Typology of Logistics Curricula – Four Categories of Logistics Undergraduate Education in Europe

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Abstract—**The field of logistics education is rather colorful. The range of possible topics is huge and so each curriculum has unique approach towards which topic areas to emphasize and which to treat briefly or even omit. There is only little effective standardization in logistics education. This study examines the content of 42 undergraduate logistics curricula in Europe via cluster analysis, with a goal to propose a typology of logistics curricula. The findings define the spectrum of logistics education in four clusters, ranging from „business administration" with little focus on most specific logistics topics, through „interdisciplinary logistics management" and „modern transport management" to „logistics engineering" with a strong quantitative and technology approach. However, a problem remains that curriculum title does not always reflect actual profile. A typical title "logistics management" might in one case contain various engineering elements, but in another none at all. Such findings point out the need for curricula boards to decide, if trying to cover the entire scope by „one-size-fits-all" program is the best option or if more distinct focus is needed. In both cases this decision needs to be intentional, agreed and clearly communicated to avoid confusing students and society. Furthermore, the study points out the need to refine standards of competences in logistics, especially for logistics engineering.**

Index Terms—**cluster analysis, logistics competence models, logistics curricula typology, logistics education.**

I. INTRODUCTION

It is challenging to present a detailed and agreed definition of logistics. When the formulation is limited to definition in a single sentence, various approaches exist and most of them can co-exist without much practical implications and debate. However, the more into details one would delve, the more confused the researcher might get – where does logistics start and where does it end?

This paper studies higher education in logistics with primary focus on undergraduate studies to reach better understanding on how logistics unfolds and what is the size and nature of disagreement and actually applied approaches on that level. The main questions asked in this paper concern the extent of agreed core in logistics that would be reflected by common denominators across curricula as well as specific ways to make a logistics curriculum differentiate. Could a typology of logistics curricula be created through clustering and if so, what are such "faces of a logistician"?

The goal of this study is to quantitatively evaluate the coverage of topics in a sample of logistics curricula and attempt to cluster logistics programs into a typology to better understand the current landscape of logistics higher education. The literature review presents an overview of what has been written on logistics education and how the scope of logistics and logistician competences has been formulated. In methodology, a structural model is introduced which is used as a tool for logistics curricula evaluation. The paper concludes with findings from the clustering, interpretations and outlining future research.

II. BACKGROUND

On the level of curricula in the general field of logistics, there are multiple ways to combine education programs with different focus to cater for various interests and different needs on the labour market. Some curricula relate to local, regional or even to some international standard, others do not. Some try to cover a wider variety of topics, others go into more detail in chosen aspects, be it technologies or business viewpoints, or leave certain topic matters even untouched. Constructs "logistics and X" (where X is most often transport) or "Y-type logistics" are common (where Y would stand for transport mode, terminal, distribution, manufacturing, retail, trade etc.).

In some cases, one could observe the title "logistics" being used without additions or specifications and then discover that such title is not the most appropriate choice judging by the content. One of the starting points of this research were comments made by students in the authors' faculty on the semester spent studying abroad – the curricula and module titles can often be vague with the most popular title being just "logistics management" and one can be misled without specifically checking the course details. In some cases, this is pure business management view. In other cases, a strong engineering and quantitative optimization element is included. The more general the title, the more chances of false assumptions and logistics is a rather general title. For example, a student might expect that "manufacturing logistics" course deals with designing conveyor lines, AS/RS technologies and process automation, and in some cases that expectation is indeed met. In other cases the approach is more on process impact on business goals, such as inventory levels and lead times, rather than on how to actually design the processes.

While this explains the interdisciplinary nature of logistics, it also leaves room for hypothesis sometimes titles are used for other goals than direct content reflection, perhaps for marketing purposes. It could also be suggested that for some universities, the ability to differentiate their curriculum from the competition is rather more important than

attempting to harmonize and standardize the education. Additionally, there are some perfectly "typical", more balanced logistics programs, which are called supply chain management (or "logistics and supply chain management" for even more marketing visibility, regardless if the authors actually distinguish between the two concepts or not).

This is not an easy question to answer. Recently, concept differences have been discussed by Dinitzen and Bohlbro [1] and Christopher [2]. General understanding appears to be that the concepts are different in terms of expected skill profiles. However, they are related enough to be merged or even replaced on the level of course titles.

It is interesting to attempt to generalize the factors that serve as main inputs to curriculum design. In authors' view, five factors should be treated together:

a) broad concept level – what do key terms actually imply;

b) own brand level – what kind of curriculum and positioning is desired by the administration;

c) feasibility – background of the current teaching staff, availability of new specialists and cost implications of teaching topics with more expensive procedural or facility requirements;

d) society and labour market needs – what knowledge and skills are the most valuable for the society;

e) student view – the most desirable study topics.

This means that there are at least four important considerations which might cause gaps between curriculum headings and content. The picture gets more complicated when other considerations, such as local or international standards and certifications or perhaps modern academic "buzz-words" are included in the mix.

In this paper, attention is on the first two elements. While all this can explain and justify contrasts between terminology, curricula titles and classroom reality, there is also a question of when is the offered study profile distinct enough to change the title to something more specific. Certainly, some universities do it today and this supports visibility. Possible titles might be strategic management of logistics or information logistics. Such differentiation is not usually standardized though, so everyone is free to introduce their own concepts, for better or worse. But what about those that do not? Are there really as substantial gaps between logistics curricula as selected observations and anecdotal evidence would indicate? This paper offers an analytical tool for curricula analysis and applies it to data of a sample of curricula.

III. LITERATURE REVIEW

To begin with, logistics is a field driven by both rapidly evolving technologies as well as dynamic and turbulent markets. These issues combined indicate that it is by nature challenging for logistics education to stay ahead of the curve and this is a common theme in logics education literature [3, 4].

A much telling viewpoint was presented by Myers *et al* [5] in a study focused on mid-entry level employees of logistics positions in 2004. In that study, it was found that direct job-related skills such as decision-making and time management, are primary factors contributing to success

and both experience and education factors were left in the distance. In authors' view, this called for a switch in logistics education towards including more soft skills and problem-solving.

A comprehensive overview of logistics education from the 1970s up until 2005 identified three main areas of logistics education research: curriculum content, skills and competences, teaching methods [6]. The dominant approaches in literature are case studies of curriculum and competence development and teaching excellence, followed by surveys [7, 8]. A recurring theme is a push for more interdisciplinary approaches. For example, Lancioni *et al* [9] have pointed out the need of logistics faculties to develop partnerships with other academic departments to facilitate the creation of cross-disciplinary logistics courses.

An insightful study on the content in logistics programs in the view of educators was carried out by Larson and Halldorsson in 2004 [10]. The study identified four schools of thought on how logistics relates to the area of supply chain management and surveyed the relevance of 88 topics in logistics and supply chain courses across 98 academic representatives. In one view of some educators, logistics and supply chain management are equal terms, covering the range of topics from forecasting to suppliers and from process re-engineering to warehousing and even to e-commerce and conflict management.

Murhpy and Poist [11] researched senior positions in logistics in 2007 and found that over 16 years, logistics had become much more business management focused as many executive search firms pointed out the supply chain orientation as a primary skill of logistics managers.

One of the few even broader studies aimed at mapping a landscape of logistics education was carried out by Wu *et al* in 2007 [12]. One of the findings across courses in logistics was that the three biggest categories were "logistics", "transportation" and "information technology", accounting for 48% of entire credit hours. Interestingly, when analyzing the background of US-based logistics curricula, it was also found that 33% of logistics departments belong under marketing or business administration faculties.

The paper also pointed out notable variations in curriculum content by analyzing the extent of operations management topics in logistics curricula in various areas. The study effectively reiterated the wide variety of topics directly connected to logistics, as many departments studied were found not only to research logistics but also areas like statistics, finance and law.

Most recently, Lutz and Birou [13] have analysed the topics taught and methods applied in logistics classes on both undergraduate and graduate levels, mostly based on data from US. The authors identified 95 topics covered in different courses in logistics on undergraduate level and noted high variance in both topics covered as well as their perceived importance.

Another recent paper identified 50 skills in nine categories that logistics experts regard as essential competences. Right next to more conventional topics, noteworthy elements were crisis management, social responsibility, production integration and independent decision-making. The paper concluded with a philosophical statement: "*An effective logistician should combine global business expertise with functional and technical skills, rather than being*

primarily a functional/technical or a logistics specialist [14]."

The term "logistics potentials" has been used to describe the logistics-related competences and capabilities utilized for successful competitive performance. Sennheiser and Schnetzler have defined the potentials in logistics as specific resources and capabilities, merging the approaches of resource-based view with the theory of dynamic capabilities and competence-based management and suggesting the most common bottleneck does not lie in resources per se but in the capabilities to adaptively and flexibly acquire and exploit them [15].

Matwiejczuk [16] has expanded this idea to explain how competences are a synergized sum of resources and human capabilities. In his view, there are ten key competence areas of logistics potentials that emphasize the integration of processes and stakeholders in a supply chain environment, with order management and customer integration forming the top of service-based advantages, and IT technologies, process management, flow leanness and transparency as primary cost-based advantages.

It appears from the literature on logistics education that there is a research gap in contrasting various curricula and identifying the focal points of curricula along with shortcomings. This is partly due to there not being a central well-defined model to compare against.

To deal with all the variety of topics, modern textbook authors merge the more hands-on aspects of physical logistics operations with systems optimization elements and strategic management, such as recently Rushton *et al* [17] and Farahani *et al* [18]. Rushton *et al* define the core of logistics through five areas: storage and warehousing, transport, inventory, packing and unitization and information and control. The authors acknowledge that through applying ideas of integration and total cost trade-offs into the scheme, the scope extends into other areas such as manufacturing, purchasing and marketing. According to Farahani *et al* [18] the key to successful strategies lies in managing both physical network of facilities as well as information network.

A more detailed approach of 48 decision areas of logistics extending across the levels of strategic planning, physical facility network and operations has been suggested by Langevin and Riopel [19]. Still, while such approaches all offer their insight, these models don't specifically treat how to approach these elements in education for curriculum analysis and course design.

Traditionally, the most detailed input for curriculum development is expected from competence models and certification programs. In logistics, there are many to choose from, with the most widely known being:

- European Qualification Standard for Logistics Professionals by European Logistics Association (ELA) [20];
- International Diploma in Logistics and Transport by Chartered Institute of Logistics and Transport (CILT) [21];
- Distribution and logistics managers' competency model by The Association for Operations Management (APICS) [22];
- Certified Master Logistician CML program by The International Society of Logistics (SOLE) [23];

- Certified in transport and logistics CTL by American Society of Transportation and Logistics (AST&L) [24];
- Certified International Trade Logistics Specialist CITLS by International Trade Certification (IIEI) [25].

Important characteristics of models are comparatively summarized below in Table I. Approach in this context means if the model is built around topic fields as study input or knowledge or competences as learning outputs.

TABLE I. COMPARISON OF LOGISTICS COMPETENCE MODELS

Viewpoint	Logistics competence models					
	ELA	*CILT*	*SOLE*	*AST&L*	*APICS*	*CITLS*
Categories	13	6	6	10	6	3
Elements	195	92	148	56	276	30
Approach	output	both	input	output	output	both
Recently updated	yes	no	no	yes	yes	yes
Scope	broad	average	broad	average	broad	average
Usability	good	good	average	good	good	average

Source: authors' compilation.

As depicted, all the models appear essentially usable for curriculum analysis. The "average" scope should be understood in relation not only to more extensive ones but to other models that were left out from this study due to being too narrow in their scope. Nevertheless, the models cover various functional areas as well as some interdisciplinary viewpoints.

IV. METHODOLOGY

A. Concerning the suitability of existing models

For successful quantitative analysis of curricula content, three components are needed:

a) A structured model and method to categorize topics, which presence can be expected in logistics curriculum and which would provide quantitative evaluation data;

b) Statistical approach to analyze the data so that the output could be meaningfully interpreted;

c) A sample of suitable curricula to be analyzed.

In terms for an objective point of reference, one could use a model of logistics decision areas or a structure of skills defined by an appropriate occupational standard, professional certificate system or competency model. However, more detailed analysis of the models summarized in Table I reveal that there is no model that would be extensive and still detailed enough to cover the rest. To visualize it, Table II presents a comparison of the most concise model, CITLS, against others.

Table II demonstrates that there are significant gaps between models. Even though all deal with logistics, they approach various aspects, dedicate careful attention towards selected areas and leave others only vaguely mentioned or even aside. SOLE model is missing from Table II because the comparison failed to give specific results on most aspects. Vagueness made it impossible to tell which of the here formulated elements was actually envisioned by SOLE authors.

TABLE II.   CITLS TOPICS IN OTHER COMPETENCE MODELS

CITLS elements	Presence in competing models			
	ELA	*CILT*	*AST&L*	*APICS*
Air freight shipments	-	+	-	-
Ocean freight practices	-	+	-	-
Intermodal shipments	-	+	-	-
Trade regulations	+	+/-	-	+
International distribution	+	+	+	+
Insurance issues in trade	-	+	-	-
Incoterms	-	+	-	-
Packaging requirements	-	+	-	+
Customs bonded warehouses and free trade zones		-	-	+
Logistics monitoring & control	+	+/-	+	+
International trade terminology	-	+	-	+
International trade documentation	-	+	-	-
International market expansion	+/-	+	+/-	+/-
Import/export potential analysis	+/-	-	-	-
International market research	+	+	+	+/-
Pricing for international markets	+/-	-	-	-
International finance tools	-	+	+/-	+
International business resources	+/-	+	+	+
Warehousing overview	+	+	+	+
Traditional warehousing	+	+	-	+
Principles of warehousing	+	+	-	+
Third-party warehousing	-		-	-
Warehousing operations	+	+	+	+
Integrated warehousing system	-	+/-	-	-
Mechanics of warehousing	+	-	-	-
Warehouse processes and practices	+	+	+	+
Warehouse layout and design	+	+	-	+
Automation and computerization technologies	+	+	-	-
Warehouse utilization and workforce design	+	-	-	-
Integrated warehouse modeling	-	+	+/-	+

Source: authors' compilation.

Given such mismatches, it can be assumed that the area of logistics curricula would reflect a similar picture. None of the models are ideal for curricula comparison purposes. Because of the gaps, the options would be to either use most extensive model, carry out curricula evaluation against multiple models or design a new model of logistician knowledge areas.

B. Applying a dedicated analytical tool

In previous research directly leading to this paper, the authors have constructed a model of logistics professional knowledge areas by merging various approaches analyzed in Table I. The result was recently published [26]. While the original intent of the model was topic coverage benchmarking in curriculum development, for this paper's purposes, the model is put to comparative quantitative use.

The implemented approach consisted of breaking the models down to fragments and creating a new structure of topics. The resulting structure, slightly modified from the original, depicted on Fig. 1, consists of five layers of topics, with sections representing various knowledge areas in logistics. In original form, each section consists of between 10-15 specific subtopics that define the areas, aiming to broadly cover the topics that could be taught to logistics students in each section. One peculiarity of this model is that it is based on learning inputs rather than outputs. This is unfortunate, given all the recent efforts to push universities towards outcome-focused approach. However, it was necessary, given that a large share of curricula are today still only defined by input.

Level I: General business administration		
Section #1: Business strategy, marketing and environment	Section #2: Accounting and financial management	Section #3: Organization, people and process management
Level II: Broad logistics core		
Section #4: Supply chain management concepts	Section #5: Logistics management and trade	Section #6: Purchasing and inventory management
Level III: Viewpoints on transport		
Section #7: Transport operations	Section #8: Transport - society and systems view	Section #9: Engineering and transport technology
Level IV: Supporting functional areas		
Section #10: Warehousing processes and technologies	Section #11: Information and communication technologies	Section #12: Manufacturing processes and technologies
Level V: Foundational topics		
Section #13: Laws and legal environment	Section #14: Basics of natural sciences	Section #15: Basics of social sciences

Figure 1.   Integrated model of logistics knowledge areas
Source: Modified based on Niine and Koppel [26].

A few models of logistics competences that the authors have come across include foundational competences and individual traits along specific topics of professional knowledge. Sometimes such factors are called graduate abilities or capabilities. These include aspects such as team working, leadership, interpersonal skills, cultural awareness and creativity. It has been suggested that managing such capabilities explicitly and dedicatedly in a curriculum has the greatest impact on the learning outcome [27]. However, such traits are in practice only rarely taught explicitly and their implicit existence in an average curriculum is difficult if not impossible to identify. Therefore, the model proposed here focuses in a more narrow fashion on specific knowledge areas.

The idea of the following analysis is that each of these sections can form a potential area of focal expertise in a curriculum. The extent to which any given curricula covers the sections, measured proportionally, can be interpreted as the actual attention profile of the program. The model is large so full balanced coverage of all sections by most curricula is not expected. Something has to be left out and perhaps the data on "what is missing" is more telling than "what is present" in terms of actual focus of the curriculum. The landscape across curricula can then be described by exploratory cluster analysis.

The main bottleneck in quantitative curricula analysis is that the result of the evaluation can only be as good as the input data from the curriculum. In that sense, errors on both directions are possible. Sometimes the plan on paper is greater than treated in the classroom or in other methods. Still in other cases the official course titles might not go into enough details compared to the reality of studies. However, there is no realistic way of getting around imperfections when quantitative approach is applied across a large pool of curricula.

It has to be said that such model analyses comparative course content in curriculum not specifically the precise amount of attention on topics or the actual quality of in-

put, nor least the quality of study output. So this analysis can point out that curriculum A has different focal points from B and indicate that C has an overall broader coverage than D, but this is only potentially a criticism towards the applied scope and perhaps naming, but not directly the quality of education of D.

C. Gathering a sample of curricula

A noteworthy constraint in detailed curricula analysis is public curricula availability. While international systematic efforts have been recently made to ensure clarity and comparability of curricula, it still happens that some universities are protective of the fine details and in some cases the data is presented deep in the university information systems, which is challenging to reach.

The selection of curricula for this analysis was defined with following criteria:

- The curricula title has to approach logistics with appropriately broad focus applied towards the subject. For example, the titles "logistics management", or "logistics and supply chain engineering" were included whereas programs with more narrow functional focus, such as "reverse logistics" or "maritime logistics" were excluded.

- The curriculum belongs to the first level of higher education with at least three year nominal full-time study duration. In most cases the graduates are awarded a bachelor degree, but in some situations, vocational diploma is awarded instead.

- The curriculum has to be international, i.e. in English. This constrained the sample notably and intentionally. With local programs, more specific regional focus can be expected. An idea of this paper is to identify variety in international programs, which could be assumed to be more universal to a certain degree.

- Finally, the sample only focused on European curricula. Valid continental differences have already been suggested in other studies. The aim here is to "zoom in" and identify variety inside a region.

The initial list of suitable curricula was identified through databases available at http://www.university-directory.eu/ and www.bachelorsportal.eu/. This approach netted altogether 71 curricula: 18 from United Kingdom, 10 from Germany, 9 from Netherlands, six from Poland, four from Turkey, three from Finland and Austria and 18 from various others.

The next step was considering specific data availability. This was partially a consideration why the research was constrained to Europe – in some areas, the information about curriculum made publicly available tends to be on average less specific. Even in Europe, with a history of specifically formulated and comparable curricula, the data was deemed suitably specific only in 42 cases and these were then measured against the model.

The measuring of each curriculum results in a 15-dimensional vector, which then can be treated as a specimen for hierarchical cluster analysis. The goal of this approach is to obtain information on meaningful groupings of curricula. The objective of cluster analysis is to classify a sample of entities into a small number of exclusive groups based on the similarities among the entities [28]. The cluster analyses allows to interpret data in exploratory fashion. The number of groups is not determined

beforehand. Instead, the most appropriate interpretation of clusters is decided after the statistical analysis. Hierarchical classifications may be presented in a two-dimensional dendrogram, which illustrates the divisions made throughout the analysis [29].

The data was analyzed with cluster analysis tools in Statistica10.0 software package. As all the data elements in this case are represented by percentages, the analysis treated the variables equally so there was no need for data normalization.

V. FINDINGS

The evaluation data was first transformed into a dendrogram, which is depicted on Fig. 2.
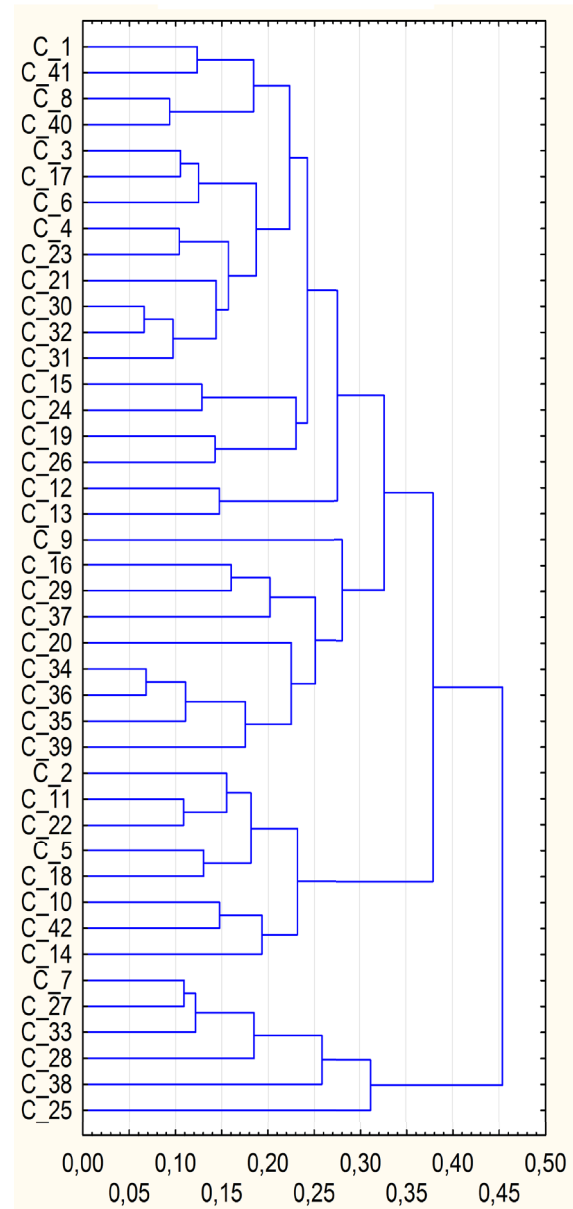

Figure 2. Formation of 42 curricula into clusters
Source: Statistica 10 cluster model output based on authors' data.

The first set of curricula that differentiates and forms a cluster is located in the bottom part of Fig. 2 with six curricula. Closer inspection reveals that these curricula stand out by emphasizing various engineering topics: transport, handling and IT technology. The curricula also

emphasize basic natural sciences: mathematics, physics, chemistry etc. All specimen carry different titles, only one actually being labelled engineering. However, due to their content profile, it is most suitable to call this cluster "#1: logistics engineering".

The next cluster forms from 8 curricula, which much differ from the first set. On Fig. 2, these form the second large segment from the bottom. These curricula include heavy emphasis on general business topics, such as marketing, business environment, operations and human resources management. Therefore it seems most fitting to label this cluster "#2: business administration and logistics". The element of logistics here comes in a form of general introductory courses to logistics operations and management. While some representatives in this cluster have indeed formulated their curriculum as traditional business administration with major in logistics, others have not. Some have titled their program "business logistics", some "logistics and supply chain management", although this cluster does not differentiate by including more courses relating to supply chain management.

The differences between clusters #1 and #2 are stark and they are visualized on Fig. 3 below. The chart demonstrates the relative focal points and topic areas of secondary attention of both types of logistics curricula.

This leaves 2/3 of curricula that could be further categorized. The 17 curricula on the top part of Fig. 2 are on average quite similar to the previous cluster, with two clear differences. Firstly, the focus of previous cluster on general management topics has been replaced by general courses of logistics and distribution management. Secondly, this cluster dedicates roughly twice as much attention

towards teaching the foundations of natural sciences – but then, not nearly as much as specimen of engineering cluster. It is perhaps not too misleading to label this cluster "#3: interdisciplinary logistics management". The focus of this type of curriculum is still on management, but specifically on management of various logistics processes and logistics network. While it could be also argued that true interdisciplinary approach can be never reached inside the boundaries of single undergraduate program, more efforts towards it have at least been made by representatives of this cluster.

While Fig. 2 suggests that the curricula from the top part of the chart form two distinctly separate clusters, the actual differences in the two profiles are not too great, as demonstrated on Fig. 4. The nine curricula from the center part of Fig. 2 have one key difference from cluster #3, which is that they dedicate much more focus on transport topics. In practical terms, this means dedicated courses on transport modes and cargo forwarding operations. To achieve greater focus on these topics, lesser focus is dedicated to foundational knowledge, while in other areas there are almost no differences. This final cluster is more focused on transport than any other so it would be appropriate to label it "#4: modern transport management".

Across four clusters, there are still common similarities. In most cases, logistics program includes one course for warehouse operations and inventory management. In some cases, purchasing is treated as a separate course, in other cases it is omitted or merged with inventory management. The study also identified aspects which vary across curricula more but still not substantially so – such as legal viewpoints and linkages to manufacturing topics.
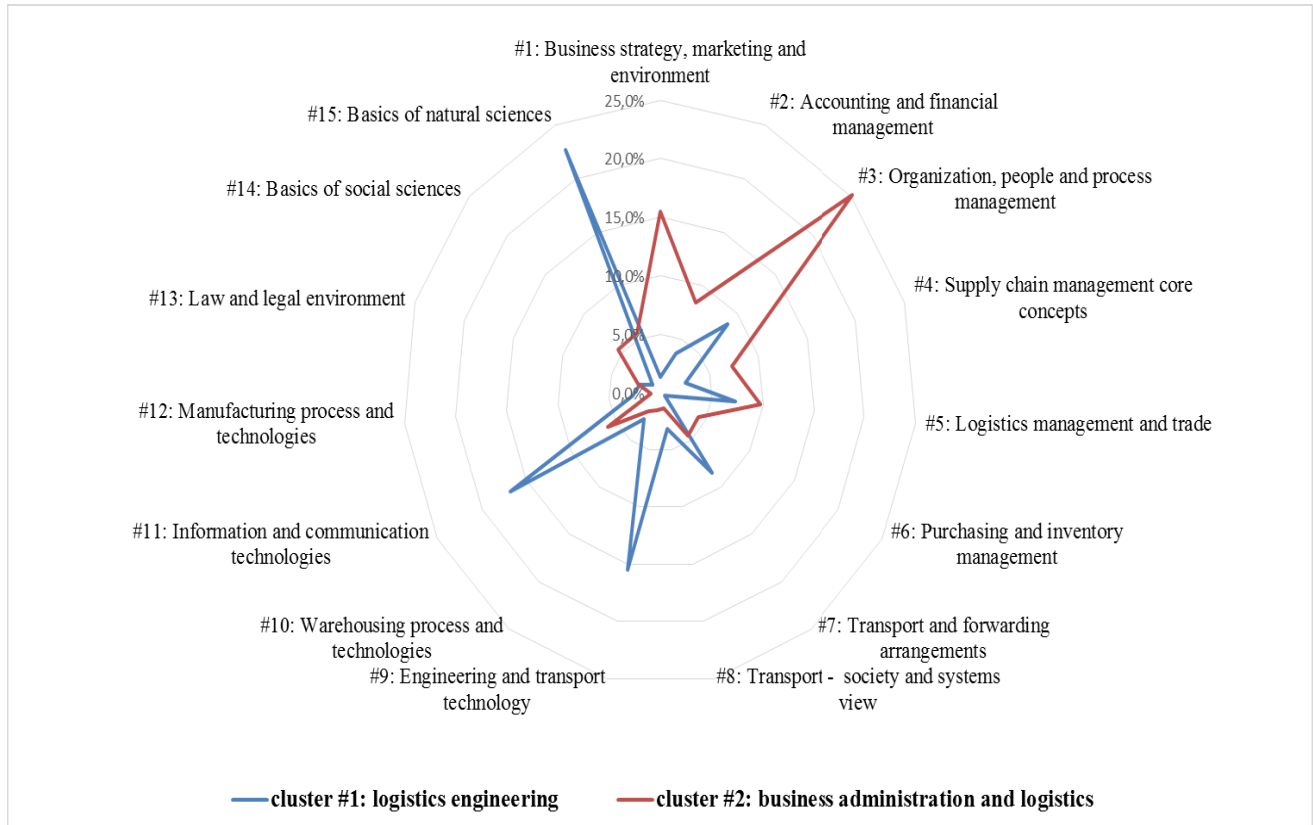

Figure 3.   The contrasted curricula profiles in logistics education: logistics engineering and business administration view
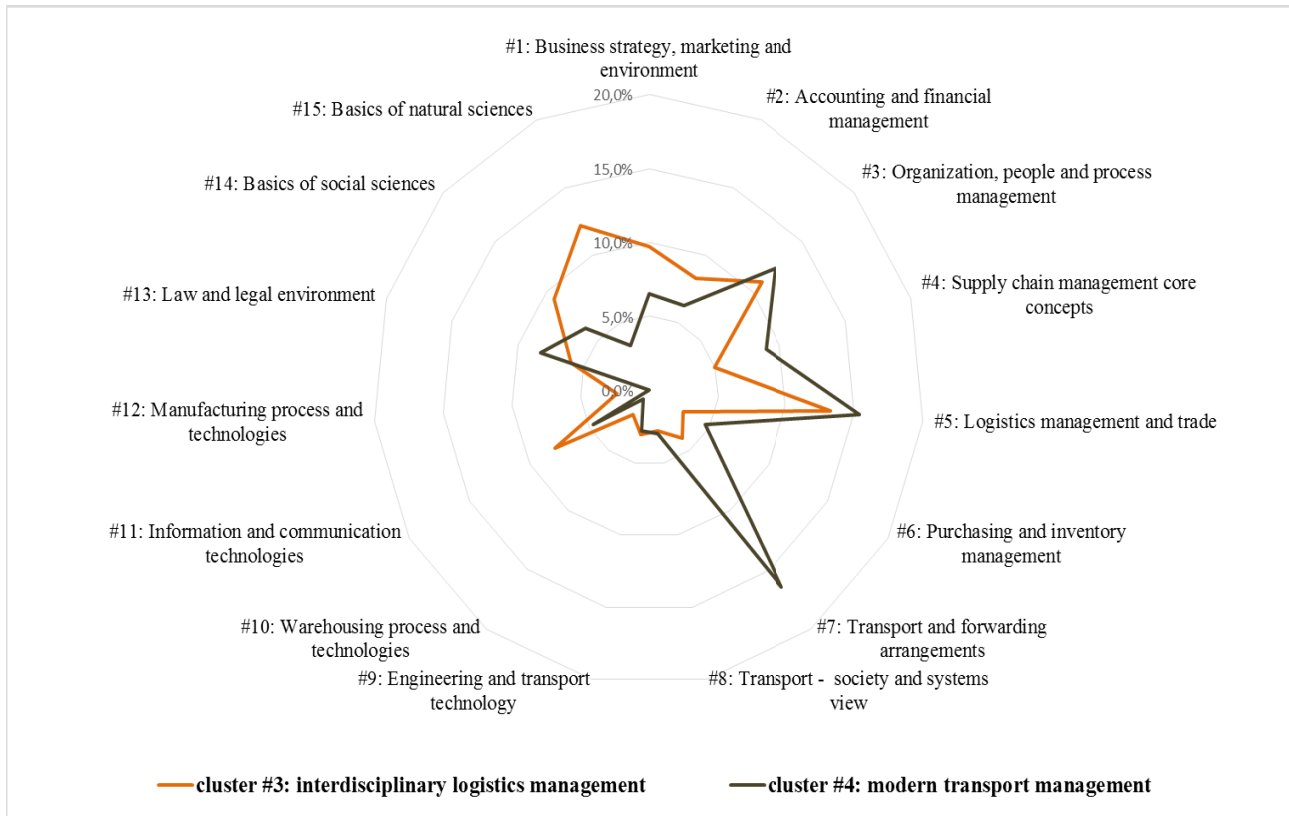Source: Authors' compilation.

Figure 4.   The contrasted curricula profiles of interdisciplinary logistics management and modern transport management
Source: Authors' compilation.

VI.   CONCLUSIONS

The authors would like to conclude with following statements and comments.

1. This study identified four approaches to logistics undergraduate curricula in Europe. It reflects the variety present on the field of modern logistics curricula. While all approaches maintain some form of common core to be worthy of the title "logistics", the actual profiling differences from curriculum to curriculum are substantial. This is in many respects also good – if basics are covered sufficiently, it is most welcome if universities also focus in niches not typically covered elsewhere.

2. In terms of differentiating logistics education, rather more than these four approaches can be applied in principle. The wide range of options comes from the very nature of logistics, which covers an extensive range of topics that creating a carefully balanced "something for everyone" curriculum is really challenging if not impossible.

3. The downside of variety is that it obfuscates the central understanding of logistics. The diversity in curricula is both cause and effect of a lack of strong agreement on conceptual issues among academic authors and organizations managing certificates. Current competence standards in logistics appear also to be more focused on differentiating from the rest rather than moving towards harmonization. Therefore, if logistics can be extensively "flavored" in so many ways, it can reach the point which raises the question if it is still in principle even the same dish.

4. Logistics education would be clearer if titles reflected the typology. Alas it is in many cases not so. An informed logistician has little trouble looking up course content and making appropriate conclusions. However, in some current cases, a high school graduate or potential exchange student is likely left confused. When it appears the actual content does not meet initial expectations, it is only partially student's own fault but also the responsibility of academia to communicate the educational offering more clearly.

5. The level of competence standards in logistics is in need of harmonization as well as development of modern niche profiles. Same applies for curricula – certain basics need to be covered regardless of profiling. Currently some curricula did raise some questions on that matter. As it is often noted, the modern required education profile needs to be T-shaped combining sturdy foundations with strong specialty.

6. One distinct profile is logistics engineering. It is encouraging that this segment appears to be growing. The profile's relevance can't be understated. If current logistics education is somehow "tilted" away from the needs of society, it is that there is too much emphasis on "supply chain management" in logistics, which can mean that traditional business administration curriculum is only slightly refurbished and rebranded. A couple of logistics courses in business programme is also relevant in some respects as it makes sure firms are supplied with people who understand the cross-functional aspect of business. However, it is not sufficient for developing specialists who will need to create the solutions for tomorrow's supply chains. The aspect of logistics engineer-

ing is the cluster which is in relatively more pressing need for dedicated competence model development.

7. Further research areas directly stemming from this study are threefold: 1) extending this approach outside Europe to better grasp the scope of logistics education; 2) updating models of competences and vocational standards to better reflect the conceptual diversity of logistics in both international and local levels; 3) studying best practices of yet different and emerging unique approaches to logistics curricula as case studies.

The authors wish to reiterate the need for constant monitoring of directions in logistics education. The future of education is moving towards higher integration of various platforms and more cooperation of universities in delivering content. In that context, developing world class core competences in a niche is a major success factor, as is knowing other existing competencies elsewhere and being able to cooperate rather than compete.

REFERENCES

[1] H. B. Dinitzen and D. Bohlbro, *Value-Added Logistics in Supply Chain Management*, Academica, 2010.

[2] M. Christopher, *Logistics and Supply Chain Management*, 4th edition. FT Prentice Hall, 2011.

[3] R. I. van Hoek, "Logistics education - achieving market and research driven skill development," *Int. J. Physical Distribution & Logistics Management*, vol. 31, no 7/8, pp. 505-519, 2001. http://dx.doi.org/10.1108/EUM0000000005906

[4] B. Gammelgaard and P. D. Larson, "Logistics skills and competencies for supply chain management," *Int. J. Physical Distribution & Logistics Management*, vol. 22, pp. 27-50, 2001. http://dx.doi.org/10.1002/j.2158-1592.2001.tb00002.x

[5] M. B. Myers, D. A. Griffith, P. J. Daugherty, and R. F. Lusch, "Maximizing the human capital equation in logistics: education, experience, and skills," *J. Business Logistics*, vol. 25, no. 1, pp. 211-232, 2004. http://dx.doi.org/10.1002/j.2158-1592.2004.tb00175.x

[6] M. Gravier and M. Harris "An analysis of logistics pedagogical literature. Past and future trends in curriculum, content and pedagogy," Int. J. Logistics Management, vol. 19 no. 2, pp. 233-253, 2008. http://dx.doi.org/10.1108/09574090810895979

[7] S. M. Rutner and S. E. Fawcett, "The state of supply chain education," *Supply Chain Review*, vol. 9, no. 6, pp. 55-60, 2005.

[8] R. Erturgut and S. Soysekerci, "Professional manager education on logistics and supply chain management," *Procedia Social and Behavioral Sciences*, 15, pp. 2771-2775, 2011. http://dx.doi.org/10.1016/j.sbspro.2011.04.186

[9] R. Lancioni, H. Forman, and M. Smith, "Logistics programs in universities: stovepipe vs cross disciplinary," *Int. J. Physical Distribution & Logistics Management*, vol. 31, no. 1, pp. 53-64, 2001. http://dx.doi.org/10.1108/09600030110366429

[10] P. D. Larson and A. Halldorsson, "Logistics versus supply chain management: an international survey," *Int. J. Logistics Research and Applications*, vol. 7, is. 1, pp. 17-31, 2004.

[11] P. Murphy and R. F. Poist, "Skill requirements of senior-level logisticians: a longitudinal assessment," *Supply Chain Management*, 12, pp. 423-431, 2007. http://dx.doi.org/10.1108/13598540710826353

[12] Y.-C. J. Wu "Contemporary logistics education: an international perspective," *Int. J. Physical Distribution & Logistics Management*, vol. 37, no. 7, pp. 504-528, 2007. http://dx.doi.org/10.1108/09600030710776455

[13] H. Lutz and L. Birou, "Logistics education: a look at the current state of the art and science," *Supply Chain Management*, Vol. 18, Is. 4, pp. 455-467, 2013.

[14] Y. J. Wu, S. K. Huang, M. Goh, and Y. J. Hsieh, "Global logistics management curriculum: perspective from practitioners in Taiwan," *Supply Chain Management*, vol. 18, is. 4, pp. 376-388, 2013.

[15] A. Sennheiser and M. Schnetzler, *Wertorientiertes Supply Chain Management*, Springer Verlag, 2008.

[16] R. Matwiejczuk, "Logistics potentials in business competitive advantage generation", *LogForum: Scientific J. Logistics*, vol. 9, is. 4, pp. 265-275, 2013.

[17] A. Rushton, P. Croucher, and P. Baker, *Handbook of Logistics and Distribution Management*, 4th edition. Kogan Page, 2010.

[18] R. Farahani, A. Rezapour, and L. Kardar, *Logistics Operations and Management Concepts and Models*, Elsevier, 2011.

[19] A. Langevin and D. Riopel, *Logistics Systems Design and Implementation*, Springer, 2005. http://dx.doi.org/10.1007/b106452

[20] *European Qualification Standards for Logistics Professionals*, Brussels: ELA European Logistics Association, 2014.

[21] *International Diploma in Logistics and Transport. Standards of Knowledge and Competence*, CILT Chartered Institute of Logistics and Transport, 2006.

[22] *Distribution and Logistics Managers Competency Model*, APICS – The Association for Operations Management, 2014.

[23] *The Designated Logistician Program*, SOLE, 2005.

[24] *Certification in Transportation and Logistics Information Booklet*, AST&L American Society of Transportation and Logistics, 2014.

[25] *Certified International Trade Logistics Specialist CITLS*, IIEI 2014. URL: http://www.iiei.org/

[26] T. Niine and O. Koppel, "Competence in logistics – designing a meta-model of logistics knowledge areas," in *DAAAM International Scientific Book*, pp. 543-556. Vienna: DAAAM International, 2014.

[27] S. Cranmer, "Enhancing graduate employability: best intentions and mixed outcomes," *Studies in Higher Education*, vol. 31, no. 2, pp. 169–184, 2006. http://dx.doi.org/10.1080/03075070600572041

[28] J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*, 7th edition. Prentice Hall, 2009.

[29] B. S. Everitt, S. Landau, M. Leese, and D. Stahl, *Cluster Analysis*, 5th ed. John Wiley & Sons, 2011. http://dx.doi.org/10.1002/9780470977811

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