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ASP, The Art and Science of Practice: What Employers Demand from Applicants for MBA-Level Supply Chain Jobs and the Coverage of Supply Chain Topics in MBA Courses

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We analyzed the text of 704 online advertisements of supply chain management jobs for MBA graduates. The content analysis of these job advertisements provided us with a list of supply chain topics, such as inventory management and supply management, and general skills, such as communication and leadership; it also showed the proportion of advertisements requesting these skills. We measured the relative coverage of the same supply chain topics in MBA-level supply chain electives and operations management core courses in 21 of the top 50 business schools in the United States by analyzing the course descriptions and the cases used in these courses. This enabled us to compare the relative importance of supply chain topics to employers on the "demand" side with the relative importance of supply chain electives in MBA curricula on the "supply" side in these schools. Our analysis indicated that the supply usually matches demand; however, there may be an undersupply of practice- or process-oriented topics, such as forecasting, procurement, supplier and vendor management, and contracts and negotiation. In addition, there may be an oversupply of conceptual and strategy-oriented topics, such as product design, supply chain design, and emerging information technology and management information.

Key words: personnel; data analysis; inventory/production; education systems: operations; forecasting; manpower planning; professional.

We analyzed the text of 704 MBA-level supply chain job advertisements (ads) to determine the skills that employers of MBA graduates want (from these graduates) in terms of both knowledge of specific supply chain topics and broad skills. Using statistical content analysis on the counts of relevant words and phrases that were present in these ads, we established the proportion of job ads requiring various supply chain topics (Johnson and Pyke 2000) and various skills (Sodhi and Son 2008).

Our results indicated that these employers demand knowledge of the following in decreasing order: sourcing and supplier management, inventory and forecasting, information and electronic mediated environments, marketing and channel restructuring, transportation and logistics, metrics and performance, and service and after-sales support. Likewise, in decreasing order, they also require communication, leadership, project management, and team-related and general analytical skills.

By analyzing online course descriptions and case study descriptions, we also explored the extent to which 21 business schools listed in the top 50 MBA programs in the United States (Appendix 5) cover these topics in their supply chain electives and operations management core courses. Our exploratory comparison of the proportion of job ads requiring each supply chain topic (demand) to the proportional coverage of these topics in these schools' elective courses (supply) indicated that there may be

an undersupply of practice- or process-oriented topics, such as forecasting, procurement, supplier and vendor management, and contracts and negotiation. In addition, there may be an oversupply of conceptual and strategy-oriented topics, such as product design, supply chain design, and emerging information technology (IT) and management information. We did not investigate the reasons for oversupply or undersupply or whether they are inevitable or undesirable; at best, these results are indicative of the supply and demand for supply chain skills.

Our contribution is twofold. First, our work provides an empirical approach to investigating the knowledge areas and skills that employers require. This approach complements information gathered from employer-educator and alumni-educator forums. The results contribute to a growing list of empirical studies that explore the skill sets for supply chain management and logistics professionals (Murphy and Poist 1994, Giunipero 2000, Gammelgaard and Larson 2001, Handfield 2004, Myers et al. 2004, Mangan and Christopher 2005). The identified skills vary from sector-specific skills, such as warehousing, to general skills, such as communication. While these studies used focus groups or questionnaires, we took the empirical approach of analyzing job ads for supply chain topics and broad skills to complement these studies. Second, we extend and update the work of Johnson and Pyke (2000) in identifying how MBA programs are responding to industry needs. Our results might also be useful to educators and program directors of MBA and other programs who are preparing their students for the job market.

However, our work has limitations. Relative to jobs, our results are broadly indicative rather than definitive because our jobs analysis does not include on-campus recruiting or job ads posted on company websites or in printed media. Relative to MBA courses, the online course descriptions we used are typically quite short and general. In addition, discrepancies often exist between the course description and the material that is actually taught because the author of the online course description is frequently not the instructor. A case description may cover many topics; however, we cannot know which aspect of each individual case the instructor will choose to emphasize or ignore in a lecture. Still, our analyses of course descriptions and cases produced relatively consistent results. Finally, our study of MBA courses is limited to supply chain electives and core operations management courses at only 21 of the top 50 universities; it does not include core marketing or IT-related courses that, at these or at other schools, might also cover supply chain related topics.

Methodology

We acquired demand-side data by collecting MBA-level supply chain ads from Internet job sites; we acquired supply-side data by collecting and analyzing online descriptions of MBA courses and descriptions of cases used in supply chain electives and core operations management courses. We then used content analysis to understand the demand side in terms of the proportion of job ads requiring specific skills. We did the same to understand the supply side in terms of the proportion of elective courses or cases providing these skills.

Data Collection of Job Ads

We obtained job ads for MBA graduates from www.monster.com and www.hotjobs.com. These include ads in which an MBA preference is stated but an MBA degree is not required. We focused on the US job market to ensure consistency of use of words and phrases and to allow comparison with the supply from US business schools. We searched for supply chain management (SCM) and MBA ads posted between the beginning of April 2006 and the end of August 2006 by using the string (*SCM* and *MBA*) or ("*supply chain*" and *MBA*). We stored these posted ads in a database and deleted duplicate or irrelevant entries to obtain the 704 ads that we used.

Our data comprise the text of these ads and two categorical variables that we manually coded for the specific industry sector, which we adapted from *Fortune* magazine's classification and for the level of minimum experience (Table 1).

The ads in our sample range widely across industries. No particular sector dominates; however, in one-sixth of the ads, which were usually from recruiting agencies, we could not determine the employer's

Job ad (text variable)	Level/years of experience	Industry sector (categorical variable)
Director, supply chain management (Watkins manufacturing) Areas of responsibility include procurement, distribution, sales order entry and management, master scheduling, production planning, warehousing, logistics, and inventory management. You will direct cost containment initiatives to align with the company's vision, strengthen supplier relationships, and be accountable for contract negotiations. In addition, you will coordinate materials management for the Mexico operations. . . . . An MBA and APICS certification are strong pluses. Demonstrated experience developing strategic alliances (global experience a plus) needed. Experience with ERP systems and system implementations highly desired.	5	Manufacturing
Sr. sourcing specialist, sourcing and procurement (Disney) Description: The Sr. Sourcing Specialist . . ..to design and implement their sourcing and procurement strategies. This person will lead efforts to source and procure materials and services to support company operational requirements. The Sr. Sourcing Specialist will build and lead cross-functional teams and will be responsible for developing and implementing strategic sourcing arrangements with preferred suppliers. This individual will continuously improve the company's procure to pay process by identifying and leading efforts with affected departments to reduce cycle times, improve customer service, and reduce total costs. The Sr. Sourcing Specialist will source and negotiate supply relationships for internal clients.	2	Entertainment

Table 1: These examples of entries in our database show typical job ads and include our manually coded variables and part of the ad text.

industry sector. Consulting, computer services, pharmaceuticals, chemicals, and electronics were among the top 11 sectors represented in these ads (Figure 1).

The ads we used are not exclusively targeted to MBAs although they state either an MBA preference or requirement; nearly half (46 percent) require a bachelor's degree; more than one-fifth (16.6 percent) require or prefer a master's degree; and only 1.3 percent require or prefer a PhD. The average years of experience requested in the SCM job ads is slightly more than six years; the majority of these ads (612 of the 704 or 86.9 percent) seek graduates with 3 to 10 years of industry experience (Figure 2).

Considering the typical industry experience of US MBA students, this suggests that the pool of job ads also includes recent MBA graduates.

Data Collection of MBA Courses

We considered the US business schools in a top-50 business schools list (Appendix 5) because of the visibility of these schools; we also wanted to avoid any selection bias. However, any inferences would only be indicative because MBA programs in universities that are not in this list might cover supply chain topics differently in their courses. We focused on US business

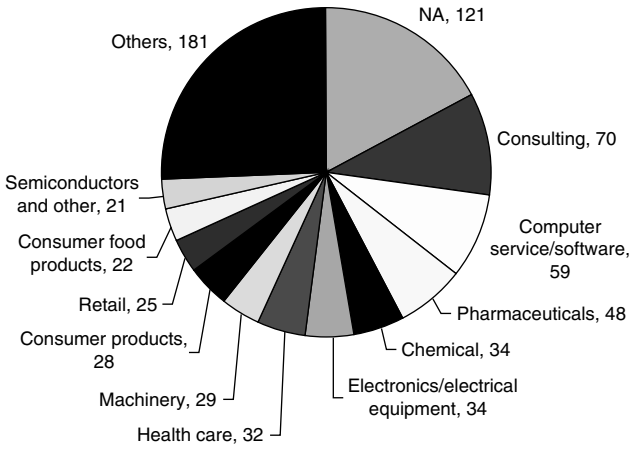

Figure 1: This graph shows the number of ads for the top 11 sectors represented in our database (NA indicates "not available").

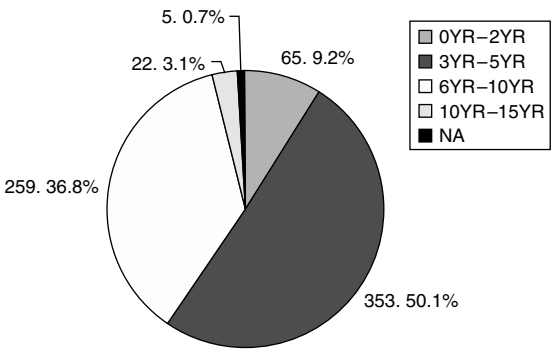

Figure 2: This graph shows the number and percentages of SCM job ads at four experience levels.

schools only to ensure consistency of MBA programs because all the programs that we considered are two-year programs (ranging from 18 to 21 months) unlike many European programs that are one year in length. In addition, this enabled us to compare supply chain topics offered in US schools with the requirements of the jobs, which are also based in the United States. We obtained 37 supply chain elective descriptions and 36 core operations courses available online from these 50 MBA programs in 2006–2007 (the online course information about supply chain electives and operations management core courses are not all from the same programs). We also collected 26 detailed syllabi of supply chain management electives and 21 syllabi of core operations management courses from academic colleagues at 21 of these 50 universities. The 21 universities are Columbia University, Carnegie Mellon University, Dartmouth College, Duke University, Georgia Tech, Harvard University, MIT, Northwestern University, Stanford University, UCLA, UC Irvine, University of Cincinnati, University of Florida, University of Maryland, University of Michigan, University of North Carolina at Chapel Hill, University of Pennsylvania, University of Washington, University of Rochester, Washington University, and Yale University. Cincinnati is not on the *U.S. News* 2006 list; however, we were able to obtain detailed information about its curricula. From these detailed syllabi, we compiled a list of 84 business cases for supply chain electives and 51 cases for core operations courses and then obtained their descriptions.

The detailed course syllabi indicate that business schools differ in the supply chain topics they emphasize in their supply chain electives and core operations management courses. This might also be true of MBA programs that are not in the top-50 list. Moreover, MBA programs have different structures; even the business schools that we studied offer their courses, whether core or elective, in different formats—six weeks (half-semester), 10 weeks (quarter), or 14 weeks (semester).

The syllabi also show that business schools in our sample use business case studies heavily. We analyzed the contents of the case studies weighted by the number of universities using each case. Most schools cover at least one business case study during each session of a course. Each case may cover many topics and each topic may be covered by any of a number of cases across these schools. For example, two Harvard Business School (HBS) cases—*Supply Chain Close-Up: The Video Vault* and *Hamptonshire Express*—illustrate how certain supply contracts influence the buyer's order quantities. However, there are many cases, and only eight cases in our sample are used by more than five of the 21 business schools (Table 2).

Supply chain management case	Number of schools (of 21) using the case
Barilla Spa (A) (HBS 1994) by J. Hammond	13
Sport Obermeyer (HBS 1996) by J. Hammond and A. Raman	10
National Bicycle Industry Co. (Wharton 1993) by M. Fisher	7
Supply Chain Close-Up: The Video Vault (HBS 2003) by V. Narayanan and L. Brem	6
Hewlett-Packard: DeskJet Printer Supply Chain A & B (Stanford 2001) by H. Lee and L. Kopczak	5
Hamptonshire Express (HBS 2002) by V. G. Narayanan and A. Raman	5
Li and Fung (A): Internet Issues (HBS 2005) by F. W. McFarlan and Fred Young	5
Supply Chain Management at World Co. Ltd. (HBS 2001) by A. Raman and M. Fisher	5

Table 2: This table shows popular supply chain management cases from among the 84 cases mentioned in 26 course syllabi from 21 business schools.

The same applies to operations management courses; there are only a few cases that appear in both supply chain electives and operations management core courses (Table 3).

Content Analysis

We analyzed the text, i.e., the words and phrases, of the job ads using *content analysis*, "a research technique for making replicable and valid inferences from text (or other meaningful matter) to the contexts of their use" (Krippendorff 2003, p. 18). Content analysis is not widely used by operations management researchers; however, "in other business disciplines [it] has been firmly established as a methodological tool" (Montabon et al. 2007, p. 1002).

Content analysis entails analyzing the occurrence of relevant words and phrases in text data. Such data can have a huge volume of words and phrases. For

Operations management case	Number of schools (of 21) using the case
Toyota Production System (HBS 1992) by K. Mishina	15
National Cranberry Cooperative (HBS 1988) by R. Shapiro	11
Barilla Spa (A) (HBS 1994) by J. Hammond*	9*
Hewlett-Packard: DeskJet Printer Supply Chain A & B (Stanford 2001) by H. Lee and L. Kopczak*	8*
Sport Obermeyer (HBS 1996) by J. Hammond and A. Raman*	7*
Kristen Cookies (HBS 2006) by R. E. Bohn	5
Manzana (HBS 1991) by S. C. Wheelwright	5
Shouldice Hospital (HBS 2004) by R. Hallowell and J. Heskett	5

Table 3: This table shows popular operations management cases from among the 51 cases mentioned in 20 core-course syllabi. Cases marked with an asterisk are also popular in supply chain electives.

example, in our study, the total word count for the job ads that we used to understand the industry needs (the demand-side analysis) exceeded 250,000. Using a computer-based data-mining tool is a good analysis method for such a large volume (Osborne et al. 2001). For the analysis of the demand side, which involves analyzing 704 job ads, we used the WordStat content analysis software by Provalis Research.

However, we carried out content analysis of supply chain and operations management courses and cases manually because of possible inconsistent terminology that required familiarity and careful reading for classification (Mar Molinero and Xie 2007). In addition, the word count was manageable in comparison to the job-ads database. Upon reading each course description or case description, we noted whether or not it covered each of the skills listed in the skills list that we used for content analysis of job ads by entering a 0 or 1 in a table that showed supply chain topics in columns and course descriptions or case descriptions in rows (Mar Molinero and Xie 2007). Each column total then indicated the proportion of courses or cases covering the particular topic.

Essentially, this is what the computer software did with job ads to provide the proportion of job ads requiring each topic. The backbone for such analysis is the "dictionary"—the specification of words and phrases, i.e., "key words," under various named categories to create counts under each topic or skill when a word or phrase under that category is found in a record. Krippendorff (2003, p. 287) notes that most content analyses would benefit from building special-purpose dictionaries although doing so from scratch can be a formidable task. We determined key words from the text of ads, i.e., from scratch; however, we associated these with categories (and subcategories) corresponding to topics (and subtopics) listed by Johnson and Pyke (2000) and to broad skills listed by Sodhi and Son (2008) (Tables 4, 5, and 6).

After listing 13,080 words and phrases up to six words long that are in the text of supply chain job ads, we placed appropriate words and phrases as "key words" in these categories and subcategories (Tables 4, 5, and 6). For example, we placed phrases such as *supplier relationship management* and *vendor management*, which occur in the ads, into category E (Sourcing and supplier management) and subcategory E4 (Supplier and vendor management). We started with the list of the most frequently occurring words and phrases and then supplemented these with other words from the list of 13,080 words and phrases that would describe any subcategory because we wanted to address a potential "long tail" problem whereby infrequently occurring words from different ads could nonetheless collectively represent an important skill required by many employers.

Categories for text are neither mutually exclusive nor exhaustive relative to ads. An ad can be in more than one category (this also applies to our analysis of cases and course descriptions). Likewise, it is possible that an ad does not belong to any category because it does not include any key words that are in the dictionary; this was not true in our study. However, note that key words under subcategories and categories are mutually exclusive.

We also appended the dictionary used by Sodhi and Son (2008) for their analysis of OR job ads, making suitable modifications to incorporate general skill categories, such as communication. We ended up with 15 more categories, each of which included subcategories (Table 6). Each subcategory has many words and phrases attached to it to enable the software to determine whether or not a particular job ad belongs to a category or subcategory.

We had 27 categories with 86 subcategories—these describe different needs of employers—and

Categories and subcategories of supply chain topics and subtopics

- A. Location and supply chain design*
  - A1. Facility location
  - A2. Supply chain design/ restructuring
- B. Transportation and logistics
  - B1. Material handling/ warehouse management
  - B2. Transportation
  - B3. Logistics
- C. Inventory and forecasting
  - C1. Inventory and materials management
  - C2. Forecasting
- D. Marketing and channel restructuring
  - D1. Customer-relationship management
  - D2. Distributor or channel management
  - D3. Replenishment (ECR/quick or accurate response)
  - D4. Pricing
  - D5. Marketing (general)
- E. Sourcing and supplier management
  - E1. Make/buy decision
  - E2. Supply management
  - E3. Procurement
  - E4. Supplier and vendor management
  - E5. Contracts and negotiation
- F. Information and electronic mediated environments
  - F1. E-commerce
  - F2. ERP systems
  - F3. E-procurement
  - F4. Business-to-business
  - F5. Emerging information technology/managing information
- G. Product design and new product introduction
  - G1. Product design (product variety/postponement)
  - G2. New product introduction
- H. Service and after-sales support
  - H1. Customer service
  - H2. After-sales service
- I. Reverse logistics and green issues
  - I1. Environmental issues
  - I2. Returns and reverse logistics
- J. Outsourcing organizational and alliances
  - J1. Outsourcing
  - J2. Organizational issues (coordinate/ collaboration)
  - J3. Alliances
- K. Metrics and performance
  - K1. Metrics
  - K2. Performance-related (incentives, etc.)
- L. Global issues
  - L1. Global management
  - L2. Government issues
  - L3. Global (other—tax, currency, etc.)

Table 4: This table shows 12 categories (A to L), which are taken from Johnson and Pyke (2000), and subcategories. Each subcategory includes many key words that we do not show above but have associated with the subcategory. Note that in the classification scheme in Johnson and Pyke (2000), the "location" category includes issues pertaining to both qualitative and quantitative aspects of facility location decisions; however, it may not include the design of a supply chain network. To maintain the same classification scheme as in Johnson and Pyke, we expand the "location" category to include "supply chain design."

745 words and phrases (key words) to allow us to analyze job ads for the needs of employers for both supply chain topics and general skills (Tables 4 and 6).

Results: Supply Chain Topics Required by Employers

As far as the number of ads goes, *sourcing and supplier management* (57.2 percent of the ads) and *inventory and forecasting* (51.6 percent of the ads) are clearly quite important to employers (Table 7). Next are skills and knowledge pertaining to *information and electronic mediated environments* (37.1 percent), mainly because familiarity with ERP systems is a requirement for many jobs, and *marketing and channel restructuring* (34.2 percent). Skills related to *transportation and logistics* (30.3 percent), *metrics and performance* (27.4 percent), and *service and after-sales support* (25.7 percent) are also very much in demand by employers.

An example of category, subcategory, and key words

- F. Information and electronic-mediated environments (Category)
- F2. ERP systems (Subcategory)
  - (Key words)
  - ERP
  - ERP and advanced planning
  - ERP implementation
  - ERP package
  - ERP systems
  - ERP systems experience
  - ERP/ERM
  - ERP/financial
  - ERP/MRP
  - ERP/MRP/forecasting
  - *ORACLE*
  - SAP
  - BAAN
  - Enterprise resource planning

Table 5: This table illustrates the key words that belong to the subcategory F2 in category F.

At a more granular subtopic level, Table 8 shows the subcategories that appear to be important to employers.

These subcategories provide additional information about the category-level analysis. For example, much of the importance of category F (Information and electronic mediated environments) is because of subcategory F2 (ERP systems). Note that most of the important subcategories are consistent with the findings at the category level shown in Table 7.

To take an even more granular view of employer demand of supply chain topics, we examined the top specific words and phrases in the ads. The benefit of these key words and their importance in terms of the proportion of job ads requiring them lies in providing specific topics for designing supply chain courses and

Categories and subcategories of broad skills and degree types
M. Other operations management
M1. Business process-related
M2. Operations misc.
M3. Supply chain misc.
M4. Six Sigma
M5. Financial economics models (e.g., real options)
M6. Accounting
M7. Audit
N. General analytical
N1. Analysis
N2. General abilities
N3. Problem-solving skills
O. Basic IT
O1. General PC skills
O2. MS Office
O3. Word and PowerPoint
P. Communication
P1. General communication
P2. Presentation skills
P3. Written and verbal skills
Q. Programming
Q1. Programming languages
Q2. Database programming
Q3. Software applications
Q4. Web applications
Q5. Programming general
R. Project
R1. Manage projects
R2. Lead projects
R3. Projects—miscellaneous
S. Team
S1. Interpersonal skills
S2. Team-related skills
T. Statistics
T1. Stats software
T2. Data set management
T3. General data analysis
T4. Data mining
T5. Data modeling
T6. Stats miscellaneous
U. Leadership
U1. Change management
U2. Leadership general
U3. Team leading
V. Modeling
V1. Modeling languages
V2. Algorithm development
V3. Optimization
V4. Optimization applications
V5. Decision science and analysis
V6. Decision support
V7. Model development
V8. Simulation
W. Spreadsheet and database
W1. MS Excel
W2. MS Access
X. Bachelor's
Y. Master's
Z. PhD
Zz. MBA

Table 6: Categories (M to Zz) and their subcategories are modified from Sodhi and Son (2008). Each subcategory includes key words, which are not shown above, that Sodhi and Son associated with that subcategory.

for choosing business cases. Broadly speaking, the top key words (Appendix 1) reflect the importance of the top categories and subcategories. For example, consider the top key word "inventory." This key word belongs to subcategory C1, which is top-rated among the subcategories (Table 8) and belongs to category C, which is second among all categories (Table 7); thus, it reflects the importance of the parent subcategory and the category.

Results: Broad Skills Required by Employers

The results regarding skills indicate that the top five skills are all "soft" skills that a particular supply chain course might not provide; however the MBA program as a whole might provide them. The students may have already acquired such skills (Table 9) before embarking on their MBA studies.

Category	Supply chain topic	Ads (%)
E	Sourcing and supplier management	57.2
C	Inventory and forecasting	51.6
F	Information and electronic mediated environments	37.1
D	Marketing and channel restructuring	34.2
B	Transportation and logistics	30.3
K	Metrics and performance	27.4
H	Service and after-sales support	25.7
L	Global issues	23.0
G	Product design and new product introduction	15.5
J	Outsourcing organizational and alliances	6.7
I	Reverse logistics and green issues	3.1
A	Location and supply chain design	1.3
Total		313.10

Table 7: The percentage of supply chain job ads correspond to each supply chain topic. Totals exceed 100 percent because each ad can fit into multiple categories; therefore, any comparisons across tables should be made by scaling all percentages by the column total.

Communication, which includes written and verbal communication and presentation skills, is the most commonly demanded skill; pertinent key words appear in 53 percent of the ads. Leadership skills, the ability to run an organization, to bring about change, or to lead a team, are requested in 46.7 percent. Project management, which we should not confuse with project scheduling as taught in some management science courses, and which includes the ability to handle multiple projects, manage projects, and lead projects, appears in 42.3 percent. Team-related skills are demanded in 36.2 percent; this category includes interpersonal skills, which 21.6 percent request, and the ability to work in a team. General analytical skills, which focus on problem solving, are also highly in demand—28.8 percent request them.

The remaining categories refer to technical skills, which are also high in terms of the proportion of ads stating a requirement for them. These include spreadsheet and database—the ability to use MS Excel and MS Access (26.4 percent), basic IT (26.0 percent) and the use of word processing and presentation software, modeling (23.0 percent), statistics (12.1 percent), and programming (7.7 percent).

The high proportion of ads requiring basic IT or programming is striking. Certainly, all employers

Cat.	Supply chain subtopic	Ads (%)	Cat.	Supply chain subtopic	Ads (%)
C1	Inventory and materials management	42.8	D3	Replenishment (ECR/quick or accurate response)	3.4
E3	Procurement	40.1	D4	Pricing	3.0
E4	Supplier and vendor management	34.9	J1	Outsourcing	3.0
F2	ERP systems	33.0	F5	Emerging information technology/managing information	2.7
D5	Marketing (general)	28.0	I1	Environmental issues	2.7
B3	Logistics	25.3	D2	Distributor or channel management	2.3
C2	Forecasting	25.3	F3	E-procurement	2.3
H1	Customer service	24.7	F1	E-commerce	1.6
K1	Metrics	20.7	G1	Product design (product variety/postponement)	1.3
L2	Government issues	19.9	H2	After-sales service	1.1
E5	Contracts and negotiation	16.5	A2	Supply chain design/restructuring	1.0
G2	New product introduction	14.8	E1	Make/buy decision	0.9
E2	Supply management	10.8	A1	Facility location	0.0
K2	Performance-related (incentives, etc.)	10.5	B1	Material handling/warehouse management	0.0
B2	Transportation	8.9	F4	Business-to-business	0.0
L1	Global management	4.7	I2	Returns and reverse logistics	0.0
J2	Organizational issues (coordinate/collaboration)	4.1	J3	Alliances	0.0
D1	Customer-relationship management	3.8	L3	Global (other—tax, currency, etc.)	0.0
		Total	394.1%		

Table 8: The proportion of ads for each subtopic among supply chain topics (A to L) appear in decreasing order. Totals exceed 100 percent because each ad can fit into multiple categories. Any comparisons across tables should be made by scaling all percentages by the column total.

expect MBAs to have word processing, presentation software, and spreadsheet skills. Thus, because nearly 26 percent of the employers mention these skills, we surmise that this reflects their dissatisfaction with their MBA (and possibly other) hires. However, we do not expect employers to use their MBA employees as programmers. Many ads request skills in SQL and spreadsheet programming using VBA; we suspect that the high proportion of ads in the programming category reflects employers' needs for comfort that their new hires will be able to use enterprise or other software rather than program it. This is confirmed by ad counts at the subcategory level in which both programming languages and programming miscellaneous are mentioned in a relatively low proportion of ads.

Category	Skill	Ads (%)
P	Communication	53.0
U	Leadership	46.7
R	Project	42.3
S	Team	36.2
N	General analytical	28.8
W	Spreadsheet and database	26.4
O	Basic IT	26.0
V	Modeling	23.0
T	Statistics	12.1
Q	Programming	7.7
Total		302.2

Table 9: This table shows the proportion of job ads that require each skill. Totals exceed 100 percent because each ad can fit into multiple categories. Any comparisons across tables should be made by scaling all percentages by the column total.

To improve the granularity of our demand analysis, we examined the subcategories (Table 10).

The results are consistent with the findings at the category level.

We can repeat this with the key words in the ads (Appendix 2). The top-occurring key words give us a sense of what employers want. The benefit of the key words is that universities can use them and their relative occurrence in job ads to evaluate their MBA-program offerings.

Some of these skills may be generic in the sense that employers require them of any employee, not just an employee with supply chain or MBA qualifications. To see which skills are generic, we compared these MBA job ads to more than 1,000 US operations research (OR) jobs ads by looking at the proportion of job ads requesting each skill. Using an arbitrary threshold of a 10 percent point difference between the

Subcat.	Subskills	Ads (%)
U2	Leadership general	41.5
R1	Manage projects	37.1
P3	Written and verbal skills	29.8
P1	General communication	28.6
W1	MS Excel	23.9
S2	Team-related skills	22.3
S1	Interpersonal skills	21.6
N3	Problem-solving skills	18.8
P2	Presentation skills	15.5
O3	Word and PowerPoint	12.9
O2	MS Office	12.2
N1	Analysis	10.1
W2	MS Access	9.5
V7	Model development	9.1
R2	Lead projects	7.2
U3	Team leading	7.0
O1	General PC skills	6.8
U1	Change management	6.8
V3	Optimization	5.8
N2	General abilities	5.7
V4	Optimization applications	5.3
Q4	Web applications	5.0
V5	Decision science and analysis	4.7
T3	General data analysis	4.0
T5	Data modeling	3.4
V6	Decision support	2.8
R3	Projects—miscellaneous	2.7
Total		360.1

Table 10: Subcategories of skills are listed by descending proportion of job ads requiring these subskills. Totals exceed 100 percent because each ad can fit into multiple categories. Comparisons should be made by scaling all percentages by the column total.

percentage of jobs requiring these skills, we found that skills pertaining to communication, spreadsheet and database, basic IT, team, and project management appeared to be in similar demand for both types of job ads (Table 11) .

For example, communication skills are requested in 53 percent of the supply chain job ads and 59.4 percent of the OR job ads; the difference is small.

Results: Supply Chain Topics Covered in MBA Courses

We analyzed core operations management courses separately from supply chain electives. The coverage of supply chain topics (Table 4) in the core courses was low relative to those in the supply chain electives (Table 12).

We could adjust the coverage of supply chain topics in the elective courses with that in the core courses.

Category/broad skill required by employers		SCM (%)	OR ads (%)	Difference (%)
M	Other operations management	66.8	41.8	25.0
U	Leadership	46.7	35.0	11.7
R	Project	**42.3**	**36.8**	**5.5**
S	Team	**36.2**	**35.3**	**0.9**
O	Basic IT	**26.0**	**27.4**	**−1.4**
W	Spreadsheet and database	**26.4**	**29.5**	**−3.1**
P	Communication	**53.0**	**59.4**	**−6.4**
N	General analytical	28.8	42.3	−13.5
V	Modeling	23.0	49.5	−26.5
T	Statistics	12.1	47.8	−35.7
Q	Programming	7.7	46.4	−38.7
Total		369.0	451.2	

Table 11: This table shows a comparison of supply chain and OR job ads at the category level based on skills and degree types. Skills P, W, O, S, and R (in bold) show a similar proportion of ads requiring them for both supply chain management and OR and may be considered generic. Totals exceed 100 percent because each ad can fit into multiple categories. Any comparisons across tables should be made by scaling all percentages by the column total.

However, the correlation between coverage in the electives alone and that of the sum with operations management courses is 96 percent for course descriptions and 98 percent for case descriptions across the 12 supply chain categories (A–L). Therefore, little is lost by focusing only on the supply chain electives. However, we did analyze the operations management core courses further; Appendix 3 provides details.

Based on our analysis of supply chain electives, categories B (mentioned in 48.6 percent of the online course descriptions), F (47.2 percent), and C (43.1 percent) are the top three categories (Table 12). However, based on our analysis of the 84 cases covered in the elective courses at the 21 institutions, categories C (covered in 32.1 percent of the cases), D (26.2 percent), G (25 percent), and L (25 percent) appear to be the supply chain topics that are covered most frequently (Table 12). We shall later see that despite these differences, the two analyses are markedly consistent in indicating undersupplied topics.

At the subcategory level (Table 13), the results resemble those of the category-level analysis with course descriptions.

B3 (mentioned in 40.3 percent of the online course descriptions), C1 (38.9 percent), and F5 (23.6 percent) appear to be the supply chain topics that are most frequently covered in the online course descriptions.

		Proportion of supply chain electives (%)		Proportion of operations management core (%)	
	Supply chain topic category	Courses	Cases	Courses	Cases
A	Location and supply chain design	36.1	13.1	6	0
B	Transportation and logistics	48.6	20.2	0	4
C	Inventory and forecasting	43.1	32.1	6	12
D	Marketing and channel restructuring	33.3	26.2	0	12
E	Sourcing and supplier management	19.4	13.1	3	6
F	Information and electronic mediated environments	47.2	23.8	17	4
G	Product design and new product introduction	13.9	25.0	3	12
H	Service and after-sales support	6.9	6.0	0	0
I	Reverse logistics and green issues	0.0	2.4	0	0
J	Outsourcing organizational and alliances	33.3	15.5	0	2
K	Metrics and performance	16.7	13.1	6	4
L	Global issues	31.9	25.0	14	8
Total		**330.40**	**215.50**	**55.0**	**64.0**

Table 12: This table shows the percentages of supply chain course and case descriptions with key words corresponding to each supply chain topic at the category level in supply chain electives and in operations management core courses. Totals exceed 100 percent because each course or case can fit into multiple categories. Any comparison should be made by scaling all percentages by the column total.

In addition, the items from the A, L, and J categories, which employers previously identified as less important (Table 8), were identified as among the most frequently covered topics in MBA classes. These include A2 (31.9 percent), L1 (26.4 percent), and J2 (16.7 percent).

We did the same analysis on cases (Table 13). Similar to the category results with cases, the most covered topics were C1 (26.2 percent), L1 (20.2 percent), and D2 (16.7 percent). However, 7 of 28 subcategories, such as B1 (Material handling/warehouse management) and F2 (ERP systems), are not covered by the cases—at least by those in our sample.

Comparison of "Demand" and "Supply" of Supply Chain Topics

To indicate the extent to which educators are actually covering topics of interest to employers in their supply chain electives, we made a scatter plot of the coverage of these topics (indicated by the proportion of course descriptions) against the demand for these topics (indicated by the proportion of job ads).

The resulting plot (Figure 3) indicates the top five oversupplied supply chain topics, i.e., those that business schools emphasize more than employers do; these are A2 (Supply chain design/restructuring), F5 (Emerging information technology/managing information), B3 (Logistics), J2 (Organizational issues (coordinate/collaboration)), and G1 (Product design (product variety/postponement)). Other oversupplied topics are L1 (Global management), F1 (E-commerce), D3 (Replenishment), and D2 (Distributor or channel management).

Likewise, the top five undersupplied topics as indicated by the same scatter plot (Figure 3) are E3 (Procurement), E4 (Supplier and vendor management), D5 (Marketing (general)), F2 (ERP systems), and C2 (Forecasting). Some of the topics identified as undersupplied are K1 (Metrics), E5 (Contracts and negotiation), H1 (Customer service), and G2 (new product introduction).

From the scatter plot, we can see similar results of the proportion of cases versus the proportion of job ads for each subskill. To make the results clearer, we also developed a scatter plot showing the gap (demand-supply) with supply being measured both ways (Figure 4) to determine if there are any supply chain (sub) topics that are indicated as being oversupplied or undersupplied by using course descriptions or cases. Given the potential for high measurement error associated with either analysis on the supply side, having consistent results gave us more confidence in the findings.

It is clear from the scatter plot of the gap and the top right (bottom left) quadrant that many subtopics are undersupplied (oversupplied) regardless of how we analyze the supply, i.e., by cases or by course descriptions (Figure 4).

Table 14 shows the subtopics that are undersupplied and oversupplied in both analyses.

It appears that undersupplied topics are practice- or process-oriented, while oversupplied topics are conceptual or strategic. However, there are many subtopics that are evenly matched, reflecting the results from the topic-level analysis that, in general,

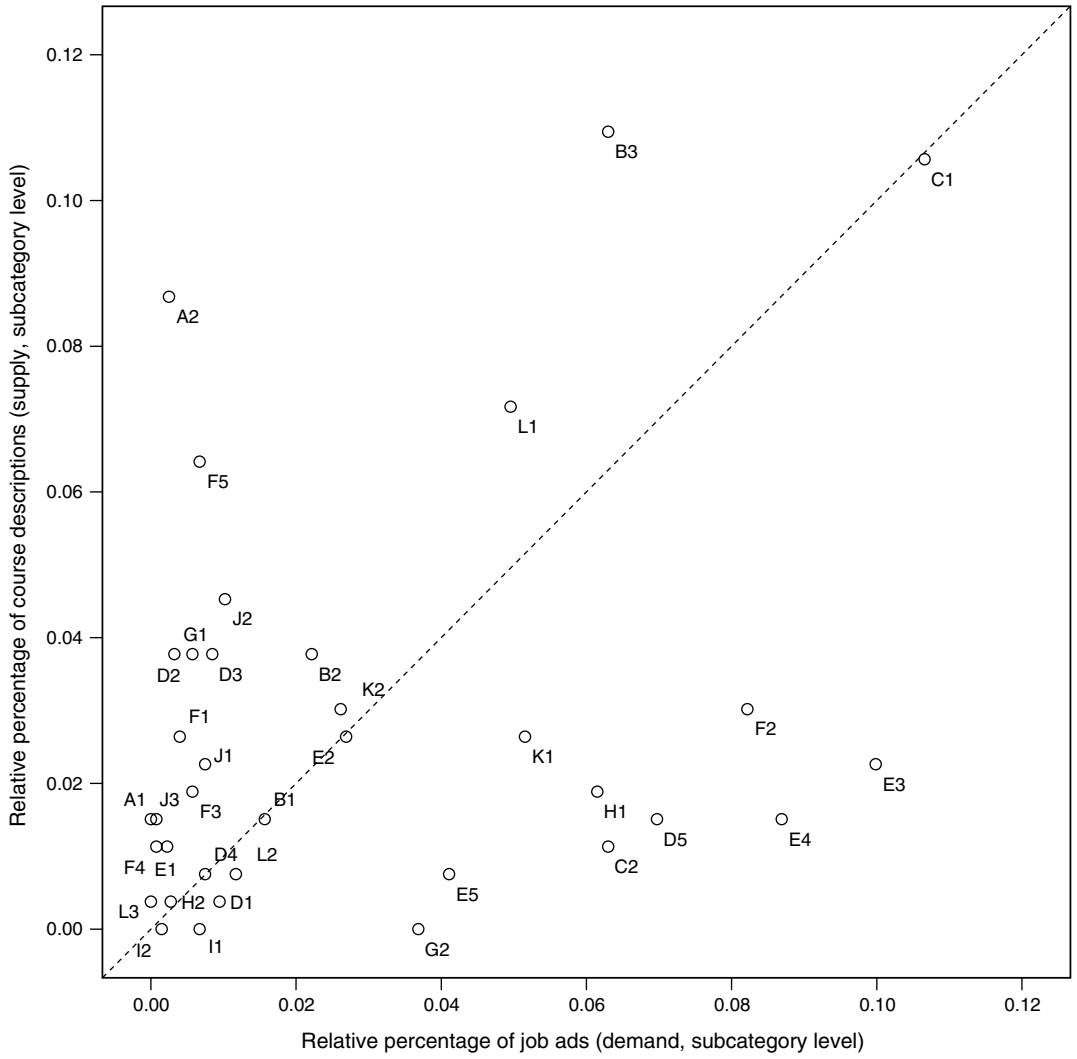

Figure 3: This graph shows a scatter chart between demand (relative percentage of job ads, subcategory level) and supply (relative percentage of course descriptions, subcategory level).

there is a good match between demand and supply in supply chain management education. This information can inform the debate on the purpose of business schools in preparing leaders versus the employers' need for specific knowledge and skills.

Interestingly, we do not find much gap in surveys of academics and practitioners when we consider only the high-level supply chain topics. We surveyed the academics who attended the Supply Chain Thought Leadership Roundtable (St. Louis, Missouri, July 27–29, 2006) about the relative importance of the concepts captured in the 12 categories of supply chain topics. These supply chain academics were representatives of various universities including: Clemson University, Columbia University, Eindhoven University of Technology, Dartmouth College, Georgia Tech, Hamburg University, Harvard University, Hong Kong University of Science and Technology, Kobe University, Lehigh University, London Business School, MIT, Purdue University, Stanford University, University of Augsburg, UCLA, University of Cincinnati, University of Michigan, University of Minnesota, University of North Carolina, University of Pennsylvania, USC, University of Santa Clara, and Washington

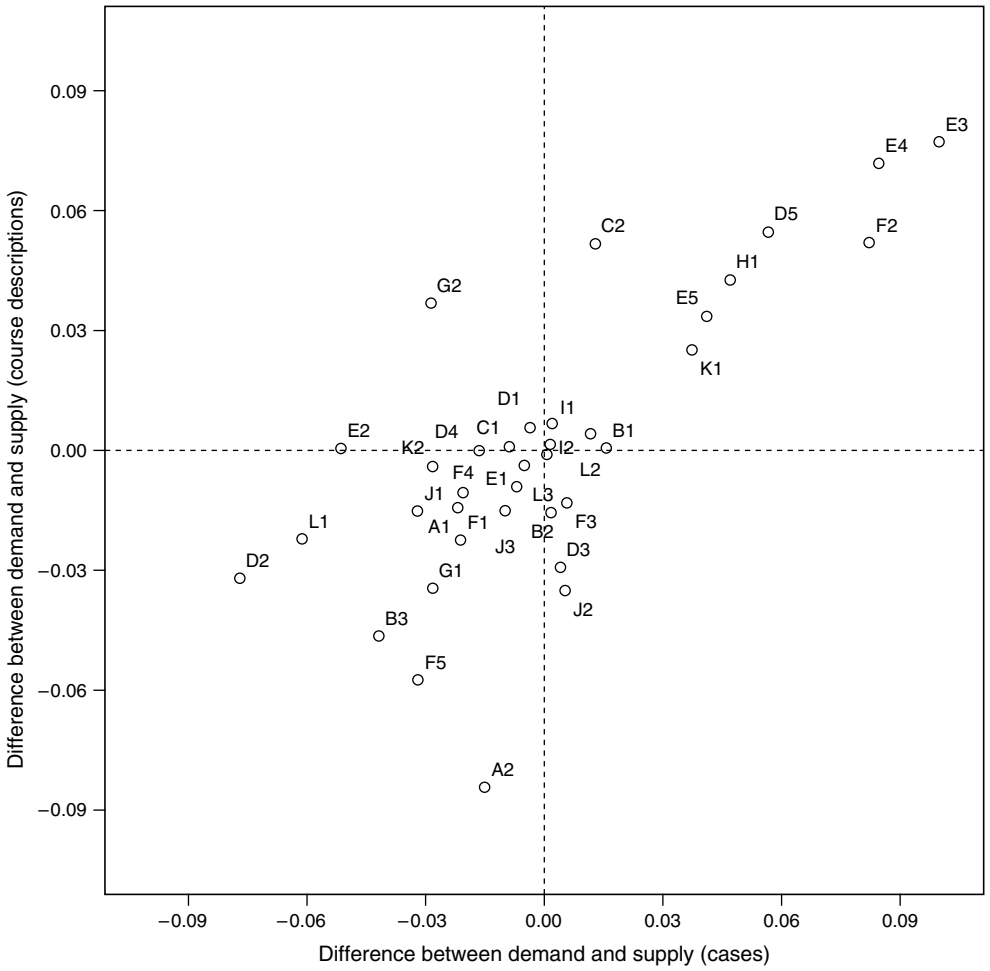

Figure 4: This graph illustrates the difference between demand and supply using both cases and courses. The top right (bottom left) quadrant shows undersupplied (oversupplied) supply chain topics as indicated by both case descriptions and course descriptions. The concentrated cluster in the center shows that many subtopics are well-matched.

University. The industry respondents were representatives of the following companies: Boeing, Claim Jumper Restaurant, Clorox, Deloitte & Touche, Dole Fresh Fruits, General Motors, Hewlett Packard, Hitachi, IBM, Ingram Micro, Intel, Mattel, Mervyn's, Nestlé, Neutrogena, Pepsi, Pfizer, Raytheon, and Xilinx.

We surveyed 36 academics and received 32 responses—a response rate of 89 percent. We also sent out 50 surveys via e-mail to UCLA alumni and recruiters working in the area of supply chain management, purchasing, or procurement and received 22 responses—a 44 percent response rate. We also asked the respondents to provide suggestions for educators. Appendix 4 shows their recommendations.

We asked both sets of respondents about the relative importance of supply chain topics for MBA graduates using a seven-point Likert scale with all 12 categories (Table 4) and compared the responses that these two groups provided. For comparison, we normalized the respective scores of each respondent (academic or industry professional) across categories so that the total score for each respondent was 48, i.e., an average score of 4 (on a seven-point Likert scale) for each of the 12 categories. This avoided the possibility that some people might give consistently low scores to all

Subcat.	Supply chain subtopic	Courses (%)	Cases (%)	Subcat.	Supply chain subtopic	Courses (%)	Cases (%)
A1	Facility location	5.6	4.8	F2	ERP systems	11.1	0.0
A2	Supply chain design/restructuring	31.9	8.3	F3	E-procurement	6.9	0.0
B1	Material handling/warehouse management	5.6	0.0	F4	Business-to-business	4.2	6.0
B2	Transportation	13.9	4.8	F5	Emerging information technology/managing information	23.6	15.5
B3	Logistics	40.3	15.5				
C1	Inventory and materials management	38.9	26.2	G1	Product design (product variety/postponement)	13.9	8.3
C2	Forecasting	4.2	10.7	G2	New product introduction	0.0	13.1
D1	Customer-relationship management	1.4	3.6	H1	Customer service	6.9	6.0
D2	Distributor or channel management	13.9	16.7	H2	After-sales service	1.4	1.2
D3	Replenishment (ECR/quick or accurate response)	13.9	1.2	I1	Environmental issues	0.0	2.4
				I2	Returns and reverse logistics	0.0	0.0
D4	Pricing	2.8	4.8	J1	Outsourcing	8.3	9.5
D5	Marketing (general)	5.6	3.6	J2	Organizational issues (coordinate/collaboration)	16.7	1.2
E1	Make/buy decision	4.2	2.4	J3	Alliances	5.6	4.8
E2	Supply management	9.7	10.7	K1	Metrics	9.7	4.8
E3	Procurement	8.3	0.0	K2	Performance-related (incentives, etc.)	11.1	8.3
E4	Supplier and vendor management	5.6	1.2	L1	Global management	26.4	20.2
E5	Contracts and negotiation	2.8	0.0	L2	Government issues	2.8	0.0
F1	E-commerce	9.7	7.1	L3	Global (other—tax, currency, etc.)	1.4	1.2

Total: 368.3% (courses) and 224.1% (cases)

Table 13: This table shows the proportion of online course and case descriptions with words and phrases corresponding to supply chain subtopics in supply chain electives. Totals exceed 100 percent because course or case description can fit into multiple categories. Any comparisons across columns or tables should be made by scaling all percentages by the column total.

categories, while others might give consistently high scores. Normalizing ensures that all people allocate a total of 48 points across the categories.

The mean scores for academics differ by at most a half point from the mean scores of industry professionals for each of the 12 categories; this results in a similar profile of the importance they accord to these categories relative to MBA graduates (Figure 5). Therefore, it would appear that academics are aware of the relative importance of topics to the industry despite the variance around the mean scores for each category.

Subcat.	Undersupplied (sub)topics	Subcat.	Oversupplied (sub)topics
C2	Forecasting	K1	Metrics
D5	Marketing (general)	G1	Product design (product variety/postponement)
E3	Procurement		
E4	Supplier and vendor management	A2	Supply chain design/restructuring
		L1	Global management
E5	Contracts and negotiation	D2	Distributor or channel management
		B3	Logistics
F2	ERP systems	F5	Emerging information technology/managing information
H1	Customer service		

Table 14: This table shows skills identified as undersupplied or oversupplied by our analyses of cases and course descriptions.

Conclusions

Our primary goal was to identify what employers want from MBA graduates in terms of knowledge of

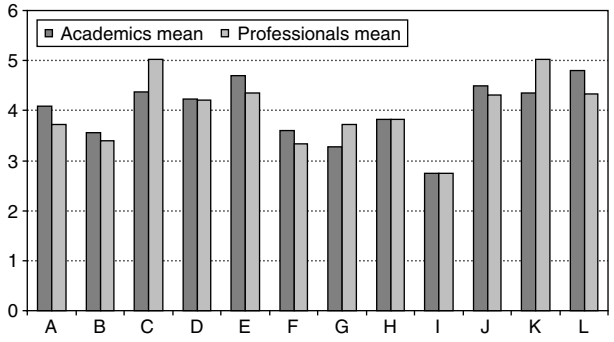

Figure 5: This graph shows mean normalized responses of industry professionals and academics regarding the importance to recruiters of the 12 categories (A to L) of supply chain topics.

specific supply chain topics and broad skills. We analyzed the text of 704 online job ads for MBA graduates and concluded that employers want knowledge of topics such as inventory and material management (43 percent of job ads), procurement (40 percent), supplier and vendor management (35 percent), and ERP systems (33 percent). The broad skills that employers want from MBA graduates are general leadership (42 percent of job ads), ability to manage projects (37 percent), written and verbal skills (30 percent), and familiarity with Microsoft Excel (24 percent).

Furthermore, using the same supply chain topics at two levels of granularity in the job ads analysis, we analyzed the text of 37 course descriptions and 84 business cases used in MBA-level supply chain electives in 21 of the top 50 business schools. We supplemented this by analyzing operations management core classes with 36 course descriptions and 51 cases. Although this analysis was interesting (Appendix 3), it provided only marginal incremental contribution to the analysis of supply chain electives.

Finally, we compared the relative coverage of supply chain topics by educators to the relative demand for these topics by employers. This comparison, done using both cases and course descriptions, indicated that there may be an oversupply of conceptual and strategy-oriented topics, such as product design and supply chain design, and an undersupply of practice- or process-oriented topics, such as procurement, supplier and vendor management, and forecasting, at least in the electives taught at the schools in our sample. Practical suggestions that practitioners offer to educators (Appendix 4) complement this undersupply. For example, academics need to develop a standard supply chain terminology and more cases on metrics, performance measures, and globalization.

Future research is needed to confirm whether there is a systematic pattern of undersupply or oversupply by MBA programs as a whole, taking such core courses as marketing or accounting into consideration. If the gap between skill supply and demand is real, one possible reason could be that some topics are covered at places other than the business schools. Employers expect that MBA students will have had a few years of industry experience before they began their MBA programs. In addition, MBA students might want to learn skills better suited to, for example, management consulting rather than manufacturing. Finally, whether such a gap is inevitable or undesirable is part of a larger debate on business education; however, we hope that our results will catalyze informed discussion on these issues.

Appendix 1

Cat.	Key words	Ads (%)	Cat.	Key words	Ads (%)
C	Inventory	26.6	E	Vendors	6.8
E	Purchasing	25.9	E	Supplier management	6.3
B	Logistics	25.3	E	Supplier relationships	6.1
E	Procurement	24.7	B	Warehousing	6.0
D	Marketing	21.0	G	New products	6.0
K	Metrics	18.6	M	Process improvements	4.8
F	SAP	17.0	M	Operations management	4.7
C	Forecasting	16.9	K	Performance metrics	4.5
F	ERP	14.6	M	Black belt	4.4
M	Six Sigma	14.3	J	Collaboration	4.1
C	Inventory management	13.6	H	Customer requirements	4.0
C	Material	12.4	H	Customer satisfaction	3.7
F	*Oracle*	9.9	H	Service levels	3.7
H	Customer service	9.5	L	Global sourcing	3.7
B	Transportation	8.9	M	Green belt	3.7
C	Forecast	8.9	E	Supplier quality	3.3
C	Materials management	8.7	K	Performance management	3.3
G	New product	8.1	M	Audit	3.1
M	Business processes	7.7	F	ERP systems	3.0
M	Process improvement	7.5	L	Global supply chain	3.0
E	Supplier performance	7.4	D	Replenishment	2.8
M	Business process	7.4	E	Supplier selection	2.8
E	Supply base	7.1	E	Contractual	2.8

Table A.1: This table's data show the top subcategory-level key words and the respective proportion of ads associated with the (grandparent) categories (A to L).

Appendix 2

Cat.	Key words for skills	Ads (%)	Cat.	Key words for skills	Ads (%)
R	Project management	26.3	O	Computer skills	5.0
R	Leadership	23.3	R	Project teams	5.0
O	Excel	22.3	U	Team environment	5.0
P	Communication skills	16.2	N	Problem solving	4.8
N	Problem solving	14.6	P	Written and verbal	4.7
S	Interpersonal	11.1	P	Ability to communicate	4.4
S	Interpersonal skills	11.1	P	Excellent written	4.4
R	Leadership skills	9.1	P	Verbal communication	4.3
O	PowerPoint	8.8	R	Multiple projects	4.3
P	Presentation skills	8.0	U	Management skills	4.1

(Appendix 2 continues on next page.)

Appendix 2. (Continued)

Cat.	Key words for skills	Ads (%)	Cat.	Key words for skills	Ads (%)
O	PowerPoint	8.8	R	Multiple projects	4.3
P	Presentation skills	8.0	U	Management skills	4.1
V	Modeling	8.0	R	Project manager	4.0
P	Presentation	7.8	V	Decision making	4.0
P	Excellent communication	7.4	P	Written communication	3.7
P	Strong communication	7.0	Q	*SQL*	3.3
U	Team members	7.0	W	MS Access	3.3
O	Microsoft Office	6.8	P	Written and oral	3.1
R	Change management	6.8	V	Capacity planning	3.1
R	Program management	6.0	N	Attention to detail	3.0
V	Optimization	5.8	R	Project plans	3.0
U	Team player	5.5	P	Verbal and written	2.8
O	MS office	5.1	U	Organizational skills	2.8

Table A.2: This table's data show the top key words from analysis of job ads for broad skills and the respective proportion of ads not including the various degrees and supply chain management.

Appendix 3

We created a categorization for operations management topics while analyzing operations management courses. However, this is only at a high level; we did not develop any subcategories. While Table 13 shows the coverage of specific supply chain topics (categories A to L), Table A.3 shows the coverage of operations management topics.

	Operations management topic	Proportion of Courses (%)	Proportion of Cases (%)
OM1	Process analysis (types of processes, product-process matrix, bottleneck analysis, capacity analysis)	97	29
OM2	TQM/JIT/Lean	58	18
OM3	Queuing theory	14	16
OM4	Inventory theory	33	4
OM5	Operations strategy	50	25
OM6	Simulation	8	4
OM7	Product development process/time-based competition	19	2
OM8	Project management	25	4
OM9	Cross-functional collaboration	11	0
Total		**315.00**	**102.00**

Table A.3: This table shows the percentage of operations management core course and case descriptions pertaining to an operations management topic at the category level. Totals exceed 100 percent because each course or case description can fit into multiple categories.

Appendix 4

Supply chain industry professionals provided the following suggestions for educators.

—There is a need to stress project management skills for planning precontract and postaward administration time and a need to address risk management.

—Supplier quality/deficiency/issue resolution, contract law, and Microsoft Project are important.

—There is a need to understand how to manage a supplier milestone for performance.

—In designing courses, please include topics such as total cost of ownership, supplier metrics, and project management.

—Topics such as IP ownership, contract negotiation, and risk management are important.

—Supply chain visibility and forecasting are important to my business.

—Getting the right metrics is one of the keys to SCM. Please cover topics regarding managing supply chains with multiple performance measures.

—Negotiation and influencing skills are very important.

—As SCM becomes more mature, we need more detailed analysis to get good ideas.

—Please include analytical SC analysis. We look for people with great analytical skills, i.e., expertise in databases and great Excel skills with large data sets.

—An MBA should have a basic understanding of supply chain practices, performance measures, and information systems. I have encountered many MBAs who do not!

Appendix 5

1	Harvard
2	Stanford
3	University of Pennsylvania
4	MIT
4	Northwestern
6	University of Chicago
7	Columbia
7	UC Berkeley
9	Dartmouth
10	UCLA
11	Duke
11	University of Michigan
13	NYU
13	University of Virginia
15	Yale
16	Carnegie Mellon

(Appendix 5 continues on next page.)

Appendix 5. (Continued)

16	Cornell
18	Emory
18	UT Austin
20	UNC at Chapel Hill
21	Purdue
22	Ohio State
23	Indiana University
23	Michigan State University
23	University of Minnesota
26	University of Rochester
26	Washington University in St. Louis
28	University of Illinois
29	University of Southern California
29	University of Washington
31	Texas A&M
31	Notre Dame
31	University of Wisconsin
34	Arizona State University
34	Brigham Young University
34	Georgetown
34	Georgia Tech
38	Penn State
38	UC Irvine
38	University of Maryland
41	Boston College
41	Southern Methodist University
41	University of Florida
44	Boston University
44	Rice
46	UC Davis
46	University of Georgia
48	University of Pittsburgh
49	Babson
49	Tulane
49	Vanderbilt

Table A.4: This table lists the *U.S. News & World Report* 2006 ranking of US business schools.

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