An Analysis of Supply Chain Related Graduate Programmes in Europe

Abstract

Purpose: Motivated by lack of studies at graduate level supply chain education, this research aims to explore trends in supply chain related graduate programmes in Europe and to propose a framework for designing such programmes.

Design/methodology/approach: We determine 'knowledge' and 'skills' areas applicable to supply chain management (SCM) education and analyse supply chain related graduate programmes published by the European Logistics Association in 2004. We revisit the same programmes in 2011 to determine the recent situation and the trends. We use cluster analysis to reveal the similarities and differences among these programmes.

Findings: We find two distinct clusters: *Focused* and *Diversified*. *Focused* programmes offer modules in knowledge and skills areas apart from SCM at a negligible level and place more emphasis on SCM in 2011 when compared to 2004. *Diversified* programmes show a similar increase in the emphasis on SCM with more variety in the knowledge and skills areas.

Research limitations: Our findings are based on SCM programmes delivered in Europe and over two discrete time periods. Future research should seek to extend this analysis to other continents with larger samples and incorporate the industry perspective to determine the potential gap between what programmes offer and what industry requires.

Practical implications: SCM related graduate programmes continue to redefine themselves. Clustering predominantly serves the universities in re-assessing and re-engineering their programmes, helps prospective graduates in their selection process and assists managers in their recruitment practices.

Originality/value: This paper establishes a baseline for assessing SCM related graduate programmes with respect to the knowledge and skills they offer and introduces a framework that may serve as a starting point for the design and positioning of such programmes.

Keywords: Supply Chain Management, Education, Cluster Analysis

Paper type: Research paper

1. Introduction

Supply chain management (SCM) has become more important than ever before due to globalization, elimination of cross country barriers, increasing customer expectations (faster deliveries, more variety, lower prices, no errors in ordering or transaction, etc.) and growing environmental importance placed on production and logistics operations (Kotzab et al., 2011). Due to the intensifying impact of globalization, more and more companies operate in larger supply chains which results in an increasing need for skilled employees trained in supply chain and logistics management (Erturgut, 2011). As a result of these factors, the demand for logistics and supply chain education has been increasing (Lancioni et al., 2001), resulting in a severe shortage of talent (Cottrill, 2010).

In order to meet this shortage of supply chain talent , a number of SCM specific education alternatives are generally offered at graduate level either as a module[1] in a general graduate level programme in Industrial Engineering (e.g. MSc Industrial Engineering and Operations Management at the University of Nottingham) or with specific concentration (e.g. MSc in Economics & Business Administration - Supply Chain Management Concentration at Copenhagen Business School), or as a specific programme on SCM (Executive Master in Global Supply Chain Management at Institut International de Management pour la Logistique, IML) (Van Hoek et al., 2011).

However, such SCM related programmes appear to be designed on a rather ad hoc basis, depending on the availability of faculty and their research areas in the school offering the programme (Ozment and Keller, 2011). This has led to an unbalanced representation of knowledge and skills areas since the available resources tend to be limited and consequently, the weight of supporting disciplines (e.g. management, quantitative methods, information systems, marketing, finance) differ. Also, additional topics, such as relationship building, collaboration, coordination and skills related to organizational behaviour and psychology are included in SCM related education programmes. Due to the expedient design of supply chain programmes, the emphasized and the neglected knowledge and skills areas critical for the supply chain education are still unclear (Myers et al., 2004; Ballou, 2007; van Hoek, et al., 2011).

A number of studies have attempted to identify the critical knowledge and skills areas for SCM education; however, consensus has not yet been reached regarding the classification and content of such areas (Murphy and Poist, 1991, 1998, 2007; Gammelgaard and Larson, 2001;

Myers et al., 2004). The problem is that there are a number of programmes offering SCM related graduate level education, but the characteristics of these programmes and how they converge to, and diverge from, each other are yet to be revealed through objective evaluation. Such evaluation should be based on a clear classification of knowledge and skills areas offered in these programmes. Therefore it is important to understand the characteristics of knowledge and skills provided in these programmes to determine the emerging patterns in the delivery of graduate education in SCM and to use these results to enhance programme assessment and design. Building on our expertise in designing and teaching graduate programmes in supply chain management, we research a sample of SCM related graduate programmes delivered in Europe to address the following research questions:

(1) What are the knowledge and skills areas incorporated into SCM related graduate programmes?

(2) What are the emerging patterns and similarities, if any, in these programmes?

(3) What curricula trends emerge between the two research periods of 2004 and 2011?

In order to address these questions we study a small sample of SCM related graduate programmes that are highlighted by the European Logistics Association (ELA, 2004). The ELA is a federation of 30 national organisations, covering almost every country in Central and Western Europe. The rationale behind our selection of this sample is the fact that the ELA formulates European Logistics Education Standards and encourages its member nations to accept these standards on a pan-European basis. This choice of sample selection also allowed us to undertake comparative analysis of the programmes in 2004 and 2011 using the data collected by means of desk research, and to reveal emerging trends in SCM education at graduate level. The remaining sections of this paper explore the extant literature relating to supply chain education, our methodological approach, research findings and discussion.

2. Supply Chain Education

Supply chain management teaching spans multiple disciplines and uses an increasing amount of methods that demonstrate the complexity associated with this growing discipline (Johnson and Pyke, 2000). Many engineering and business schools offer integrated programmes for supply chain management. However, universities are often perceived to have an overly theoretical approach to delivering what could be regarded as highly practical topics and they design curricula which are dense with theory and rigour but lacking practical information and knowledge applicable to the business environment (Ankers and Brennan, 2002). In the search

3

for what universities provide in terms of SCM education, we identify key papers that approach the issue from 'knowledge' and 'skills' perspectives.

2.1. Description of knowledge and skills areas in supply chain education

There are a number of knowledge and skills areas that have been emphasized by a number of previous studies which we summarize in this section. For example, Murphy and Poist (1991) categorize the necessary skills of logistics managers as business skills, logistics skills and management skills. They determine the importance of skills to the companies researched and identify transportation and logistics, general business administration and business ethics as the most important skills areas. In terms of logistics skills; traffic / transportation management, customer service and warehousing are regarded as the most important areas, whereas in terms of managerial skills; personal integrity, ability to motivate and ability to plan are the most critical skills. Building on the findings of this research, the authors later explain the subareas included in these skills (Murphy and Poist, 1998). Their results demonstrate an overlap between the three skills areas, i.e. management related skills, such as human resources management or strategic management, are included under business skills. Also management skills largely include soft skills, such as communication or leadership. Almost 10 years later they revisit this study to reveal emerging trends in SCM (Murphy and Poist, 2007) and conclude that supply chain management related skills have become the highest ranked within the business skills category.

Mangan and Christopher (2005) codify key knowledge areas and skills required by logistics and supply chain managers into three groups - *general* (finance; IT; management / strategy), *logistics / SCM specific* (operations / SCM; processes / flows; legislation, security and international trade; multimodal logistics; logistics in emerging markets) and *competencies / skills* (analytical; interpersonal; leadership; change management; project management). In their study of human capital in SCM, Myers et al. (2004) identify the required skills as social, decision making, problem solving and time management. Similarly, Gammelgaard and Larson (2001) consider 45 skills relevant to SCM and group these skills under interpersonal / managerial basic skills, quantitative / technological skills, and SCM core skills with some overlaps in these areas. For example, leadership, negotiation and confidence skills are included in SCM core skills, which would fall under the general heading of interpersonal skills. Moreover, this research is limited to soft skills and does not include core SCM knowledge areas, such as logistics or materials management.

Ballou (2007) attributes SCM the same importance as marketing or finance in an organization and considers purchasing (procurement), production and logistics as functions of supply chain. Sodhi et al. (2008) analyse the online advertisements of supply chain management jobs for MBA graduates and also measure the relative coverage of the same supply chain topics in modules offered at business schools. They classify supply chain topics as location and supply chain design, transportation and logistics, inventory and forecasting, marketing and channel restructuring, sourcing and supplier management, information and electronic mediated environments, product design and new product introduction, service and after-sales support, reverse logistics and green issues, outsourcing and organizational alliances, metrics and performance, and global issues. They categorize supply chain electives and operations management core modules in 21 of the 50 business schools in the United States based on these codes and conclude that there may be an undersupply of practice- or process-oriented topics, such as forecasting, procurement, supplier and vendor management, contracts and negotiation while 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. Gravier and Farris (2008) consider the SCM related knowledge and skills areas within the broad area of SCM with particular emphasis on IS / IT and soft skills. Analysing the future of logistics education, Ozment and Keller (2011) highlight management, marketing and finance in addition to the core area of SCM. Similarly, Vokurka et al. (2011), emphasise management, quantitative methods, IS / IT and finance and point the problem as the lack of defined competencies required by supply chain professionals. In addition to the abovementioned studies at programme level, Kopczak and Fransoo (2000) design a Global Project Coordination module at Master's level to develop the key capabilities in SCM education. They identify the knowledge and skills areas to be included in this module as project management and consulting skills, SCM knowledge, IS theory, soft SCM issues (risk sharing, competitive strategy, selling) and the ability to work in cross cultural, global teams.

2.2. Synthesis of knowledge and skills areas in supply chain education

SCM exists as a fragmented discipline, housed in a range of departments at universities including production management, marketing, industrial engineering, management science or supply chain management (Gravier and Farris, 2008). Having identified the key literature on supply chain management education and descriptions of knowledge and skills areas offered on such programmes, we now synthesise the knowledge and skills areas explained in Section 2.1. in Table 1; this synthesis sets the foundation of our research. Since our review concerns

5

SCM education, SCM knowledge appears as the core knowledge and skills area in Table 1. We observe that management and quantitative methods are also most cited knowledge and skills areas in terms of SCM education whilst law and legal knowledge is recognised by fewer researchers (Murphy and Poist, 1991, 1998, 2007; Mangan and Christopher, 2005). However, to be comprehensive, we include all knowledge and skills areas identified in these key papers to analyse the curricula of the programmes. Therefore, despite the fact that the law / legal knowledge and skills area is identified by only two of the papers, we still incorporate it into our synthesis since it is a valid knowledge and skills area offered on supply chain related programmes.

Table 1 Knowledge areas and skills necessary for supply chain management education

Paper	SCM	Management	Quantitative Methods	IS / IT	Marketing	Finance / Economy	Law/ Legal	Soft* skills
Murphy and Poist, 1991, 1998, 2007	✓	✓	✓	✓	✓	✓	✓	✓
Kopczack and Fransoo, 2000	✓	✓	✓	✓	✓	✓		✓
Gammelgaard and Larson, 2001	✓	✓	✓	✓				✓
Myers et al., 2004	✓		✓					✓
Mangan and Christopher, 2005	✓	✓	✓	✓		✓	✓	✓
Ballou 2007	✓	✓	✓		✓	✓		✓
Gravier and Farris, 2008	✓			✓				✓
Sodhi et al., 2008	✓	✓	✓	✓	✓			✓
Ozment and Keller, 2011	✓	✓			✓	✓		
Vokurka, 2011	✓	✓	✓	✓		✓		✓

* Soft skills: Foreign languages, communication, personal development, negotiation and influencing skills.

To summarize, from a SCM education perspective, we consider inclusion of SCM knowledge and skills under 'business skills' in Murphy and Poist (1991, 1998, 2007) an underestimation, since SCM is multidisciplinary and supported by management, quantitative methods, Information Systems / Information Technology (IS / IT) or finance disciplines. We take on the classification of Mangan and Christopher (2005) with caution because the groups of knowledge and skills areas they identify are not comprehensive and there is an overlap between these areas, i.e. project management and change management are listed as skills but not knowledge areas, which seems contrary to the extant literature analysing these as

belonging primarily to the broad area of management knowledge. However, we acknowledge that these are the themes that have emerged from their field research. Although there is a wide consensus on which knowledge and skills areas should be included in SCM programmes, we see in Kopczak and Fransoo (2000) no clear distinction between the knowledge and skills areas to be incorporated in a supply chain project module. A single module cannot address all aspects that would be included in a SCM related graduate level programme, however it is interesting that the marketing and sales function is regarded as a soft SCM skill. Social, decision making, problem solving and time management skills highlighted in Myers et al. (2004) are listed in addition to the formal SCM related education. They are also provided on a number of the graduate level programmes under quantitative methods (decision making, problem solving) or soft skills (social, time management) which signals the lack of a formal framework for understanding and analysing the knowledge and skills areas offered in SCM related programmes.

We clearly observe in our literature the importance attached to soft skills. These skills are explained as communication, writing, leadership and language skills and they are highlighted in each paper in Table 1. Despite the importance of soft skills highlighted by researchers, modules on soft skills are included sparingly in SCM related graduate programmes. In conclusion, the literature suggests a balanced, multidisciplinary approach to SCM education. Eventually, SCM will be regarded as a concept that is supported by the traditional business functions, such as marketing, human resources, finance and accounting because, in essence, SCM is the coordination of the material, information and capital flows between all entities involved in the provision of products or services to the end consumers.

3. Methodology

Building on the knowledge and skills areas we identify in our literature review, we survey the curricula of a sample of SCM related graduate programmes. We analyse the modules offered in the curricula of these programmes with respect to the eight knowledge and skills areas identified in Table 1 and also detail subareas which we present in the Findings section.

We follow a three stage approach in our research. In the first stage, we determine the sample and then collect data comprised of the programmes and the modules included in the curricula of these programmes. We base our sample on the programmes listed in the ELA's Master Programmes in Logistics in Europe (ELA, 2004), which constitute our 2004 data. Then, to analyse trends, we revisit these programmes in 2011 and collect module information from

their websites (see Appendix 1, Table 14). We observe a large number of changes in terms of the programme titles and the knowledge and skills areas offered in the modules of such programmes (detailed in Findings section).

In the second stage, we classify the modules of the programmes in 2004 and 2011 according to the knowledge and skills areas, which we have synthesized from the literature review. Due to the unavailability of comparable information across all programmes, such as module aims or learning objectives, this classification is based only on module names. We assume that the module name indicates the broad knowledge and skills area addressed in the module. In a similar vein, it is not possible to incorporate the prerequisite information to our analyses since this information is not publicly available for all of the programmes. So we assume that there is no prerequisite relation among the various modules of a programme. Once we determine which knowledge and skills area a module is offering, we are able to determine the configuration of these programmes and how the changes in the presence of knowledge and skills are reflected in the period between 2004 and 2011.

In the third stage, we perform cluster analysis to establish whether there are specific areas concentrated on by different groups of programmes. Cluster analysis, like factor analysis and multidimensional scaling, is an interdependence method where the relationships between objects and subjects are explored without a dependent variable being identified. We follow the framework suggested by Saunders (1994) for conducting cluster analysis and employ hierarchical cluster analysis based on the frequency counts of the modules in the knowledge and skills areas. Since frequency counts cannot be treated as interval scale data, we use chi-squared measures for calculating similarities between the programmes (Greenacre and Blasius, 2006). Chi-square distance is a special version of weighted Euclidean distance which uses the relative counts and standardizes these counts based on the mean values (Greenacre and Blasius, 2006). We use the 'between group linkage' clustering procedure to create the clusters. This procedure calculates the similarity of two clusters using the average similarity of all individuals in one cluster with all individuals in another cluster (Hair, 2010). The 'between group linkage procedure' does not depend on extreme values; therefore it is less affected by outliers and also it tends to generate clusters with small within-cluster variation. In addition, we use dendrograms to choose the desired number of clusters (Kaufman and Rousseeuw, 1990) and the observations grouped together at various levels of the topology are inspected further for validating the results (Brock et al., 2008). Demonstration of the statistical significance and stability of a cluster solution is necessary before the clusters can

be used for inference (Punj and Stewart, 1983). We assess the stability of the clusters by the number of cases assigned to the same cluster across cluster solutions (Hair et al., 2010). The next section presents our findings.

4. Findings

We analyse a total of 19 programmes in 2004 and 15 in 2011 (Table 2) due to closure of four programmes in the initial sample (marked as *Discontinued* in Table 2). The 2004 data is based on the ELA's Master Programmes in Logistics in Europe which covers 19 programmes delivered at 15 universities in eight countries, namely the UK (five universities), France (four universities), Sweden, Denmark, Switzerland, the Netherlands, Norway and Spain. Among these 19 programmes, seven are from the UK, six are from France, and two are from Spain. Sweden, Denmark, Switzerland have one programme each. Finally, three different universities from the UK, the Netherlands and Norway offer a joint programme. Three programmes in France and one in the UK were discontinued in 2011. A summary of these programmes is provided in Table 2 with the school offering the programme indicated in the first column in alphabetical order. We provide the key, which we later refer to in subsequent analyses in the first column of Table 2. We mark the changes from 2004 to 2011 in *italics*. If the programme in 2004 is no longer offered by the university in 2011, then we indicate this with "*Discontinued*" in the fourth column. If the programme has changed its name from 2004 to 2011, then we give the new name in *italics* in the fourth column.

Table 2 Programmes included in the research

Key	School	2004	2011
BOR1	Bordeaux School of Management (FR)	MSc in Global Logistics Management	MSc in Global Supply chain Management
BOR2	Bordeaux School of Management (FR)	MBA in Supply Chain Management	*Discontinued*
CAR1	Cardiff University (UK)	MSc in International Transport	MSc in International Transport
CAR2	Cardiff University (UK)	MBA in Supply Chain Management	*MSc in Logistics and Operations Management*
CHA1	Chalmers University of Technology (SE)	MSc in Management of Logistics and Transportation	*MSc in Supply Chain Management*
COP1	Copenhagen Business School (DK)	MSc in Supply Chain Management	*MSc in Economics & Business Administration - Supply Chain Management Concentration*
CRA1	Cranfield University (UK)	MSc in Logistics & Supply Chain Management	MSc in Logistics & Supply Chain Management

Key	School	2004	2011
CRA2	Cranfield University (UK)	Executive MSc in Logistics & Supply Chain Management	Executive part-time MSc in Logistics and Supply Chain Management
CRA3	Cranfield University (UK)	Global MSc in Logistics and Supply Chain Management	*Discontinued*
ESC1	ESC Lille - Lille Graduate School of Management (FR)	MSc in Supply Chain Management	*Skema MSc in Supply Chain Management and Purchasing*
ESC2	ESC Lille - Lille Graduate School of Management (FR)	Executive MBA in Supply Chain Management	*Discontinued*
HER1	Heriot-Watt University (UK)	MSc in Logistics and Supply Chain Management	MSc in Logistics And Supply Chain Management
IML1	Institut International de Management pour la Logistique IML (CH)	Executive Master in Management of Logistical Systems	Executive Master in Global Supply Chain Management
MAR1	L'Université d'Aix-Marseille (FR)	MSc in Logistics	*Master in Management, Logistics and Strategy*
SUP1	SUP de CO Montpellier (FR)	MBA in Logistics & Supply Chain Management	*Discontinued*
WAM1	University of Westminster (UK) Arnhem Business School (NL) Molde College (NO)	MSc European Logistics, Transport & Distribution	*MSc Logistics and Supply Chain Management*
WES1	University of Westminster (UK)	MSc Transport Planning & Management	MSc Transport Planning and Management
ZAR1	Zaragoza Logistics Center (ES)	Master of Engineering in Logistics & Supply Chain Management	Master of Engineering in Logistics and Supply Chain Management
ZAR2	Zaragoza Logistics Center (ES)	Master Degree in Logistics	Master in Logistics

In Table 3, we provide the classification of modules into the eight knowledge and skills areas that we have determined from the literature. We also derive subareas under the knowledge and skill areas from our analysis of the curricula. These subareas follow logically from the knowledge and skills area, as they are topics or themes studied in the respective knowledge and skills area. We give knowledge and skills areas in Table 3 in *italics* and grey-shaded. The percentage of supply chain management, management, quantitative methods, IS / IT, marketing, finance / economy, law / legal and soft skills in the curricula of the analysed programmes in 2004 and 2011 are given in the third and fourth column, respectively. We also present the break-down of each subarea within each knowledge and skills area. So, the sum of the percentage of modules in supply chain management, management, quantitative methods, IS / IT, marketing, finance / economy, law / legal and soft skills areas is 100%. Subsequently, the sum of the percentage of each knowledge and skills subarea within a knowledge and skills area is 100%. For example, the sum of core SCM, logistics,

transportation, materials management, production planning, purchasing / procurement and green SCM is 100% within the supply chain management knowledge and skills area.

Table 3 Representation of knowledge and skills areas in the curricula

Knowledge and Skills Area	Knowledge and Skills Subarea	2004	2011
Supply Chain Management		*40%*	*49%*
	Core SCM	31%	36%
	Logistics	32%	22%
	Transportation	10%	15%
	Materials management	9%	8%
	Production Planning	11%	7%
	Purchasing / Procurement	4%	7%
	Green SCM	3%	5%
Management		*11%*	*11%*
	General Management	42%	23%
	Strategic Management	16%	19%
	Human Resources Management	21%	23%
	Project management	21%	35%
Quantitative Methods		*19%*	*17%*
	Quantitative methods as an umbrella module	13%	33%
	Operations research	28%	12%
	Operations management	42%	43%
	Decision making	8%	5%
	Statistics	9%	7%
IS / IT		*8%*	*6%*
	IS / IT as an umbrella module	71%	79%
	Data management	4%	7%
	ERP systems	4%	7%
	Technology	21%	7%
Marketing		*7%*	*4%*
	Marketing	100%	100%
Finance / Economy		*8%*	*8%*
	Finance	52%	37%
	Economics	27%	37%
	Accounting	21%	26%
Law/Legal		*1%*	*2%*
	Law/Legal	100%	100%
Soft skills		*5%*	*4%*
	Soft skills as an umbrella module	12%	0%
	Communication /Language	59%	80%
	Ethics / CSR / Sustainability	17%	10%
	Leadership	12%	10%

We use SCM subareas to analyse the programmes in more detail. The total number of modules included in our sample is 344 in 2004 and 245 in 2011. The columns "2004" and "2011" represent the proportion of modules classified under these knowledge and skills areas

and subareas. What is particularly evident from Table 3 is the increasing proportion of modules classified under SCM knowledge in 2011. We notice a considerable shift in the share of the logistics subarea under the supply chain management knowledge and skills area and this shift is also reflected in the change of the names of the programmes (e.g. the programme of Chalmers University of Technology, from MSc in Management of Logistics and Transportation in 2004 to MSc in Supply Chain Management in 2011). Similarly, the share of the general management subarea within the management knowledge and skills area has decreased in favour of more specific management topics, i.e. strategic management, human resources management and project management. We also observe that the programmes have tended to move away from operations research subarea towards offering quantitative methods as an umbrella. In terms of IS / IT knowledge and skills area, the percentage of technology subarea has decreased in favour of data management, ERP systems, and IS / IT as an umbrella. In addition, the percentage of marketing has decreased from 7% in 2004 to 4% in 2011. The final knowledge and skills area which has witnessed considerable shift in the distribution of subareas is the soft skills. Soft skills as an umbrella has disappeared in 2011 and the percentage of ethics, CSR, sustainability and leadership subareas decreased in favour of the communication and foreign languages subarea. This change is not surprising given the increasing rate of globalization and the subsequent impact upon the communication with suppliers located in various countries.

The relatively stable areas observed in our research include finance / economy, law / legal and soft skills but the proportion of these areas is small in comparison to the others. Excluding the marginal increase in the Law / Legal area, the trend is to increase the SCM knowledge in the programmes and to decrease the presence of other knowledge and skills areas. This contradicts with the literature suggesting a balanced, multidisciplinary approach to SCM education. We observe a more balanced distribution of subareas in Management and Finance / Economy areas. In addition, the programmes tend to introduce Quantitative Methods, IS / IT and Soft Skills areas with umbrella modules which may be regarded as "taster" modules in the related areas. In Section 4.1. we use the knowledge and skills areas to analyse the configuration of programmes whereas in Section 4.2. we perform a similar analysis based on SCM knowledge and skills subareas.

4.1. Clustering of programmes at curriculum level

Initial cluster analysis was performed on the knowledge and skills areas and revealed two distinct clusters, which we label as *Focused* and *Diversified*, both in 2004 and 2011. The *Focused* group, as the name implies, includes those programmes that are focused on the area of SCM and offer modules from other knowledge and skills areas at a negligible level or do not offer them at all. On the other hand, the programmes in the *Diversified* group offer higher number of modules from knowledge and skills areas apart from the SCM area. Table 4 presents the mean number of modules in each knowledge and skills area for *Focused* and *Diversified* groups in 2004 and 2011.

Table 4 Cluster means based on "average" linkage

Groups	SCM	MNG	QM	IS / IT	MRK	FIN	LAW	SOFT
2011 *Focused*	7.00	0.17	1.17	0.17	0.17	0.67	0.00	0.00
2011 *Diversified*	9.13	3.00	4.38	1.50	1.00	1.75	0.25	1.25
2004 *Focused*	5.86	0.71	2.14	0.71	0.43	0.71	0.00	0.14
2004 *Diversified*	7.90	2.50	4.10	2.20	1.50	2.00	0.10	1.50

SCM: Supply Chain Management
QM: Quantitative Methods
MRK: Marketing
LAW: Law / Legal

MNG: Management
IS /IT: Information Systems / Information Technology
FIN: Finance / Economy
SOFT: Soft skills

Since we study count data (i.e. number of modules in each knowledge and skills area) and we cannot assume the data have a distribution of Gaussian type, we use the nonparametric Mann-Whitney U-test to compare the two clusters (Lehmann, 1975). In both analysis years, the difference between the median number of modules in programmes in the *Focused* group and the *Diversified* group is significant (Table 5).

Table 5 Median comparisons of Focused and Diversified groups

	Focused median	*Diversified* median	W	$n_{Focused}$	$n_{Diversified}$	p (two tailed)
2004	12	22.5	5	7	10	0.003
2011	8	21.5	2	6	8	0.004

It is also evident from Table 4 that the *Focused* group have become more concentrated on the SCM area in 2011 in comparison to 2004. Contrary to what is discussed in the literature, all modules related to "soft skills" have been stopped and the proportion of all supporting areas has been decreased in favour of SCM. A similar trend of placing greater emphasis on SCM is also observed in the *Diversified* group; this time, however, the number of modules on the

13

programme is slightly increased and the proportion of management and quantitative methods is also increased. Figure 1 provides a comparison of *Focused* and *Diversified* groups of programmes.
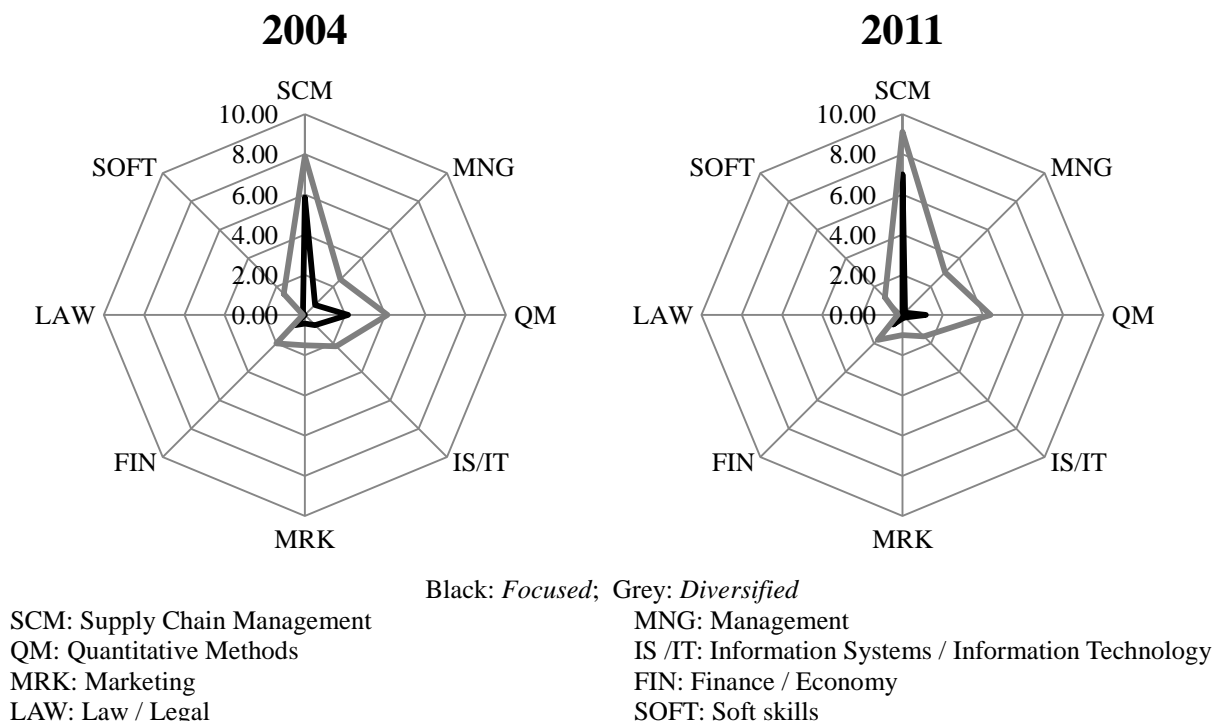

Black: *Focused*; Grey: *Diversified*

SCM: Supply Chain Management	MNG: Management
QM: Quantitative Methods	IS /IT: Information Systems / Information Technology
MRK: Marketing	FIN: Finance / Economy
LAW: Law / Legal	SOFT: Soft skills

Figure 1 Focused and Diversified clusters apparent in 2004 and 2011 data

It is evident in Figure 1 that the presence of other knowledge and skills areas has almost disappeared in the *Focused* group in 2011. This contradicts the suggestions we highlight in the literature review which state that SCM related programmes should also incorporate a diverse range of knowledge and skills areas. The reason for this may be the low marginal representation of these areas in 2004 and the difficulty in measuring the tangible contribution of these areas to the programme. In Table 6, we provide the schools and programmes using the key we present in Table 2 along with their respective clusters in 2004 and 2011.

Table 6 Cluster membership of programmes in 2011 and 2004

Key	2004 Cluster	2011 Cluster
BOR1	2	2
BOR2	1	*Discontinued.*
CAR1	1	5
CAR2	4	1
CHA1	1	2
COP1	3	1
CRA1	2	2
CRA2	2	2

Key	2004 Cluster	2011 Cluster
CRA3	1	*Discontinued.*
ESC1	2	1
ESC2	2	*Discontinued.*
HER1	2	1
IML1	2	2
MAR1	2	2
SUP1	2	*Discontinued.*
WAM1	1	1
WES1	1	1
ZAR1	2	2
ZAR2	1	1

1: *Focused*; 2: *Diversified*; 3: outlier$_1$; 4: outlier$_2$; 5: outlier$_3$

In 2004, there are two outlier programmes; namely, the MSc in Supply Chain Management at Copenhagen Business School (COP1) and the MBA in Supply Chain Management at Cardiff University (CAR2). Firstly, the MSc in Supply Chain Management programme at Copenhagen Business School (Outlier$_1$) has higher number of modules than the sample median in SCM, Management, Quantitative Methods and Marketing knowledge and skills areas (Table 7). With this configuration, this programme is unique, and does not resemble any other programme in the sample.

Table 7 Median comparisons of the sample and Outlier$_1$

Knowledge and skill area	Sample median	Outlier$_1$ Median	W	*p* (one tailed)
SCM	6	12	17.5	0.081
Management	2	5	18.5	0.055
Quantitative Methods	3	8	18	0.068
Marketing	1	6	18.5	0.053

Secondly, the MBA in Supply Chain Management programme at Cardiff University (Outlier$_2$) has a lower number of modules than the sample average in SCM and significantly higher number of modules than the sample average in law (Table 8). In that respect, the MBA in Supply Chain Management programme at Cardiff University (UK) is again distinctly different from the rest of the sample.

Table 8 Median comparisons of the sample and Outlier$_2$

Knowledge and skill area	Sample median	Outlier$_2$ median	W	*p* (one tailed)
SCM	6	1	1	0.069
Law	0	3	18.5	0.006

We observe that in 2011, these programmes (Outlier$_1$ and Outlier$_2$) have changed their names and curricula. Moreover, four programmes are discontinued and six programmes changed their names and reorganized their curricula. This indicates the high level of dynamism in the SCM related graduate programmes; the discipline and the programmes are still in search for the ideal.

Thirdly, the MSc in International Transport programme at Cardiff University (CAR1) is the only outlier (Outlier$_3$) in the 2011 cluster. The main reason for this programme's departing from the sample is the high importance given to the area of law. In this programme, law related modules constitute 27.27% of the curricula, a level not observed in any of the programmes in the sample.

There is only one programme, MSc in Logistics and Supply Chain Management at Heriot-Watt University (HER1) which has become *Focused* in 2011 after being *Diversified* in 2004 without changing its name. A detailed analysis on this programme reveals that the number of modules in the programme is reduced by 56.5% (from 23 to 10) and this reduction has led to total exclusion of modules in management (from 4 to 0), in IS / IT (from 1 to 0) in marketing (from 3 to 0) and in soft skills (from 3 to 0). Also, the number of SCM related modules is decreased from 9 to 8 and the number of finance and economy related modules are decreased from 2 to 1. Apart from that, the clusters are robust and those programmes which have not changed their names in the two analysis periods have also not changed their clusters (i.e. *Focused* / *Diversified*). In the next subsection we further analyse the programmes in terms of their SCM related modules to provide more insight into the characteristics of the programmes.

4.2. Clustering of programmes at SCM modules level

From the literature and the analysis of the individual modules in our 2004 and 2011 samples, the SCM area is divided into seven subareas; namely, core SCM, logistics, transportation, materials management, production planning, purchasing / procurement and green SCM. The same clustering algorithm is used to reveal the two groups of programmes in 2004 and 2011 as *Compact* and *Expanded* in terms of the number of modules they offer in each SCM knowledge and skills subarea (Table 9).

Table 9 Clusters with respect to SCM detail in 2004 and 2011

Groups	SCM	Logistics	Transportation	Materials Management	Production Planning	Purchasing / Procurement	Green SCM

Groups	SCM	Logistics	Transportation	Materials Management	Production Planning	Purchasing / Procurement	Green SCM
2011 Compact	2.36	1.18	0.82	0.55	0.82	0.45	0.18
2011 Expanded	4.25	3.25	2.25	1.00	0.00	0.75	1.00
2004 Compact	1.93	1.60	0.53	0.33	0.60	0.27	0.07
2004 Expanded	3.00	4.33	1.67	2.00	1.00	0.67	1.00

When we analyse the programmes with respect to subareas of SCM knowledge, we find that there are two groups of clusters similar to the previous analysis. Programmes in both groups offer modules that are classified into the subareas of SCM knowledge; however, the difference relates to the number of modules offered in each subarea. For a comparison of clusters in the SCM knowledge subareas, again we use the nonparametric Mann-Whitney U-test. In both analysis years, the difference between the median number of modules in programmes in the *Compact* group and the *Expanded* group is significant (Table 10).

Table 10 Median comparisons of Compact and Expanded groups

	Compact median	*Expanded* median	W	$n_{Compact}$	$n_{Expanded}$	p (two tailed)
2004	6	14	1	15	3	0.010
2011	8	21.5	3	11	4	0.013

It is also evident from Figure 2 that the programmes clustered as *Compact* offer the same type of programmes in the *Expanded* group with the only difference being the number of modules offered in each subarea. Apart from these observations, the representation of SCM knowledge subareas is very similar in both groups.

2004   **2011**
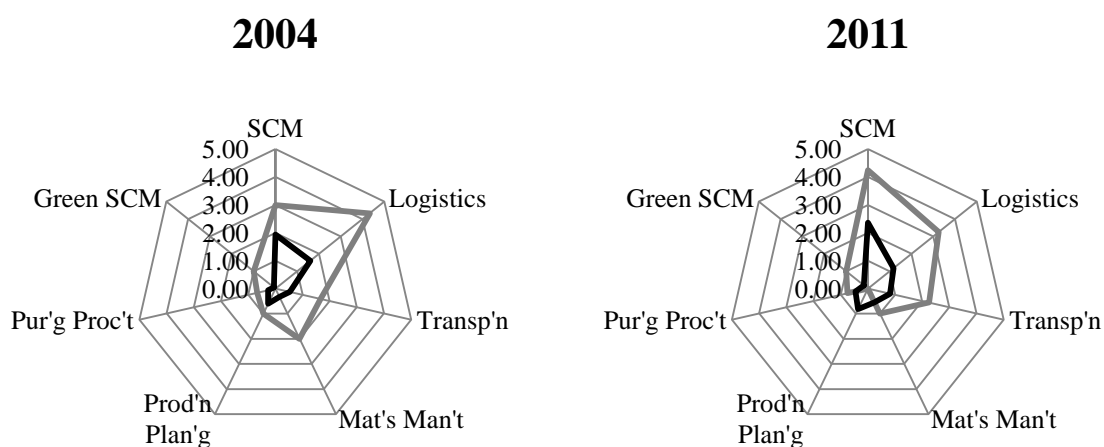
Black: *Compact*; Grey: *Expanded*;

17

Figure 2 Compact and Expanded clusters with respect to SCM detail in 2004 and 2011 data

Clusters of individual programmes with respect to SCM detail are given in Table 11. There is only one outlier (3: *outlier*₁ in Table 11) in the 2004 clustering which is the MSc in Supply Chain Management programme at Copenhagen Business School (COP1). The reason for this programme's varying from other clusters is that 46.7% of the modules within SCM knowledge area are concentrated on Logistics subarea, which is divergent from the rest of the programmes included in this study. However, we observe that in 2011, with the content and direction change in MSc in Supply Chain Management at Copenhagen Business School, the programme has decreased its logistics modules to a noticeable "zero" and become more similar to other programmes in the *Compact* cluster.

Table 11 Cluster membership of programmes with respect to SCM detail in 2011 and 2004

Key	2004 Cluster	2011 Cluster
BOR1	1	1
BOR2	1	*Discontinued.*
CAR1	1	1
CAR2	1	1
CHA1	1	1
COP1	3	1
CRA1	2	2
CRA2	1	2
CRA3	2	*Discontinued.*
ESC1	1	1
ESC2	1	*Discontinued.*
HER1	2	2
IML1	1	1
MAR1	1	1
SUP1	1	*Discontinued.*
WAM1	1	2
WES1	1	1
ZAR1	1	1
ZAR2	1	1

1: *Compact*; 2: *Expanded*; 3: outlier₁

We iterate our analysis of the programmes one step further and present their membership to *Focused* and *Diversified* as well as *Compact* and *Expanded* clusters in 2004 and 2011 in Figure 3. The programmes which have shifted their clusters are given in boxes (CHA1, CRA2, ESC1, HER1, WAM1). The programmes which are discontinued in 2011 have strikethrough on their names (BOR2, ESC2, SUP1). The programmes which are outliers in any year are given in italics (CAR1: outlier in *Focused − Diversified* clustering in 2011; CAR2: outlier in *Focused − Diversified* clustering in 2004; COP1: outlier in *Focused −*

Diversified and *Compact – Expanded* clustering in 2004). ESC Lille - Lille Graduate School of Management MSc in Supply Chain Management (ESC1) is classified as *Diversified – Compact* in 2004 whereas it has shifted to *Focused – Compact* in 2011. Cranfield University Executive MSc in Logistics & Supply Chain Management (CRA2) has shifted from being *Diversified – Compact* to *Diversified – Expanded*. Heriot-Watt University MSc in Logistics and Supply Chain Management (HER1) has shifted from being *Diversified – Expanded* to *Focused – Expanded*. Chalmers University of Technology MSc in Management of Logistics and Transportation (CHA1) has shifted from *Focused – Compact* to *Diversified – Compact*. University of Westminster - Arnhem Business School - Molde College MSc European Logistics, Transport & Distribution (WAM1) has shifted from *Focused – Compact* to *Focused – Expanded*. The remaining programmes did not change their clusters from 2004 to 2011. These changes reflect the fact that the academia is still searching for the ideal programme.
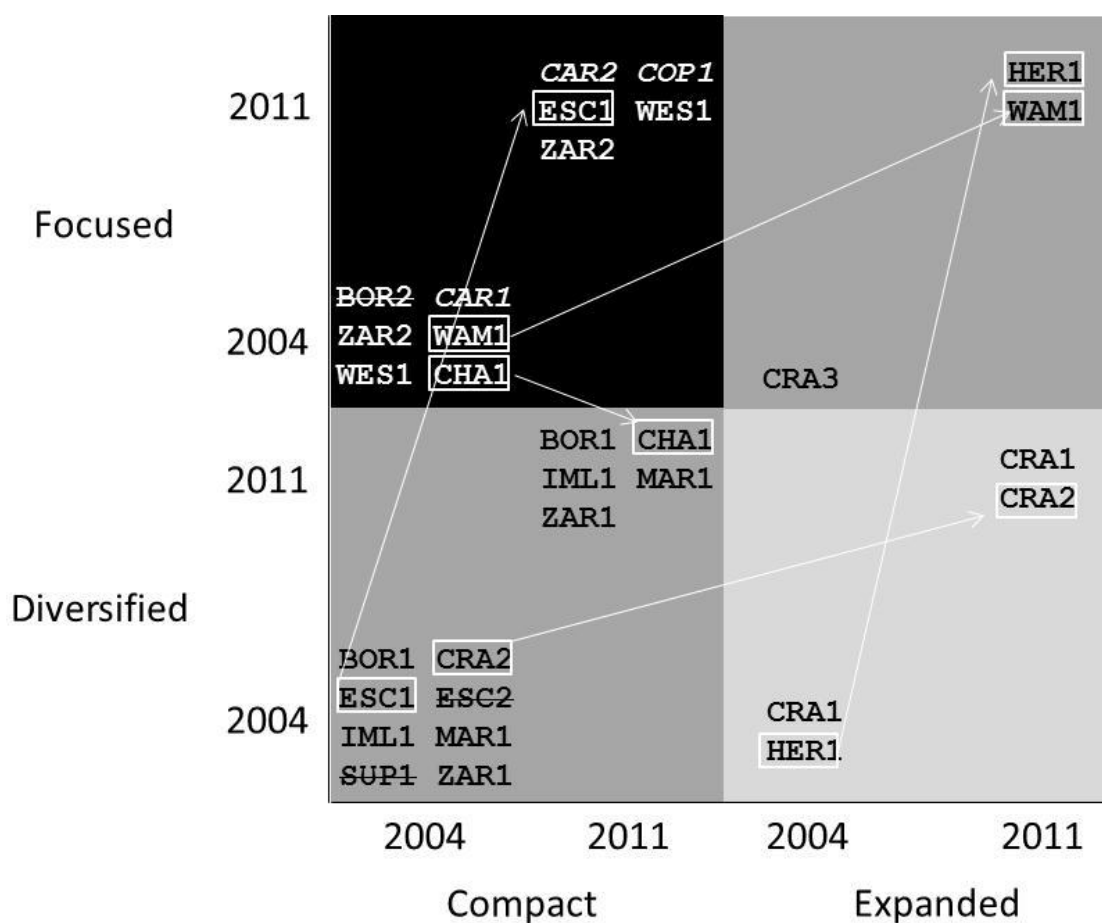

Figure 3 Dynamism observed in the programmes from 2004 to 2011

19

Finally, when we examine the changes in proportions of the knowledge and skills areas from 2004 to 2011, on average the weight of SCM skills in SCM education is increasing, whereas there is a slight decrease in the weight of almost all other skills. However, six out of 15 programmes act oppositely to this trend. This is probably due to the highly dynamic nature of education in this discipline since there are many programme openings and closures as well as slight or radical changes in the programmes as the needs of the industry also change (e.g. green SCM is a recent concept populating in the programmes). Such changes observed in the programmes included in our sample can be explained by the rapid developments in practice, the advances in research undertaken by the available faculty and the emerging trends in the supply chain education sector. One of the reasons for these changes is the fact that SCM, as a discipline, is not yet underpinned by a strong theory base and the academia have yet to agree on what constitutes the SCM field of enquiry. This is also due to the multi-disciplinary nature of problems faced in supply chains. On that account, this confusion amongst academics is manifested in the design and revision of SCM programmes. Another reason for these changes in programmes is the trends around the world from a logistics and transportation perspective towards a holistic supply chain management perspective. This is evidenced by the change in the name of the programme at Bordeaux School of Management from "MSc in Global Logistics Management" to "MSc in Global Supply Chain Management". "Logistics" and "Transportation" are no longer sufficient to satisfy the needs of the industry which now need a holistic supply chain approach to their operations. A reverse trend is observed in Cardiff University's programme (CAR2) which has changed its name from "Supply Chain Management (MBA)" towards "Logistics and Operations Management (MSc)". This programme is an outlier in *Focused / Diversified* clustering in 2004 but consistent with this change, it is classified as *Focused - Compact* in 2011. Although supply chain management concept is emphasised in this programme, the main aim is to offer knowledge and expertise for management roles in companies involved with logistics and operations management on a national or international basis. So the name of the programme is driven by the immediate receivers of the graduates of the programme, i.e. companies involved in logistics and operations management at national and international level.

Table 15 in Appendix 1 shows the changes in proportions of knowledge and skills areas from 2004 to 2011 which show that on average the proportion of core SCM modules is increasing whereas the proportion of logistics modules is decreasing. Based on these observations, we conclude that the SCM education is becoming more concentrated on the core SCM

knowledge subarea instead of incorporating a number of different SCM knowledge subareas.

4.3. Framework for designing supply chain programmes

Based on the analyses we have conducted in Sections 4.1. and 4.2, we propose the following two frameworks (Table 12, Table 13) to be used by the academia for designing new programmes or reviewing existing programmes on SCM education at graduate level. In Table 12 and Table 13, the figures are the interquartile range $[Q_1, Q_3]$ in the *Focused* / *Diversified* and *Compact* / *Expanded* clusters we present in Section 4.1. and Section 4.2., respectively.

Table 12 Representative number of modules for Focused and Diversified Programmes

Knowledge and Skills Area	Focused	Diversified
Supply Chain Management	[6, 9]	[7, 14]
Management	[0, 0]	[2, 4]
Quantitative Methods	[0, 2]	[3, 6]
IS / IT	[0, 0]	[1, 2]
Marketing	[0, 0]	[1, 1]
Finance / Economy	[0, 1]	[1, 3]
Law/Legal	[0, 0]	[0, 1]
Soft skills	[0, 0]	[1, 2]
Total	[6, 12]	[18, 26]

According to Table 12, if a new, *Focused* programme on supply chain is to be designed at the graduate level, then six to nine SCM modules can be offered along with zero to two modules in quantitative methods and zero to one module in finance / economy knowledge and skills areas. A programme which positions itself as *Focused* would not include modules in management, IS / IT, marketing, law / legal and soft skills knowledge and skills areas. Total number of modules can be six to twelve.

On the other hand, a *Diversified* programme can include seven to 14 modules in SCM, two to four modules in management, three to six modules in quantitative methods, one to two modules in IS / IT, one module in marketing, one to three modules in finance / economy, zero to one module in law / legal and one to two modules in soft skills knowledge and skills areas. Total number of modules could be 18 to 26. Repeating the analysis for SCM knowledge and skills subareas, we propose the following framework (Table 13) to be used for the design or review of *Compact* and *Expanded* programmes.

Table 13 Representative number of modules for Compact and Expanded Programmes

SCM Knowledge and Skills Subareas	*Compact*	*Expanded*
Core SCM	[1, 4]	[2, 7]
Logistics	[0, 2]	[3, 4]
Transportation	[0, 1]	[1, 4]
Materials management	[0, 1]	[0, 2]
Production Planning	[0, 1]	[0, 0]
Purchasing / Procurement	[0, 1]	[0, 1]
Green SCM	[0, 0]	[1, 1]
Total	[5, 8]	[9, 16]

In a similar vein, a programme that would position itself as *Compact* can include one to four modules in core SCM, zero to two modules in logistics, zero to one module in transportation, materials management, production planning and purchasing / procurement and zero modules in green SCM knowledge and skills subareas. The total number of modules in SCM knowledge and skills area can be five to eight. In comparison, an *Expanded* programme can include two to seven modules in core SCM, three to four modules in logistics, one to four modules in transportation, zero to two modules in materials management, zero modules in production planning, zero to one module in purchasing / procurement and one module in green SCM knowledge and skills subareas with the total number of modules ranging from nine to 16.

Moreover, the directors of the existing programmes can compare their curricula to the figures we present here and use this *Focused* / *Diversified* and *Compact* / *Expanded* approach to promote their programmes in the education market. It is also possible to use these frameworks for revision purposes if there is a decision to position the existing programme as, for example, a *Focused* and *Compact* programme.

5. Conclusions

In this study, we examine a sample of SCM related graduate programmes in Europe in two analysis periods (2004 and 2011) with respect to the distribution of knowledge and skills areas in their curricula. Our analysis across 2004 and 2011 reveal that SCM related graduate programmes have a dynamic structure and not only the curricula but also the programmes undergo frequent and sometimes radical changes. Using cluster analysis, we suggest that the programmes can be classified as *Focused* and *Diversified* based on their curricula. In terms of SCM specific knowledge and skills area, they can be grouped as *Compact* and *Expanded*

depending on the number and type of modules they offer in the SCM knowledge and skills subareas.

The contribution of this research lies within its objective approach to programmes and its revealing the changes over time together with the recent status of the SCM related graduate programmes in Europe. Our research analyses SCM related graduate programmes from the knowledge and skills areas perspective and clusters them with respect to their curricula. This research can be a guide to the members of graduate programme committees in the review process of existing SCM related programmes or in the design process of new SCM programmes. They can have an insight for the distribution of the knowledge and skills areas within the programme. We find in the observed SCM related graduate programmes that there is a tendency to increase the proportion of SCM knowledge and skills area in 2011 when compared to that in 2004 whilst proportion of management, quantitative methods, IS / IT, marketing, finance / economy and soft skills knowledge and skills areas decrease in the same time period. According to the cluster analysis of the programmes at curriculum level, two groups are formed and labelled as *Focused* and *Diversified*. Programmes in the *Focused* group place more emphasis on SCM knowledge and skills area in 2011 than in 2004. This shift consequently leads to placing less emphasis on other knowledge and skills areas for the programmes in the *Focused* group. On the other hand, there is a similar increase in the emphasis on SCM knowledge and skills areas for programmes in the *Diversified* group. But contrary to the programmes in the *Focused* group, there are also slight increases in the emphasis on management and quantitative methods knowledge and skills areas for programmes in the *Diversified* group. When we cluster the programmes according to the SCM knowledge and skills subarea, two groups are formed and labelled as *Compact* and *Expanded*. The main difference between these two groups is the number of modules offered at each SCM knowledge and skills subarea. Both groups address same SCM knowledge and skills subareas with *Expanded* offering more modules in a subarea than *Compact*.

There are several managerial implications of this research: (a) this study sets a baseline for assessing SCM related graduate programmes with respect to the knowledge and skills they offer. The knowledge and skills areas that we have identified together with their subareas may serve as a starting point for designing a SCM related programme. (b) We are aware of the limited sample size and this research can be extended to include a wider variety of programmes across the world to give a bigger picture of the SCM graduate education. (c) This research analyses programmes from the providers' point of view and programmes are

generally designed depending on the teaching and research interests of the available faculty at the institution (Lancioni et al., 2001; Ankers and Brennan, 2002). It is recognized by the academia that SCM education has lagged behind the needs of the industry (Ozment and Keller, 2011).

The practical implications of this research are threefold: (1a, 1b) it can assist the academia in their design of future and review of existing programmes on supply chain management; (2) it can help prospective graduates in their selection of programmes; and (3) it can assist managers in their recruitment process. We unfold these implications as follows:

1a: When a new programme on supply chain management is to be launched, there are several strategic decisions to be made. We try to clarify these decisions by analysing the available programmes and presenting the emerging patterns at the programme level (*Focused* or *Diversified*) and at the core supply chain modules level (*Compact* or *Expanded*). The decision to choose between a *Focused*, a *Diversified* or a combination of these programmes mainly depends on the available faculty, the target industries who will be employing the graduates as well as where the school wishes to position its programme in reference to the programmes analysed in this research. Depending on the core competences, a hypothetical school may decide to start a *Focused* programme, leaving out knowledge and skills areas such as law, marketing or IS / IT outside. These suggestions are applicable to the review of existing programmes as well.

1b: The decision of providing core supply chain modules in a *Compact* or *Expanded* manner can be a matter of module content design as well as available faculty capacity. Assuming a hypothetical school has sufficient resources to deliver *Compact*, *Expanded* or a combination of these, then the decision can be based on external factors such as target student population and target industries for the graduates. For example, purchasing and procurement and materials management knowledge and skills areas are underrepresented in *Compact* programmes. So if the graduates of the programme are anticipated to be employed in the manufacturing industry, then the school may prefer an *Expanded* programme rather than a *Compact* one. It is also possible to review existing programmes considering these suggestions.

2: Having read the results of our research, prospective graduates of supply chain programmes will have a more clear idea of what to expect in a diverse range of programmes. They can match what is offered by the programmes with their plans for their graduate studies and make

an informed decision. Drawing from the results we present in the paper, they can have a more critical approach towards their degree programme in supply chain management. Considering the structured analysis of programmes with respect to what they offer in their curricula, prospective graduates can have greater awareness of their selected programme. This awareness will help the graduates to have a holistic understanding of their programme and consequently, improve the decision making process of them in their job applications by matching the knowledge and skills offered by the programme with what is required by the particular job vacancy.

3: Similar to the practical implications for prospective graduates, our framework can assist managers in their recruitment process by scientifically presenting similar and different programmes as *Focused* and *Diversified* as well as *Compact* and *Expanded*, with average number of modules in each specific knowledge and skills area. Depending on their requirements, the managers can use the results of this study for the purposes of pre-screening applicants. For example, if a graduate with quantitative methods is required for a particular position, then the managers can invite graduates of the programmes classified as *Diversified* in 2011. If they need green SCM knowledge and skills along with the core supply chain management, then they can recruit from the programmes which are classified as *Expanded*. Since finding the right workforce for supply chain operations is of critical importance for any company, managers can also see the supply chain management qualification of the job applicant from the viewpoint of the eight knowledge and skills areas which we have synthesised and match the qualification with the requirements of the job.

The programmes can only be fully assessed if the industry perspective is also incorporated into the research and if the researchers investigate how important these knowledge and skills areas are as well as how frequently they are required in day to day operations in managing supply chains. Therefore future research should explore which areas of supply chain education have fallen behind industry requirements so as to direct universities and education institutions in shaping their programmes to meet the requirements of the industry. There may be certain discrepancies as the needs of the industry may differ with respect to the geographical location or the industry itself. This may lead to development of innovative industry- and location-specific programmes in the medium term.

References

Ankers, P. and Brennan, R. (2002), "Managerial relevance in academic research: an exploratory study", *Marketing Intelligence & Planning*, Vol. 20 No. 1 pp. 15-21.

Ballou, R.H. (2007), "The evolution and future of logistics and supply chain management", *European Business Review*, Vol. 19 No. 4, pp. 332 – 348.

Brock, G., Pihur, V., Datta, S. and Datta, S. (2008), clValid: An R package for cluster validation, *Journal of Statistical Software*, Vol. 25 No. 4, pp. 1-22.

Cottrill, K. (2010), Are you prepared for the supply chain talent crisis? MIT CTL White Paper, http://ctl-test1.mit.edu/library/are_you_prepared_supply_chain_talent_crisis last accessed: 30 September 2012.

ELA, (2004). "Master programmes in logistics in Europe" http://www.elalog.org/publications/0412MasterLogistics.pdf last accessed: 29 April 2012.

Erturgut, R. (2011), "Increasing demand for logistics technician in business world and rising trend of logistics programs in higher vocational schools: Turkey case", *The 3rd World Conference on Educational Sciences 2011 Procedia - Social and Behavioral Sciences*, Vol. 15, pp. 2776-2780.

Gammelgaard, B. and Larson, P.D. (2001), "Logistics skills and competencies for supply chain management", *Journal of Business Logistics*, Vol. 22 No. 2, pp. 27-50.

Gravier, M.J., and Farris, M.T. (2008), "An analysis of logistics pedagogical literature Past and future trends in curriculum, content, and pedagogy", *The International Journal of Logistics Management*, Vol. 19 No. 2, pp. 233-253.

Greenacre, M.J. and Blasius, J. (eds) (2006), *Multiple Correspondence Analysis and Related Methods*, Chapman & Hall/CRC Press, London.

Hair, Jr. J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010), *Multivariate Data Analysis: A Global Perspective*, Pearson, London.

Johnson, M.E. and Pyke, D.F. (2000), "A framework for teaching supply chain management", *Production and Operations Management*, Vol. 9 No. 1, pp. 2-18.

Kaufman L. and Rousseeuw P.J. (1990), *Finding Groups in Data: An Introduction to Cluster Analysis*, Wiley, New York.

Kopczak, L.R. and Fransoo, J.C., (2000), "Teaching supply chain management through global projects with global project teams", *Production and Operations Management*, Vol. 9 No. 1, pp. 91-104.

Kotzab, H., Munch, H.M., de Faultrier, B. and Teller, C. (2011), "Environmental retail supply chains: when global Goliaths become environmental Davids", *International Journal of Retail & Distribution Management*, Vol. 39 No. 9, pp. 658-681.

Lancioni, R., Forman, H. and Smith, M.F. (2001), "Logistics and supply chain education Roadblocks and challenges", *International Journal of Physical Distribution & Logistics Management*, Vol. 31 No. 10, pp.733-745.

Lehmann, E. L. (1975), *Nonparametrics: Statistical methods based on ranks*, Holden-Day. San Francisco, CA.

Mangan, J. and Christopher, M. (2005). "Management development and the supply chain manager of the future", *The International Journal of Logistics Management*, Vol. 16 No. 2, pp. 178-191.

Murphy, P.R. and Poist, R.F. (1991), "Skill requirements of senior-level logistics executives: and empirical assessment", *Journal of Business Logistics*, Vol. 12 No. 2, pp. 73-94.

Murphy, P.R. and Poist, R.F. (1998) "Skill requirements of senior-level logisticians Practitioner perspectives", *International Journal of Physical Distribution & Logistics Management*, Vol. 28 No. 4, pp. 284-301.

Murphy, P.R. and Poist, R.F. (2007), "Skill requirements of senior level logisticians: a longitudinal assessment", *Supply Chain Management: An International Journal*, Vol. 12 No. 6, pp. 423-431.

Myers, M.B., Griffith, D.A., Daugherty, P.J. and Lusch, R.F. (2004), "Maximizing the human capital equation in logistics: Education, experience, and skills" *Journal of Business Logistics*, Vol. 25 No. 1, pp. 211-232.

Ozment, J., and Keller, S.B. (2011), "The future of logistics education", *Transportation Journal*, Vol. 50, No. 1, pp. 65-83.

Punj, G., and Stewart, D.W. (1983), "Cluster analysis in marketing research: review and suggestions for application", *Journal of Marketing Research*, Vol. 20 No. 2, pp. 134-148.

Saunders, J. (1994), "Cluster analysis", *Journal of Marketing Management*, Vol. 10 No. 1-3, pp. 13-28.

Sodhi, M.S., Son, B., and Tang, C.S. (2008), "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", *Interfaces*, Vol. 38 No. 6, pp. 469-484.

van Hoek, R., Godsell, J. and Harrison, A. (2011), "Embedding "insights from industry" in supply chain programmes: the role of guest lecturers", *Supply Chain Management: An International Journal*, Vol. 16 No. 2, pp. 142-147.

Vokurka, R.J. (2011), "Supply chain manager competencies", *S.A.M. Advanced Management Journal*, Vol. 76 No. 2, pp. 23-37.

Appendix 1 Websites of the programmes analysed in the paper

Table 14 SCM related graduate programmes and their current websites

University	Program	Webpage
Bordeaux School of Management	MSc in Global Supply chain Management	http://www.bem.edu/en/Programmes/Postgraduate-Specialized-masters/Global-Supply-Chain-Management-ISLI/ISLI-MSc/ISLI
Chalmers University of Technology	MSc in Supply Chain Management	http://www.chalmers.se/en/education/programmes/masters-info/Pages/Supply-Chain-Management.aspx
Cardiff University	MSc in International Transport	http://business.cardiff.ac.uk/degree-programmes/logistics-operations-management/msc-international-transport
Cardiff University	MSc In Logistics And Operations Management	http://business.cardiff.ac.uk/degree-programmes/postgraduate/logistics-operations-management/msc-logistics-and-operations-management
Copenhagen Business School	MSc in Supply Chain Management	http://www.cbs.dk/en/Degree-Programmes/CBS-Graduate/Kandidatuddannelser/Supply-Chain-Management
Cranfield University	MSc in Logistics & Supply Chain Management	http://www.som.cranfield.ac.uk/som/p2172/Programmes-and-Executive-Development/MSc/Full-time-MSc-in-Logistics-and-Supply-Chain-Management
Cranfield University	Executive part-time in Logistics and Supply Chain Management	http://www.cranfield.ac.uk/students/courses/page1552.html
Heriot-Watt University	MSc in Logistics And Supply Chain Management	http://www.postgraduate.hw.ac.uk/course/206/
Institut International de Management pour la Logistique IML	Executive Master in Global Supply Chain Management	http://iml.epfl.ch/education.php
L'Université d'Aix-Marseille	Master in Management, Logistics and Strategy	http://www.univmed.fr/fr/formations/master-management-logistique-strategie
SKEMA	MSc in Supply Chain Management and Purchasing	http://www.skema.edu/programs/masters-of-science/msc-supply-chain-management-and-purchasing
University of Westminster (UK); Arnhem Business School (NL); Molde University College (NO); ICN (FR)	MSc Logistics and Supply Chain Management	http://2009.westminster.ac.uk/schools/architecture/transport/msc-logistics-and-supply-chain-management
University of Westminster	MSc Transport Planning and Management	http://2009.westminster.ac.uk/schools/architecture/transport/msc-transport-planning-and-management
Zaragoza Logistics Center	Master of Engineering in Logistics and Supply Chain Management	http://mastersupplychain.edu.es/
Zaragoza Logistics Center	Master in Logistics	http://www.zlc.edu.es/education/master-in-logistics/

Table 15 Changes in weights of main skills from 2004 to 2011

University	Programmes	YEAR	SCM	Management	Quantitative Methods	IS / IT	Marketing	Finance / Economy	Law / Legal	Soft skills
Bordeaux School of Management (FR)	MBA in Supply Chain Management	2004	38%	6%	31%	13%	6%	0%	0%	6%
Bordeaux School of Management (FR)	MSc in Global Supply chain Management	2011	39%	17%	13%	4%	9%	13%	0%	4%
	MSc in Global Logistics Management	2004	20%	12%	28%	12%	8%	12%	0%	8%
Chalmers University of Technology (SE)	*MSc in Supply Chain Management*	2011	32%	24%	24%	4%	4%	8%	0%	4%
	MSc in Management of Logistics and Transportation	2004	54%	8%	15%	8%	8%	8%	0%	0%
Copenhagen Business School (DK)	*MSc in Economics & Business Administration - Supply Chain Management Concentration*	2011	86%	0%	0%	0%	0%	14%	0%	0%
	MSc in Supply Chain Management	2004	41%	14%	22%	0%	16%	8%	0%	0%
Cranfield University (UK)	Executive part-time MSc in Logistics and Supply Chain Management	2011	50%	6%	22%	9%	3%	3%	0%	6%
	Executive MSc in Logistics & Supply Chain Management	2004	52%	7%	19%	7%	11%	4%	0%	0%
Cranfield University (UK)	Global MSc in Logistics and Supply Chain Management	2004	67%	17%	17%	0%	0%	0%	0%	0%
Cranfield University (UK)	MSc in Logistics & Supply Chain Management	2011	58%	8%	23%	4%	0%	4%	0%	4%
	MSc in Logistics & Supply Chain Management	2004	55%	9%	15%	9%	6%	3%	0%	3%
ESC Lille - Lille Graduate School of Management (FR)

Skema | Executive MBA in Supply Chain Management | 2004 | 8% | 23% | 15% | 8% | 8% | 23% | 0% | 15% |
	MSc in Supply Chain Management and Purchasing	2011	53%	18%	0%	6%	6%	6%	0%	12%
ESC Lille - Lille Graduate School of Management (FR)	MSc in Supply Chain Management	2004	33%	20%	13%	20%	0%	7%	0%	7%
Heriot-Watt University (UK)	MSc in Logistics And Supply Chain Management	2011	80%	0%	10%	0%	0%	10%	0%	0%
	MSc in Logistics and Supply Chain Management	2004	39%	17%	4%	4%	13%	9%	0%	13%

University	Programmes	YEAR	SCM	Management	Quantitative Methods	IS / IT	Marketing	Finance / Economy	Law / Legal	Soft skills
Institut International de Management pour la Logistique IML (CH)	Executive Master in Global Supply Chain Management	2011	35%	15%	15%	10%	5%	15%	5%	0%
	Executive Master in Management of Logistical Systems	2004	32%	11%	16%	16%	11%	16%	0%	0%
L'Université d'Aix-Marseille (FR)	*Master in Management, Logistics and Strategy*	2011	7%	20%	27%	7%	7%	13%	7%	13%
	MSc in Logistics	2004	27%	5%	32%	9%	0%	14%	5%	9%
SUP de CO Montpellier (FR)	MBA in Logistics & Supply Chain Management	2004	23%	23%	8%	15%	8%	15%	0%	8%
Cardiff University (UK)	*MSc In Logistics And Operations Management*	2011	67%	0%	17%	17%	0%	0%	0%	0%
	MBA in Supply Chain Management	2004	7%	21%	21%	7%	7%	7%	21%	7%
Cardiff University (UK)	MSc in International Transport	2011	45%	9%	0%	9%	0%	9%	27%	0%
	MSc in International Transport	2004	67%	0%	0%	17%	0%	17%	0%	0%
University of Westminster (UK) Arnhem Business School (NL) Molde College (NO)	*MSc Logistics and Supply Chain Management*	2011	61%	6%	22%	0%	6%	6%	0%	0%
	MSc European Logistics, Transport & Distribution	2004	46%	0%	31%	0%	8%	15%	0%	0%
University of Westminster (UK)	MSc Transport Planning and Management	2011	78%	0%	11%	0%	0%	11%	0%	0%
	MSc Transport Planning & Management	2004	78%	0%	11%	0%	0%	11%	0%	0%
Zaragoza Logistics Center (ES) MIT (US)	Master of Engineering in Logistics and Supply Chain Management	2011	40%	5%	30%	10%	5%	5%	0%	5%
	Master of Engineering in Logistics & Supply Chain Management	2004	43%	4%	29%	7%	4%	4%	0%	11%
Zaragoza Logistics Center (ES)	Master in Logistics	2011	100%	0%	0%	0%	0%	0%	0%	0%
	Master Degree in Logistics	2004	58%	17%	17%	8%	0%	0%	0%	0%

[1] The difference in the terminology used in the US and the UK: the American term "course" has the same meaning as the British term "module" (http://www.fulbright.org.uk/pre-departure/academics/academic-terminology-differences). This paper follows the British terminology.