessitates the needs to



separate core from functional competencies, so as to identify the unique occupational requirements for the profession. We posit that: *Comparisons between SCM professionals and other business professionals show differences in functional knowledge domains, but not in other business/management knowledge domains.*

### 3. Research Methods

The previous section demonstrates that researchers recognize the importance of equipping a firm with SCM professionals possessing competencies consistent with the design and implementation of effective supply chain initiatives. It also reviews the SCM literature and displays a long list of requisite SCM knowledge, skills, abilities, and other attributes. We posit three propositions concerned with identifying the defining competencies that differentiate SCM professionals from other business professionals. This section describes the data sources, sample selection, data analyses, and statistical methods we use to examine these propositions.

#### 3.1. Data Source and Collection

In addition to synthesizing prior literature and developing the conceptual O\*NET Content Model (as shown in Figure 1), the U.S. Department of Labor also populates and updates O\*NET with data from job incumbents and occupational analysts, resulting in a large-scale, cross-sectional and longitudinal, publicly-available, frequently-updated database that describes over 1100 major U.S. occupations by using hundreds of descriptors [38], [47]. The O\*NET initiative is supported and endorsed by nearly 500 professional associations or councils, such as the Council of Supply Chain Management Professionals, American Purchasing Society, American Institute of Certified Public Accountants, and National Association of Sales and Marketing Agencies [42]. The secondary data utilized for this study was collected from the the online O\*NET database ([www.onetonline.org](http://www.onetonline.org)).

The O\*NET database is used by career counselors, employers, job seekers, industrial/organizational psychologists, job analysts, and curriculum developers [42], [47], as well as by academic researchers for their empirical studies in various domains. Examples include labor economics [49],

human resource management [50], occupational psychology [39], [48], education and training [51], occupational health [52], accounting [47], [53], [54], and so forth. To the best of our knowledge, this is one of the first SCM studies to use O\*NET as a data source.

Except for those in the Abilities database, most O\*NET descriptors are collected by a two-stage large-scale probability sampling program. The O\*NET workgroup first randomly selects a sample of U.S. businesses that are expected to employ workers in targeted occupations. Then, a random sample of incumbents who work in those occupations, and within those businesses, answer the O\*NET questionnaires. To ensure data quality, data on occupations with too-small or non-representative samples are collected from occupational experts, instead of random samples [38]. Supported by abundant financial resources, such sampling process and scope lead to a unprecedented cross-sectional and long-term longitudinal database that strives for a representative sample of all U.S major job incumbents by occupation [47] with acceptable construct validity [38], [55], [56]. Since its inception in 1998, the O\*NET database has been updated at least sixteen times. We use the nearest release of occupational employment statistics to adjust for the relative representations in each comparison group [57].

#### 3.2. Sample Selection

To reflect the nature of supply chain operations, we select appropriate SCM professionals from the O\*NET database and categorize them into three major supply chain functions: Logistics (LOG), Purchasing (PUR), and Operation Management (OM). Table 3 shows these occupations with their descriptions. Note that O\*NET classifies occupations based on work content and business functions, instead of levels or nominal titles. For example, a transportation manager is defined as anyone who “plans, directs, and coordinates the transportation operations within an organization or the activities of organizations that provide transportation services,” regardless of his/her ranking or title as a shipping manager, transportation supervisor, or otherwise. In addition, Table 3 shows the sample size for each group and incumbent respondents’ substantial work experience with current employers, suggesting their

considerable first-hand, detailed knowledge about requisite competencies.

**Table 3. O\*NET Respondents' Degrees of Experience at Their Current Employer**

O*NET Occupational Title and Descriptions	n	Years with Current Employer (in %)				
		Missing	<1	1-5	6-9	>10
<b>Logistics Professionals (LOG)</b>						
<ul style="list-style-type: none"> <li><b>Transportation Managers</b> – Plan, direct, or coordinate the transportation operations within an org. or the activities of organizations that provide transportation services.</li> </ul>	98	-	8.2	30.6	8.2	53.1
<ul style="list-style-type: none"> <li><b>Storage and Distribution Managers</b> – Plan, direct, or coordinate the storage or distribution operations within an organization or the activities of organizations that are engaged in storing or distributing materials or products.</li> </ul>	24	-	-	-	8.3	91.7
<ul style="list-style-type: none"> <li><b>Logistics Managers</b> – Plan, direct, or coordinate purchasing, warehousing, distribution, forecasting, customer service, or planning services. Manage logistics personnel and logistics systems and direct daily operations.</li> </ul>	23	-	-	4.3	8.7	87.0
<ul style="list-style-type: none"> <li><b>Logisticians</b> – Analyze and coordinate the logistical functions of a firm or organization. Responsible for the entire life cycle of a product, including acquisition, distribution, allocation, delivery, and disposal of resources.</li> </ul>	82	6.1	11.0	35.4	15.9	31.7
<ul style="list-style-type: none"> <li><b>Logistics Engineers</b> – Design or analyze operational solutions for projects such as transportation optimization, network modeling, process and methods analysis, cost containment, capacity and information management.</li> </ul>	22	-	-	-	9.1	90.9
<ul style="list-style-type: none"> <li><b>Logistics Analysts</b> – Analyze product delivery or supply chain processes to identify or recommend changes. May manage route activity including invoicing, electronic bills, and shipment tracing.</li> </ul>	26	3.8	-	-	15.4	80.8
<b>Purchasing Professionals (PUR)</b>						
<ul style="list-style-type: none"> <li><b>Purchasing Managers</b> – Plan, direct, or coordinate the activities of buyers, purchasing officers, and related workers involved in purchasing materials, products, and services.</li> </ul>	24	-	-	4.2	8.3	87.5
<ul style="list-style-type: none"> <li><b>Purchasing Agents and Buyers, Farm Products</b> – Purchase farm products either for further processing or resale. Includes tree farm contractors, grain brokers and market operators, grain buyers, and tobacco buyers.</li> </ul>	71	-	12.7	28.2	19.7	39.4
<ul style="list-style-type: none"> <li><b>Wholesale and Retail Buyers, Except Farm Products</b> – Buy merchandise or commodities, other than farm products, for resale to consumers at the wholesale or retail level, including both durable and nondurable goods.</li> </ul>	82	2.4	6.1	24.4	15.9	51.2
<ul style="list-style-type: none"> <li><b>Purchasing Agents, Except Wholesale, Retail, and Farm Products</b> – Purchase machinery, equipment, tools, parts, supplies, or services necessary for operations.</li> </ul>	21	9.5	-	-	28.6	61.9
<b>Operation Management Professionals (OM)</b>						
<ul style="list-style-type: none"> <li><b>General and Operations Managers</b> – Plan, direct, or coordinate operations of public/private sector organizations.</li> </ul>	158	0.6	7.6	17.7	17.7	56.3
<ul style="list-style-type: none"> <li><b>Industrial Production Managers</b> – Plan, direct, or coordinate the work activities and resources necessary for manufacturing products in accordance with cost, quality, and quantity specifications.</li> </ul>	118	2.5	4.2	31.4	15.3	46.6
<ul style="list-style-type: none"> <li><b>Administrative Services Managers</b> – Plan, direct, or coordinate one or more administrative services of an organization, such as records and information management, mail distribution, facilities planning and maintenance, custodial operations, and other office support services.</li> </ul>	116	1.7	6.0	27.6	21.6	43.1
<ul style="list-style-type: none"> <li><b>Quality Control Systems Managers</b> – Plan, direct, or coordinate quality assurance programs.</li> </ul>	60	-	6.7	43.3	18.3	31.7
<ul style="list-style-type: none"> <li><b>Architectural and Engineering Managers</b></li> </ul>	127	0.8	6.3	44.9	8.7	39.4
<ul style="list-style-type: none"> <li><b>Food Service Managers</b></li> </ul>	69	-	5.8	31.9	13.0	49.3
<ul style="list-style-type: none"> <li><b>Funeral Service Managers</b></li> </ul>	56	-	-	23.2	7.1	69.6
<ul style="list-style-type: none"> <li><b>Gaming Managers</b></li> </ul>	91	-	8.8	24.2	18.7	48.4
<ul style="list-style-type: none"> <li><b>Lodging Managers</b></li> </ul>	61	3.3	26.2	32.8	16.4	21.3
<ul style="list-style-type: none"> <li><b>Medical and Health Services Managers</b></li> </ul>	29	-	-	3.4	6.9	89.6
<ul style="list-style-type: none"> <li><b>Natural Sciences Managers</b></li> </ul>	70	-	5.7	30.0	15.7	48.6



O\*NET classifies major U.S. occupations into 23 job families. Job Families 11 and 13 are for professionals in Management and in Business/Financial Operations, respectively. For the purpose of comparisons, we define “Other Business Professionals” (OBP) as the professionals in Job Families 11 and 13 that perform non-SCM functions (e.g., accounting, finance, information systems, HRM). Non-business or non-professional occupations are excluded in this study. The list of other business professionals in this study is: Advertising and Promotions Managers, Marketing Managers, Sales Managers, Public Relations and Fundraising Managers, Market Research Analysts and Marketing Specialists, Computer and Information Systems Managers, Treasurers and Controllers, Financial Managers, Branch or Department, Financial Analysts, Personal Financial Advisors, Insurance Underwriters, Financial Examiners, Loan Counselors, Loan Officers, Compensation and Benefits Managers, Human Resources Managers, Training and Development Managers, Human Resources Specialists, Compensation, Benefits, and Job Analysis Specialists, Training and Development Specialists, Management Analysts, Cost Estimators, Accountants, Auditors, Assessors, Budget Analysts, Credit Analysts, Tax Preparers.

### 3.3. Data Analyses

To examine our proposition, we perform two levels of data analyses – professional and functional comparisons. Professional comparisons treat all SCM professionals involved in supply chain operations as a single group and compare it with OBP, so as to reveal their differences in requisite competencies. The purpose of functional comparisons is to highlight the difference within various SCM functions, yielding implications to supplement professional comparisons. Note that not all requisite competencies identified in SCM literature are available in O\*NET. Therefore, we do our best mapping to connect O\*NET descriptors with SCM competencies.

Also noteworthy is that our proposition aims to identifying the defining competencies that differentiate SCM professionals from OBP through various comparisons. Thus, we focus on the domains that are worker-oriented and relatively comparable (i.e., the top-left corner of the Content

Model). Prior empirical studies list tasks performed by SCM professionals and emphasize the importance of these tasks’ related skills or knowledge (e.g., inventory control, packaging) [21], [23], [29], [32]. We acknowledge the importance of these job-oriented, occupation-specific characteristics and recommend readers to consult the O\*NET Task database for more details.

### 3.4. Statistical Methods

To examine our propositions, we perform a series of analysis of variance (ANOVA) for professional and functional comparisons. One might attempt to perform factor analysis or principal component analysis (PCA) to reduce the dimensionality of competencies. Instead, we choose to report our results individually because occupational characteristics are formative constructs with low inter-item correlations. Synthesizing such constructs unavoidably leads to costly loss of information content. For example, performing PCA on the 12 knowledge domains in Table 6 yield four principal components (using eigenvalue>1 as the criterion). These components can hardly be named, have limited meaningful interpretations, and explain 71.52% of original variance in total. Other dimensions or combinations show similar losses of information content.

## 4. Results

O\*NET uses a 5-point scale to measure the importance of each descriptor, where 1 indicates “Not Important” and 5 “Extremely Important”. Table 4 shows the definitions, weighted-average importance ratings, and ANOVA results for professional and functional comparisons on requisite knowledge. Consistent with prior literature, most knowledge domains are deemed important for SCM professionals, as most average importance ratings are greater than 3, where exceptions include transportation (2.41), foreign language (1.66), and geography (1.87). We posit that comparisons between SCM professionals and OBP show differences in functional knowledge domains. This is statistically supported for the knowledge domains of transportation, production & processing, customer service, and sales & marketing.

Table 4. Empirical Tests on Requisite Knowledge for SCM professionals

Knowledge Domains	Professional Comparisons			Functional Comparisons			
	SCM <sup>^</sup>	OBP <sup>^</sup>	p. <sup>^^</sup>	LOG <sup>^</sup>	PUR <sup>^</sup>	OM <sup>^</sup>	p. <sup>^^</sup>
<b>Operations/ Functional Knowledge</b>							
Transportation	2.41 (.10)	1.62 (.08)	.00**	3.85 (.34)	3.20 (.24)	2.19 (.09)	.00** L vs. O (.00**) P vs. O (.00**)
Production & Processing	3.26 (.12)	2.11 (.10)	.00**	3.16 (.55)	3.34 (.38)	3.26 (.15)	.96
Customer Service	3.94 (.11)	3.67 (.09)	.06*	3.67 (.16)	3.66 (.11)	4.01 (.04)	.01** L vs. O (.06*) P vs. O (.01**)
Sales & Marketing	3.21 (.18)	2.73 (.14)	.04**	2.41 (.35)	3.11 (.25)	3.28 (.09)	.08* L vs. O (.03**)
<b>Business Knowledge</b>							
Human Resources Management	3.57 (.15)	3.08 (.12)	.02**	3.05 (.27)	2.71 (.19)	3.73 (.07)	.00** L vs. O (.03**) P vs. O (.00**)
Administration & Management	4.20 (.08)	3.68 (.07)	.00**	3.83 (.23)	3.74 (.16)	4.30 (.06)	.01** L vs. O (.06*) P vs. O (.00**)
Accounting & Economics	3.37 (.16)	3.49 (.13)	.55	2.83 (.34)	3.58 (.23)	3.37 (.09)	.21
Information Technology	3.29 (.09)	3.3 (.08)	.92	2.75 (.21)	3.56 (.14)	3.08 (.06)	.85
Mathematics & Statistics	3.51 (.12)	3.3 (.10)	.18	3.42 (.32)	3.36 (.22)	3.27 (.09)	.93
Law & Government	2.99 (.11)	2.83 (.09)	.27	3.60 (.28)	3.54 (.19)	3.50 (.07)	.48
<b>General Knowledge</b>							
Foreign Language	1.66 (.06)	1.51 (.05)	.07*	1.65 (.21)	1.86 (.14)	1.63 (.06)	.35
Geography	1.87 (.08)	1.60 (.06)	.01*	2.51 (.29)	2.13 (.20)	1.79 (.08)	.05** L vs. O (.03**)
^ Weighted importance ratings and weighted standard errors within parentheses							
^^ Numbers indicate the p-values for ANOVA							
**, * denotes significance at p< .05 or .10 level, respectively							

Proposition 1 also posits that comparisons between SCM professionals and OBP will reveal no significant differences in other business knowledge domains. While this is largely the case, ANOVA shows significant differences for the HRM (p=.02) and general administration (p=.00) business knowledge domains. One possible explanation is that HRM and general administration are both

person-oriented functions, whereas accounting, economics, IT, mathematics, statistics, and law are more data-oriented. Interestingly, although importance ratings for SCM professionals are low for foreign language (1.66) and for geography (1.87), they do show statistical differences when compared with OBP, probably due to the nature of supply chain operations.

Among the three occupations, Table 4 shows several knowledge domain differences that reflect occupational requirements. Compared to logistics and purchasing positions, operation managers require more knowledge in customer service, HRM, and general administration, but less in transportation and geography. However, logistics and purchasing managers show little statistical differences for the various knowledge domains.

## 5. Conclusion

To separate core from functional competencies and to identify defining characteristics that distinguish SCM professionals from OBP, we perform multiple ANOVA analyses to examine our propositions and reveal the requisite competencies required by the SCM profession. Weighted-average importance ratings from O\*NET generally support prior SCM literature and demonstrate a long list of requisite KSAOs.

Statistical tests on requisite knowledge show that SCM professionals require more functional knowledge (e.g., transportation, production) and person-oriented management (e.g., HRM) to enable effective operations, but not so in other business/management domains, thereby supporting our proposition. Ref. [58] emphasizes that tomorrow's SCM professionals should be "jack of all trades, master of some." Our empirical results provide evidence that functional knowledge and levels of interpersonal skills are the major defining occupational competencies that distinguish SCM professionals from OBP.

### 5.1. Theoretical Contributions

This research extends the SCM literature on the requisite competencies for SCM professional and reaffirms the importance of these identified knowledge, skills, abilities, and other attributes through the lenses of a large, frequently-updated, publicly-available, U.S.-based database. Empirical tests of the proposition support prior conclusions that SCM professionals must "be a manager first and a functional/technical specialist second" [22], [28], [32]. Statistical comparisons show that these functional/technical specialties include functional knowledge; general knowledge in foreign knowledge and geography; interpersonal skills; and

management skills in leadership and managerial controls.

Moreover, ref. [2] stress that: "The best-run companies tend to view supply chain management not as a necessary evil, but as a business-oriented discipline that can be used to increase revenue and profit" (p.4). Our results reveal the substantial difference between SCM professionals and OBP, and indicate that SCM is indeed a distinct discipline within the business world. Our findings are supported by other recent studies on supply chain practices as well [59].

Methodologically, through surveying various related groups, prior empirical studies identify a broad range of important competencies for SCM professionals. To the best of our knowledge, this is the first study in the SCM field to use O\*NET as a data source, although O\*NET has been used widely in other disciplines. Scrutinizing O\*NET not only separates core from functional competencies, but also sparks a new approach to occupational research in SCM.

Furthermore, whereas most prior studies focus on individual occupations/functions within the supply chain discipline, this research views the supply chain discipline as a whole and performs two levels of data analyses – professional and functional comparisons. The former tests our proposition and identifies the differentiating factors between SCM professionals and OBP. The latter provides more contextual details on each SCM function.

### 5.2. Practical Contributions

Prior literature identifies a broad range of KSAOs essential to support effective SCM. This research contributes to practices in separating core from functional competencies and in focusing on the defining characteristics of SCM professionals, yielding implications to corporate recruitment and training, career choices and development, and curriculum design. For example, results of this study can be used to help recruiters identify candidates that possess suitable competencies for enabling effective supply chain operations. As the SCM field continues to evolve, SCM professionals need to continuously build their knowledge base and refine their skills in related domains. Our functional comparisons show the differences within

SCM functions and provide guidance for ongoing professional development, specifically continuing education or future training needs. This research also assists in identifying job opportunities or training needs for dislocated workers.

When designing curricula and corporate development, educators and trainers can pinpoint their aim at enhancing students' or trainees' functional knowledge and interpersonal skills, while developing other core competencies for each worker. This research supports ongoing efforts by organizations, as well as recent studies [60] that highlight the relationship between human resources management and supply chain management. Many new (and existing) SCM programs rely on advisory boards to define knowledge and skill requirements for future SCM graduates, which may be limited to the opinions of a select few individuals that serve on the board. While we are not suggesting that the advisory board approach is flawed, we offer findings of this study as complements to other sources used during curriculum development. As new SCM programs continue to develop and evolve, educators will benefit from a recent study that captures requisite competencies for SCM professionals as reported by the diverse respondents to the O\*NET survey.

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