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# Curriculum Development And Design For University Programmes In Rail Freight And Logistics

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## Abstract

Influenced by globalisation, internationalisation and different social needs it appears that the higher education is currently changing from an input-output based professor-led approach towards a more integrated competence-based student-led approach. The necessity to develop deep understanding of multi-disciplinary concepts and orientations for a sustainable future has forced industrial, technological and service sectors to cross boundaries. In this paper we discuss concepts, standards and designs for innovative curricula for an MSc in Rail Freight and Logistics which employs a flexible mobility-based hybrid model integrating subjects, teaching and learning methods from four European Universities.

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## 1. Introduction

Over the last decade rail freight in many European countries benefited significantly from innovative logistics principles. New business models have been developed, piloted and implemented to serve national and international markets. Knowledge sharing and trans-boundary skills were required to achieve this.

Rail freight and logistics is multi-disciplinary by nature. It includes a vast spectrum of subject areas spanning from mechanical engineering to social sciences.

Rapidly changing demands for services and goods, international trade and globalisation call for a reliable, strongly efficient rail freight system, operating at full capacity. Implementation of rapid technology advances is also needed to guarantee service of good quality is delivered. To design and operate efficient rail freight systems

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responding adequately to the most recent changes of the global economy and local markets creation, promotion and application of knowledge and competence crossing over subject areas have to be secured.

Universities are the main sources of knowledge and competences. They deliver higher education and create innovation through alternative research. Dictated by internationalisation and social needs the higher education is currently changing from an input-output based, professor-led approach towards a more integrated competence-based student-led approach, aiming at employing deep thinking to develop deep understanding of multi-disciplinary concepts and environment to guarantee a sustainable growth across industrial, technological and service sectors.

Rail freight and logistics do not exist in isolation; just on the contrary. Rail freight and logistics complement the operations of almost all other sectors; this reveals their multidisciplinary nature. To ensure the smooth operation of other sectors, rail freight and logistics have to be flexible and efficient to be able to respond adequately to any changes and/or particular needs of the sectors they complement and work with. Rail freight and logistics programme curricula have to be therefore flexible and efficient to be able to adequately respond to any changes and/or particular needs too.

We developed innovative curricula for an MSc in Rail Freight and Logistics which incorporates a flexible mobility-based hybrid model integrating subjects, teaching and learning methods from four European Universities.

## 2. Joint Quality Standards for Curricula in Higher Education

There are “joint quality standards for curricula in higher education” introduced by:

- American system of ABET criteria for engineering curricula;
- Australian generic graduate attributes;
- Office of Qualifications and Examinations Regulation (Ofqual): regulator of qualifications, examinations and assessments in England and of vocational qualifications in Northern Ireland;
- The Department for Children, Education, Lifelong Learning and Skills (DCELLS) acting as the regulator of general and vocational qualifications in Wales; The DCELLS is not responsible for regulating university degrees; instead it works closely with the England’s regulator: the Ofqual;
- The Council for the Curriculum, Examinations and Assessment (CCEA) acting as the regulator of qualifications and awarding body in Northern Ireland;
- The Scottish Qualifications Authority (SQA) is Scotland’s national awarding and accreditation body;
- European qualification framework of the Bologna process based on the Dublin Descriptor Criteria.

For the purposes of this discussion we focus on the Dublin Descriptor Criteria/European Qualification Framework of October 2004 (DD 2004). Whilst strongly input-output based, professor-led approach employs strict fixed curricula, integrated competence-based, student-led approach employs flexible curricula characterised by floating frameworks, allowing more freedom and choice.

How do we define competence in general and in rail freight and logistics in particular? Is competence connected with qualifications or expectations?

As per the definition given in the Dublin Descriptor of October, 2004 ‘*competence*’ is used in its broadest sense, allowing for gradation of abilities and skills, where a yes-no assessment does not apply. The given degree of freedom is significant.

It is a commonly held opinion that to ensure that service of good quality has been provided highly skilled workforce is needed. Presumably highly skilled workforce is secured by “highly skilled professionals”.

How do we define “highly skilled professionals” in general and in rail freight and logistics in particular?

Recalling the definition given in the Dublin Descriptor of October, 2004 the ‘*professional*’ is used in the descriptors in its broadest sense, relating to those attributes relevant to undertaking work or a vocation and that involves the application of some aspects of advanced learning. The given degree of freedom is again significant.

To develop deep understanding of processes, systems, phenomena we research. Through research we have developed a great deal of knowledge. Research helps us learn, realise, invent and evolve. Through research we become more sensible and aware. Research makes us active learners in life. That is why a research-based learning approach should be employed to help develop competences and build highly skilled professionals.

The definition of research given in the Dublin Descriptor of October, 2004 says ‘*research*’ is used to cover a wide variety of activities, with the context often related to a field of study; the term is used here to represent a careful study or investigation based on a systematic understanding and critical awareness of knowledge. The word is used in

an inclusive way to accommodate the range of activities that support original and innovative work in the whole range of academic, professional and technological fields, including the humanities, and traditional, performing, and other creative arts. It is not used in any limited or restricted sense, or relating solely to a traditional 'scientific method'.

Academic curricula centred on a strong input-output based, professor-led approach are often designed for passive learners. Students receive knowledge through clearly state objectives in a didactic form. Universities operating such approaches are often part of a centrally managed educational system in which academic curricula have to be granted central-governmental, industrial, and/or supervisory permission for accreditation and implementation.

Regardless of definitions and approaches: *how can a good quality of learning outcomes be secured?*

### 3. Concepts and Designs

Introverts and extroverts learn in different ways and bring different expertise and skills to the class/group/team. Also, similar to adult learning (McKimm and Jollie 2007) the learning at postgraduate level is purposeful, suggesting that most of the students will be active learners of knowledge. That is why a number of different teaching and learning methods need to be applied to secure flexibility and dynamism during the educational process and hence guarantee an interest, involvement and contribution.

A holistic, more flexible approach rather than a fragmented, strong input-output based approach is likely to secure a good quality of learning outcomes, because holistic approaches are centred on analysis of case studies and problem solving activities where learners are given the opportunity to generate and research their own ideas.

The postgraduate students should be allowed to participate in the build of their own curriculum to the extent possible where an integrated (hybrid) model will have to be considered.

To be highly skilled professionals, learners have to acquire study skills and self-motivation and hence become self-lifelong learners.

On the other hand academic curriculum should not be developed in isolation; instead every curriculum should be developed in a partnership with the institutions delivering it and seen as an integral part of a larger educational process, policy and practice as well as strategy. Curricula should be design with respect to sectorial structural, organisational and technical constraints where key trends in industry have to be taken into account, incorporated in it and updated on a regular basis.

### 4. Curricula for an MSc in Rail freight and Logistics

An integrated (hybrid) curriculum model integrating subjects, teaching and learning methods from four European Universities (UNEW, DICEA, VTU and HAW-Ingolstadt) has been developed. Mobility levels mainly for students have been envisaged and stipulated. The curricula have been presented, discussed and approved by stakeholders during a validation workshop. Specifically four curricula have been developed to reflect on every university students' perspective: From a Newcastle University Student Perspective; From a Rome University Student Perspective; From a Sofia Transport University Student Perspective; and From an Ingolstadt University Student Perspective.

The subjects identified in every university partner of the programme were grouped under six subject streams: Logistics (L); Technology and Management of Rail Transport (TMRT); Rail and Logistics Infrastructure (RLI); Management and Marketing in Rail Freight and Logistics (MMRFL); Safety, Security and Risk Management (SSRM); and Transport Planning and Economics (TPE). The information gathered for every subject was analysed and systemised in tables giving the subject title, university offering the subject, ECTS, short description of subject as well as teaching and learning methods. Subjects such as "Rail Systems and Rail Skills" and "Major Rail Project" due to their strong multidisciplinary/trans-boundary nature have been included under all subject streams.

Each curriculum was designed to secure that a student can be granted 90 ECTS. In the cases where 90 ECTS could not be guaranteed by one university, mobility of students has been envisaged. Specifically, five student mobility levels have been identified: Low Mobility Level; Between Low and Medium; Medium Mobility Level; Between Medium and High; and High Mobility Level.

Simplified structural presentations of curricula developed are shown in Figures 1 (a) – (d). Due to a rather weak supply side in comparison to the other partnering Universities, Ingolstadt will experience high mobility levels.

Title	Stream	Credits in	Title	Stream	Credits in
1 Freight Transport Logistics	L	5	1 Rail Transport	TMRT	9
2 Railway Vehicles	TMRT	5	2 Goods Transport and Logistics	MMRFL	6
3 Rail Environment and Energy	TMRT	5	3 Safety of Transport	SSRM	6
4 Rail infrastructure	RLI	5	4 Transport Techniques and Economics	TPE	6
5 Rail Freight Operations and Management	MMRFL	5	-	L	0
6 Rail Safety and Security	SSRM	5	-	RLI	0
7 Multimodal Transport Policy and Practice	TPE	5	-	-	-
8 Rail Planning & Timetabling	TPE	5	-	All St.	0
9 Rail Systems and Rail Skills	All St.	10			
10 Major Rail Project	All St.	40			
<b>Total Credits</b>			<b>27</b>		
<b>Missing Credits</b>			<b>63</b>		
<b>Mobility Level</b>			<b>Medium/High</b>		
<b>Low</b>					

  

Title	Stream	Credits in	Title	Stream	Credits in
1 Fundamentals of Logistics	L	5	Fundamentals of Logistics and Production	L	5
2 Operations Research in Logistics and Transport	L	7	1 Planning		
3 Design and Management of Logistic Chains	L	6	2 International Supply Chain Management	L	5
4 Management and Marketing Logistics and Transport	L	6		TPE	0
5 Technical Operation and Safety of Transport	SSRM	6		MMRFL	0
6 Technology and Organisation of Transport	TPE	5		SSRM	0
7 Financial Engineering and Project Management	TPE	6		TMRT	0
8 Commercial Operations	TPE	6	-	-	-
9 Fundamentals of Accounting	TPE	6		RLI	0
10 Traffic Forecast	TPE	6		All St.	0
	TMRT	0			
	RLI	0			
	All St.	0			
<b>Total Credits</b>			<b>10</b>		
<b>Missing Credits</b>			<b>80</b>		
<b>Mobility Level</b>			<b>High</b>		
<b>Low / Medium</b>					

Fig.1. (a) Top Left: Curriculum1-Newcastle; (b) Top Right: Curriculum2-Rome; (c) Bottom Left: Curriculum3-Sofia; (d) Bottom Right: Curriculum 4-Ingolstadt; (source: RiFLE 2012)

5. Conclusions

The rail freight and logistics sector is booming. The role of rail freight in our world is showing an increasing significance due to its environmental credentials and ability to transport quickly and every time more and more reliably commodities we need to produce and consume every day. Logistics have contributed significantly to the growth and revitalisation of rail freight. Rail freight and logistics in combination provide a vibrant sector which serves many of our social needs without causing damages to the environment.

A vibrant sector cannot be sustained without education and training. Factors such as: globalisation, trade, internationalisation and different social needs around the world necessitate a flexible and efficient rail freight service based on optimised logistics. This situation presents opportunities for university degree programmes to revisit their teaching methods, learning approaches, policy and practice to introduce improvements, tune their curricula with the

industry current needs and hence guarantee a good learning outcome.

In this paper we provided a discussion on concepts, standards and approaches for curriculum development and design for university programmes in rail freight and logistics. An MSc in rail freight and logistics incorporating a flexible mobility-based approach has been developed. The programme curricula employed an integrated innovative (hybrid) model integrating subjects, teaching methods and learning approaches from four European Universities; this initiative will result in joint degree programmes in rail freight and logistics.

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