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What curriculum for mobility and transport studies?

A critical exploration

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Abstract

To understand the complex meanings of mobility and to engage in transport planning and management processes a variety of disciplines, skills, and tools are potentially useful. Universities have a limited amount of time and resources to train future professionals though. This poses a problem: where the teaching priorities should be? By means of a web-survey this study has asked to academics based at a number of universities what are the disciplines, skills, and tools that – according to their personal viewpoints – are the most relevant for practitioners in the mobility and transport sector. The respondents generally support curricula that facilitate a holistic, non-specialised, understanding of mobility and transport issues.

Keywords

Curriculum, education, transport, mobility, survey

1. Introduction

In our increasingly more fluid world, mobility and transport studies are becoming essential for understanding individuals, places, events and institutions (Bauman, 2007; Cresswell, 2006a; Ferreira et al., 2012a; Urry, 2000). Due to its influence on many social, financial, and environmental dimensions, mobility is also at the core of various debates about the futures of the economy, technology, and the environment (Banister, 2005; Bertolini, 2006; Hillier, 1996; Urry, 2008). The relevance of mobility and transport studies (henceforth MTS) remains therefore unquestioned.

MTS has not only a technical dimension concerned with the economics of the transport sector, infrastructure design, and networks modelling (e.g. Meyer and Miller, 2001; Ortúzar and Willumsen, 2002); but also a governance dimension concerned with topics on how to make decisions and design institutions (e.g. Banister, 2008; Ferreira and Batey, 2007; Marsden and Rye, 2010; Willson, 2001). Much good work has also been done on the psychological and emotional dimensions of mobility (e.g. Anable, 2005; Sheller, 2004), on the relationships between mobility and social exclusion (Cass, Shove and Urry, 2005; Kenyon et al., 2002; Lucas, 2004, 2012; Preston and Rajé, 2007), and on mobility and health (e.g. Murray et al., 2004; Tranter, 2010). Authors have brought together several of these (and other) dimensions in their research (e.g. Kwan, 1999; Schwanen et al., 2004). In sociology, MTS is increasingly gaining recognition as shown by the rise of the journal Mobilities. Urry (2000, 2004) and Cresswell (2006a) provide contributions on the debates that accompany this rise.

MTS is yet to gain a formal definition. Due to this lack of a consensual understanding of what are the intellectual cornerstones of this vast field, there is no clarity on its exact underpinnings in terms of basic knowledge, disciplines, skills, and

abilities (henceforth KDSAs) that professionals should master. Previous research analysing nearly 1600 papers presented at the Universities Transport Study Group Conferences from 1969 to 2006 suggests that MTS have moved away from focusing primarily on the transport system itself (e.g. studies about traffic flows and traffic management) to focus increasingly more on the social and the behavioural aspects of transport (Allsop, 2006). Generating a debate on what are the key KDSAs for practitioners is therefore important for preparing the best academic curricula for this expanding field. To promote such debate is the drive of this paper which is structured as follows. First, we will introduce general reflections about curriculum, and why these reflections are so important for MTS today. Then, a brief description of some of the key topics being studied in MTS will be presented. That will allow us to argue that MTS is an 'interstitial' field (Abbott, 2001) and explain what that entails. After that, we will introduce the setup of the study by addressing how we gathered and analysed the empirical data. Then we will present the empirical results. The conclusion is that the participants on this study support a holistic curriculum for MTS. In the following section a brief discussion on the pros and cons of holistic curriculums will be articulated. This paper finishes with suggestions for future research.

2. Setting up the debate

In MTS discussions about curriculum are uncommon (even though there are exceptions – see Allsop, 2006). This follows a general trend in academia. Downgrading curriculum studies partially results from the rise of an instrumentalist-managerial rationale centred on teaching to students practice-oriented skills which enhance their employability. Deep philosophical questions about the curriculum become less relevant in this setting. Such questions were replaced by analyses of indicators such as employability rates after graduation and student satisfaction. The

downside of this is that students might end up lacking the capacity to critically approach professional practice as their training was excessively practice-oriented (e.g. Barnett et al. 2001; Moore and Young, 2001; Priestley, 2011; Wheelahan, 2010).

MTS professionals are experiencing difficult times because the practice of managing and planning mobility systems is undergoing complex transitions (Bertolini et al., 2008). On the one hand, leading scholars are questioning what the role of mobility in contemporary society is, whether mobility is a good thing, and the extent to which we can afford to continue accepting its negative social and environmental impacts (Bauman, 2007; Ferreira et al., 2012b; Urry 2000, 2008, 2010). On the other hand, mobility is a valued activity and to change people's mobility patterns is a challenging task (Stopher 2004; Tennøy 2010) which requires complex approaches to be successful (Bertolini and le Clercq 2003; Banister 2008; May and Marsden 2010). This task is challenging because mobility choices frequently result from strong emotional drives (Sheller 2004; Anable 2005; Steg 2005). In summary, MTS professionals operate in a highly contested socio-technical environment. To facilitate students to cope with that, it might be desirable to equip them with strong philosophical and critical skills. However, to equip them with the practical skills that employers are looking for does not seem less important. Time and resources to teach students are limited though, which means that MTS curriculum planners are facing a challenging question: what should be taught to students? A discussion on MTS curricula is much needed.

Curriculum and society have interesting relationships. First, the chosen curriculum for a certain field tends to somehow emulate the existing social structures (Apple, 1995; Grundy, 1987; Lau, 2001). Second, there is a causal relationship between what universities teach and what future practitioners will do in practice.

Third, there is a relationship between what universities teach and what professional identities students will adopt when they will engage in practice. This last relationship is nowadays 'almost universally' accepted (Yates 2009, p. 22). The process of curriculum design is to a large extent perceived as having intended consequences on the students' personal identities. This is a potentially problematic issue for contemporary multicultural societies because it 'raises the question of which or whose culture should be promoted through schooling' (Osberg and Biesta, 2008, p. 313). In this light, MTS will profit from careful reflections on curriculum design because this will influence the future of MTS students in particular and society in general. Several questions are central in this debate: What kind of professional training MTS scholars support? Which subjects are perceived as constituting the core of MTS, and how important are they in relation to each other? What are the perceptions on the skills which professionals working in MTS are supposed to need, and how are they ranked in relation to each other? In this field, should knowledge be specialised or should it be 'holistic' (Cresswell, 2008)?

One key element of this paper is the debate on holism vs. specialism. For a fierce critique on holism see Lynch and Rodwin (1958, p. 203). They argued that holism leads to poor performance because it jeopardises proficiency in all specific areas of activity. Does this mean that professionals involved with the transport sector should be trained as specialists? Specialism can lead individuals to become dismissive of linkages between phenomena which are not covered by their area of expertise. The relationships between particular interventions and their full range of effects are typically poorly understood by experts (for further insights on this topic see Forester, 1999; Morin, 1992; Sterman, 2002). As a result, is it better to train MTS professionals adopting a holistic stance which might jeopardise their proficiency in specific areas of

activity (Lynch and Rodwin, 1958) but has been several times presented as the best approach (e.g. Davy, 2008; Ferreira et al., 2009)? This research aimed at providing a small contribution in debating these issues.

It is relevant to mention that the concept of 'curriculum' comprehends but is not restricted to what should be formally taught in the classroom. Even though in this occasion we shall narrow down the discussion to that, it is equally important to reflect on what kind of learning experiences should be provided to students, how should they be organised and/or what kind of processes should be facilitated, and how students should be assessed. For two classical contributions on this read Tyler (1949) and Stenhouse (1975). Such debate, however, transcends the scope of this paper.

3. MTS: an 'interstitial' field beyond Biglan's typology

A note on terminology is necessary before continuing. We have not called this a study on 'transport planning' because that would alienate many other professionals that also contribute to manage and plan the transport sector (e.g. urban planners, urban geographers, economists, civil engineers, sociologists). One should also be aware that MTS is an ancient field of knowledge and practice. The terms 'transport planning', 'transport studies' and 'mobilities studies' were coined much more recently than the emergence of the understanding that transport needs to be carefully managed and planned. Indeed, since the Roman Empire that transport infrastructures were perceived as key elements in the management and development of a complex society (Luttwak, 1976). The study of mobility and transport systems is in fact a time-honoured trans-disciplinary field of knowledge and practice.

In an attempt to bring unification to MTS, Sheller and Urry shared their views about its foundations when adopting sociological lenses (2006). The first foundation is based on Simmel's work, who crafted a theoretical basis for the study of urbanism

and how people experience the city (see, for example, Frisby and Featherstone, 1997; Simmel, 1971). The second addresses the study of mobile systems, which, according to Sheller and Urry, should be analysed as hybrids in-between the social and the technical world. The third concerns the spatial turn in social sciences, while the fourth is concerned with embodiment and emotions. The fifth concerns social network analysis, while the sixth is about complexity theory and emergence.

The bodies of knowledge proposed by Sheller and Urry as the 'foundations' of the field are based on social and qualitative sciences. The research methods proposed in their paper are predominantly qualitative. However, MTS is obviously not an exclusively qualitative field. Along with qualitative authors – such as Lynch (1960), Pred (1981), Bauman (2007), Ascher (2003), Hagerstrand (1970), and McLuhan (1995) – also professionals from quantitative areas – such as transport planners, civil engineers, economists, mathematicians, and others – have been engaged in the study of mobility for a long time (e.g. Folger, 1953; Hansen, 1959; Isbell, 1944; Stouffer, 1940). The work of quantitative researchers never ceased to be produced and be relevant since these early times (e.g. Banister, 1992; Breheny, 1995; Cervero, 1989; Giuliano, 1992; Hanson, 1980; Janelle, 1969; Levinson and Kumar, 1997; Metz, 2004; Newman and Kenworthy, 1989; Schwanen, Dieleman and Dijst, 2003; Weber, 2003). Sometimes, however, quantitative professionals and researchers were the target of criticism due to their simplifications, tendency to focus on excessively small areas of concern, and perhaps a certain lack of self-reflection (Forester, 1999; Friedmann, 1987; Talvitie, 1997). Nevertheless, on countless occasions, insightful contributions came from quantitative work. This knowledge is part of the intellectual legacy of MTS and it is instrumental for professional practice. In any case, this raises the question of the role that quantitative approaches and methods have in MTS today.

MTS is developing the research methods necessary to cope with the increasing complexity of the contemporary world. Büscher et al. (2011) discuss the challenges of conducting research on highly mobile people and offer some solutions. However, if the challenges are there and deserve careful attention, also promising opportunities for conducting cutting-edge research exist. For example, there is a growing interest on the gamification of daily-life and in virtual realities (Cheok and Nilsen, 2005; Amati and McNeill, 2012). These hybrids of the physical, the imaginary, and the virtual worlds are likely to play a key role in the future.

It is important to mention that 'interdisciplinarity' does not necessarily mean a mutual interest between disciplines – the curiosity of one discipline for another might not be reciprocated. Indeed, well-established environmental criminologists used mobility in their theories (Brantingham and Brantingham, 1993a; 1993b). Will mobility academics react to the criminologists' interdisciplinary motivation, and see criminology and studies on deviance and transgression as valuable for MTS? This is a powerful possibility, as demonstrated by Creswell (1996). To what extent are MTS scholars interested in criminology? What about gender studies or minority and ethnicity studies? Research shows that acknowledging people's unique characteristics is crucial for precluding the development of geographies of exclusion and oppression (Laws, 1994; Sibley, 1995) and to understand their modal choices (Anable, 2005). Other research shows the importance of acknowledging that different people have different mobility needs and perceive the benefits and drawbacks of mobility quite differently (Kenyon et al., 2002; Lucas, 2006; Rajé, 2007; Schwanen and Kwan, 2008). Research has also suggested that the knowledge produced by a certain field is a reflection of the characteristics of those working in the field. As a result, the excluded individuals might feel less motivated or even become incapable to join the field and

the problem is reinforced (for a discussion of this topic see, for example, Monk and Hanson, 1982). Following this, if all the key actors of the transport sector are male it is likely that they will produce and implement biased policies which are dismissive of the specific transport needs of women. A sharp example of this was provided by Turner et al. (1998). The same can be said about people's ethnicity, political views, and religious views. This suggests that MTS professionals should have detailed understanding of psychology, gender studies, and minority and ethnicity studies. Do MTS scholars agree with this?

The challenge posed by the lack of sustainability of the transport sector needs to be addressed as well (Urry, 2008, 2010; WBCSD, 2001, 2004). What is the role of environmental science in MTS (and vice-versa)? For example, Banister critically addressed the importance of environmental marketing in the promotion of sustainable mobility practices (2008). But are scholars interested in promoting environmental science and media studies in MTS curricula?

The previous reflections show that a number of KDSAs are potentially relevant for MTS. This happens because MTS challenges the typical typologies used in curriculum studies. In a classical paper, Biglan (1973) argued that fields can be characterised as being hard-pure (natural sciences such as geology), soft-pure (social sciences and humanities), hard-applied (practical scientific professions such as medicine), and soft-applied (social professions such as counselling and law). Kolb's (1981) work has substantiated this typology. Interestingly, MTS can be described as simultaneously being a soft-pure field (consider, for example, the work of those involved in the 'mobilities turn'), as a hard-applied field (e.g. consider those developing new green technologies for transport), and as a soft-applied field (e.g. consider transport planners dealing with the public and with economic actors). One

might therefore argue that MTS is actually an 'interstitial field' (Abbott, 2001, p. 6). According to Abbott it is very difficult to impede a certain KDSA from joining an interstitial field because, by definition, an interstitial field does not have effective intellectual devices to perform that exclusion. The same applies regarding methods of enquiry: an interstitial field does not have tools to definitely exclude a method (e.g. qualitative) in favour of another (e.g. quantitative) as both are equally useful. This is a strength of MTS because it facilitates intellectual diversity and the use of copious resources. But if the objective is to offer a well-structured, necessarily limited, package of KDSAs capable of preparing future professionals for effective and insightful practice, how should universities proceed regarding curriculum development in an interstitial field? Indeed, the curriculum possibilities are vast but bounded by practical limitations (e.g. bachelor students have to be trained within three years and master students within one year). What is the best course of action for MTS schools then? The next sections explain how this debate was approached.

4. Research questions

Four research questions were formulated to achieve the goal of creating self-reflective insights about MTS. These questions structure the remainder of this paper. The first question is, Which KDSAs are generally considered to be of high/low relevance for MTS? To answer this question we asked a group of respondents to rate the relevance of a wide variety of KDSAs, as we will further elaborate below. To find out which KDSAs are the most (and the least) relevant, we then calculated the overall averages of these responses. The KDSAs with a higher score are the ones that were considered more important for future MTS professionals. The least relevant disciplines would be those that, according to the respondents, could be dismissed more easily from the curriculum.

The second research question is, What type of 'knowledge profile' should be taught to future MTS practitioners? The answer can be found by looking at the shape of the curve of the average relevance scores as ranked from high to low. Linked to the abovementioned holism vs. specialism debate, two ideal-type knowledge profiles can be considered (Figure 1). Profile 1 represents a holistic curriculum: the majority of disciplines have high or at least relatively high relevance; no discipline is considered irrelevant or having very low relevance. The relevance of the disciplines decreases smoothly from highest to lowest. Profile 2 represents a specialist curriculum: a limited number of KDSAs are seen as deserving maximum attention, while the other disciplines are seen as having negligible relevance. There is a sharp cut between what is relevant and what is not.

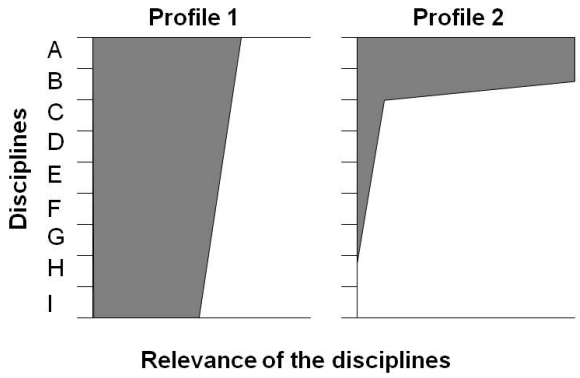

Figure 1: A holistic knowledge profile (left) and a specialist knowledge profile (right)

The third research question is, What are the most contested KDSAs in MTS? We anticipated that some KDSAs would be rated as being highly relevant by some respondents and rated as irrelevant by others. It is important to uncover these disciplines, and, conversely, to discover those that enjoy consensus regarding their relevance.

The final research question is, How do respondents cluster in relation to their opinions about the relevance of KDSAs? Respondents can be placed in distinct groups

according to their opinions about which types of knowledge profiles should be offered in MTS. This will provide insights about whether holism or specialism is supported by these more disaggregated groups.

Note that we have deliberately left vague the definition of what a 'mobility practitioner' is (see Appendix 1). This deliberately fuzzy approach was adopted to allow respondents to think about MTS professionals in general terms, and not with specific focus on one exact professional sub-type (e.g. traffic lights programmers, managers of transport companies) or academic sub-field of MTS (e.g. sociology, planning, economics).

5. Research methodology

We developed a web-based survey to gather the empirical data. In this survey we listed a wide range of possible KDSAs (and their definitions) and asked academics working in schools teaching transport- and mobility-related subjects to express the extent to which they agree with the relevance of each KDSA for MTS (based on a 0-10 Likert Scale). Concretely, for each item we asked the respondents whether they considered that practitioners should have a detailed understanding about its fundamental assumptions, paradigms, concepts, methods, and ways of applying it in professional practice (see Appendix 1).

To develop a comprehensive list of KDSAs to be used in the online survey we looked at the literature already mentioned in the theoretical sections. This list was improved with an interactive approach where academics and practitioners were asked whether they missed any possible KDSA, and whether they thought that the proposed definitions of each KDSA needed improvement. After consulting a total of seven individuals we achieved theoretical saturation. Because this approach is vulnerable to tunnel vision, we allowed survey respondents to criticise the definitions and suggest

new KDSAs. The respondents suggested KDSAs which we unfortunately did not considered, namely health studies, space syntax, migration studies, and history – four KDSAs which we would like to have seen rated. The list of KDSAs and their definitions can be found in Appendix 1.

A large variety of people based at schools which teach mobility- and transport-related subjects were then asked by e-mail to participate in the research by completing the questionnaire. The individuals contacted in the previous stage were not approached again. This participation request consisted of a formal email sent to all academic and research staff, and PhD students (the list of schools is available in Appendix 2). The method to identify participants was based on a web-search for departments involved in transport and mobility research and teaching. Email addresses were found by means of exploring the departmental websites or by means of contacting administrative or managing staff working for the departments.

By contacting a variety of schools we have tried to cover a wide range of disciplinary, national, and cultural backgrounds. Only people from two institutions did not reply to our request at all, the University of Princeton and Adam Mickiewicz University. A total of 891 people were contacted and 71 responded to the questionnaire. This low response rate (8%) is a limitation of this study. The analysis and interpretation of the results should take into consideration that some form of self-selection might have occurred.

6. Characteristics of respondents

Although the questionnaire was anonymous, the respondents were asked to specify their department, university, and current academic position (e.g. professor, PhD student, senior researcher). The characteristics of the 71 respondents are presented below.

Figure 2 shows the respondents' hosting universities (above) and countries (below). The sample is dominated by respondents from the United Kingdom. This can be explained by the large number of British universities we contacted (Cardiff, Oxford, Leeds, West of England, and Lancaster). This is partially the result of the web-design adopted by these institutions where contacts of the academic staff can be very easily found. Some other countries tend to have web-sites that conceal much more the email addresses of staff members while administrative staff is less receptive to be contacted. Although there is substantial national diversity, the majority of respondents reside in European countries. Only seven respondents were based at non-European universities: Brazil (three respondents), Australia (another three), and South Africa (one respondent).

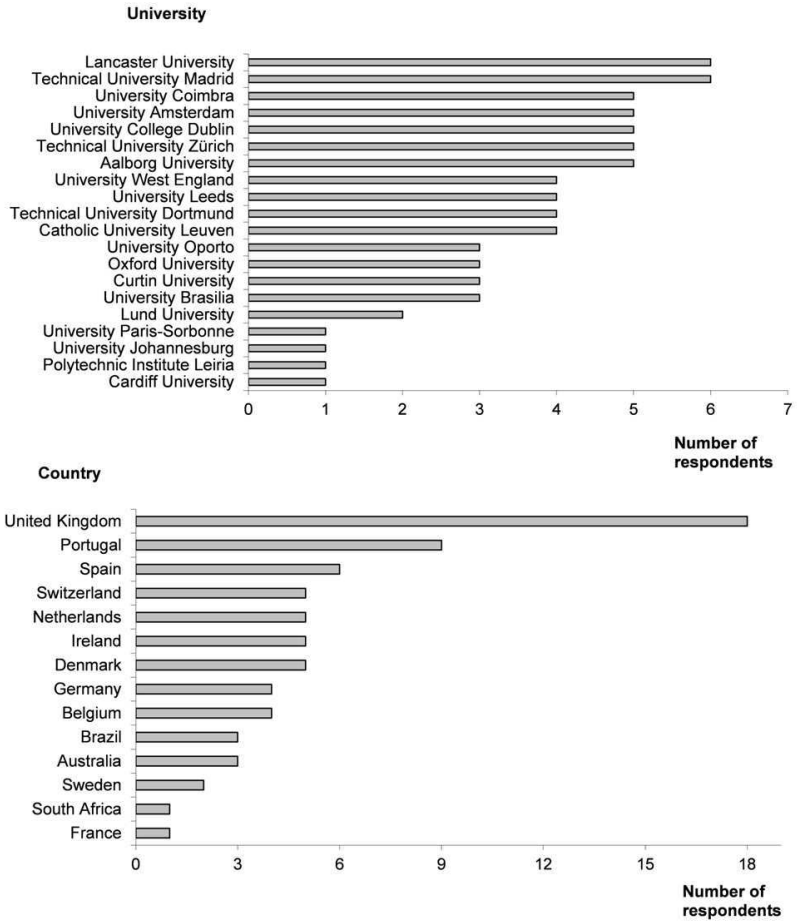

Figure 2: Number of respondents from each university (top) and country (bottom)

In Figure 3 the academic position of the respondents and the disciplinary areas of their departments are shown. PhD students and, to a lesser extent, lecturers and assistant professors dominate the sample. However, a relatively high number of respondents held senior positions: nine full professors (13% of all respondents), five senior researchers (7%) and four senior lecturers or associate professors (5.6%). These respondents represented 25% of the total sample. In terms of departments, the most common category is 'Planning Department' and departments that have planning as one of their themes. Unfortunately, the coverage of architecture departments is very small. Nevertheless, there is substantial diversity among the theme areas, ranging from planning to urban studies, from transport studies itself to sociology.

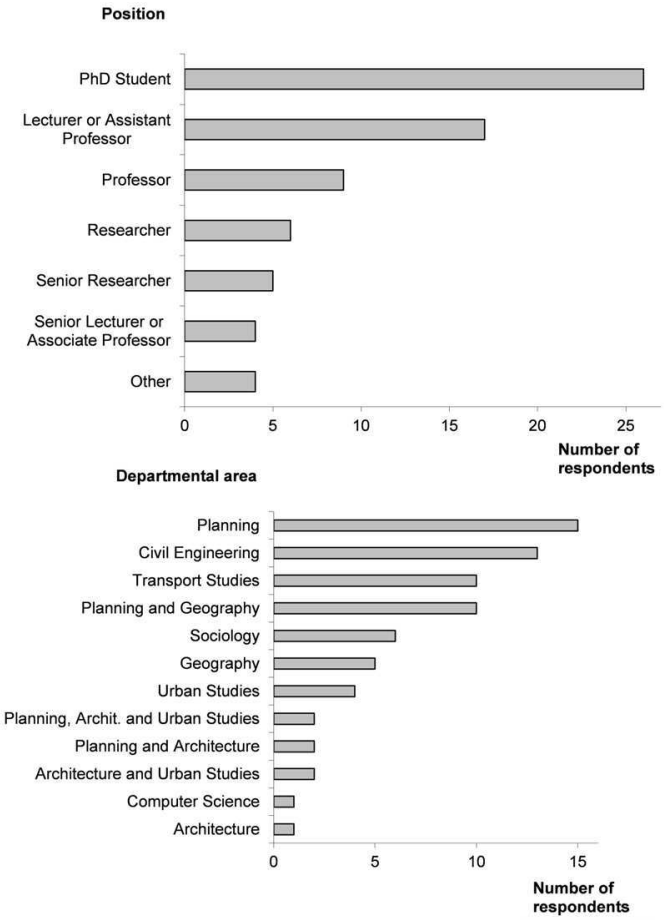

Figure 3: Number of respondents by academic position (top) and departmental area (bottom)

7. The most and least relevant KDSAs

In Table 1 the results of the questionnaire are summarised: the mean of the relevance of each KDSA, the standard deviation, and the skewness of the statistical distributions are shown. Note that all skewness values are small or relatively small, and therefore we assumed the simplification of considering all variables as normally distributed. As shown in the table, research methods is the KDSA with the highest mean value for relevance. Human geography, sociology, economics, statistics, and planning theory all have quite high mean values. Indeed, there are a large number of KDSAs that rate very high in terms of relevance. In aggregate terms, the respondents were not very eager to rate any KDSA as having very low relevance. Nevertheless, the least relevant KDSA was materials science, followed by criminology, philosophy, and gender studies.

KDSAs	Mean	Standard deviation	Skewness
Research methods	8.21	1.37	-0.33
Human geography	8.07	1.99	-1.22
Sociology	7.94	1.72	-0.70
Economics	7.83	1.82	-0.88
Statistics	7.77	2.01	-1.23
Planning theory	7.70	1.93	-0.58
Interviewing techniques	7.52	1.81	-0.79
Urban design	7.42	2.27	-1.01
Project and policy implementation	7.39	1.95	-0.92
Environmental science	7.39	2.29	-0.84
Political science	7.35	1.94	-0.48
Geographical Information Systems	7.34	2.05	-0.50
Performance measurement and impact analysis	7.31	2.16	-1.20
Demand analysis	7.27	1.99	-1.03
Logistics	7.21	2.65	-0.99
Decision-support tools and methods	7.06	2.04	-0.68
Railway design	7.00	2.43	-0.93
Psychology	6.87	1.80	-0.20
Road design	6.76	2.72	-0.86
Negotiation theory	6.70	2.16	-0.79
Landscape design	6.66	2.44	-0.71
System analysis and system dynamics	6.65	2.34	-0.70

Physical geography	6.39	2.90	-0.42
Mathematics	6.25	2.59	-0.58
Social network analysis	6.21	2.06	-0.21
Computer science	6.01	2.50	-0.63
Housing studies	5.93	2.43	-0.42
Law studies	5.85	2.32	0.21
Media studies	5.77	2.64	-0.41
Minority and ethnicity studies	5.54	2.57	-0.31
Epistemology	5.54	2.86	-0.30
Gender studies	5.23	2.78	0.03
Philosophy	5.21	2.81	-0.10
Criminology	4.82	2.52	0.01
Materials science	4.65	3.20	0.15

Table 1: Mean, standard deviation, and skewness for relevance of all KDSAs (ordered from the highest to the lowest mean value)

8. Knowledge profiles for MTS

In order to determine the knowledge profile supported by the respondents in aggregate terms, we have displayed in Figure 4 the relevance of the KDSAs ranked from high to low. The majority of KDSAs have high or at least relatively high relevance; no KDSA is considered to be irrelevant or to have very low relevance. The relevance of the KDSAs decreases smoothly from highest to lowest. As a result we concluded that the first profile (see Figure 1) is the one that better describes the general understandings of the respondents. This provides an answer to the second research question: the respondents support a holistic, comprehensive, knowledge profile and do not seem to be in favour of specialism. This outcome can be seen, however, as the inevitable result of the interdisciplinary nature of the survey: as individuals from a variety of disciplinary backgrounds were contacted, one can argue that it would be very unlikely to obtain a specialist-oriented aggregate knowledge profile. However, the answer to the last research question provided further evidence supporting that the respondents are generally in favour of holism.

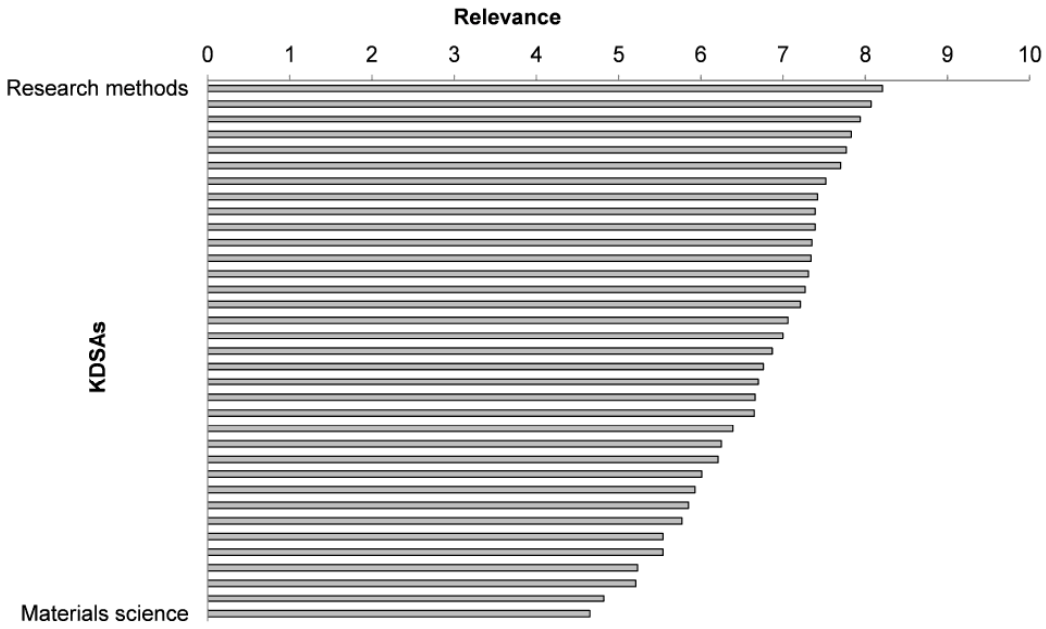

Figure 4: Shape of the knowledge profile supported by the respondents

9. Identifying the most contested KDSAs

Using the data shown in Table 1, we created a chart of KDSAs sorted by standard deviation (Figure 5). As we assumed the variables as being normally distributed, standard deviation is an acceptable measure of the extent to which the relevance of the KDSAs is contested by the respondents. The idea is that a KDSA with a higher standard deviation would then be more 'contested' in terms of its relevance than a KDSA with a smaller standard deviation. The chart displays the values of the mean plus standard deviation and the values of the mean minus standard deviation. The relevance of quite a few KDSAs can be considered as quite contested. Materials science is the most contested of all.

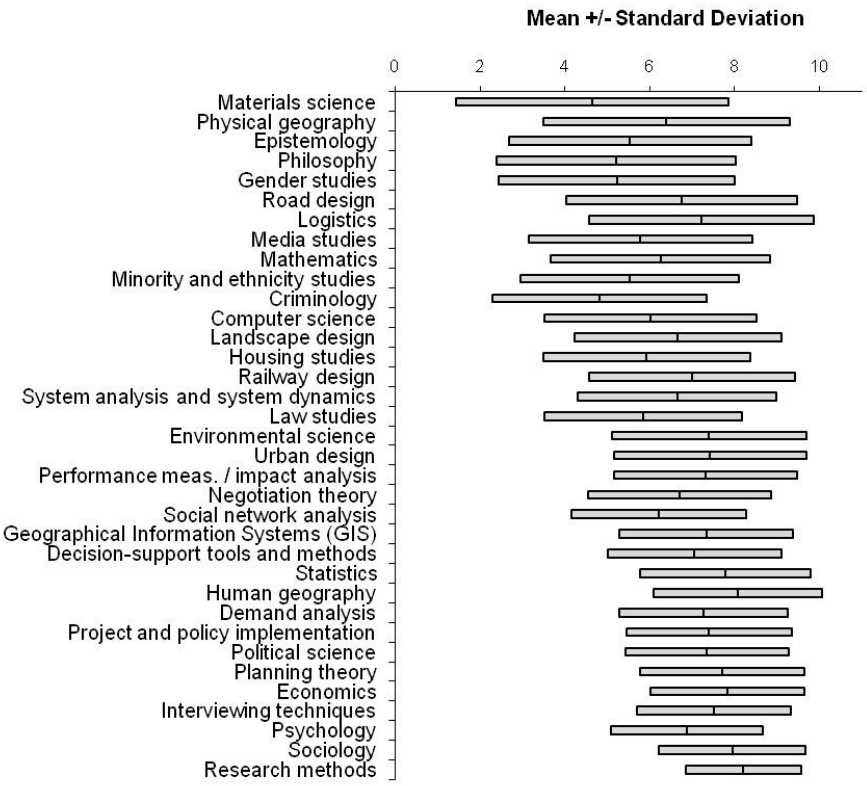

Figure 5: Values of the mean for relevance plus and minus standard deviation (ordered from the highest to the smallest standard deviation)

Let us consider the ten most contested KDSAs (i.e. those with highest standard deviation) in two groups: materials science, physical geography, road design, logistics and mathematics on the one hand; and epistemology, philosophy, gender studies, media studies, and minority and ethnicity studies on the other. We have grouped them and changed their given order to highlight this point: the first five are essentially quantitative KDSAs, while the other five are essentially qualitative. Among the most contested there are no in-between cases, such as decision-support tools and methods, which is not easily categorised as either qualitative or quantitative. Another example is social network analysis, also difficult to characterise in these terms. In opposition, the ten most contested KDSAs are quite easy to characterise as being traditionally

seen as either quantitative or qualitative or, perhaps, as being either oriented towards a 'hard-applied' understanding of MTS or a 'soft-applied' understanding of the field (Biglan, 1973). Note that research methods displays a very small standard deviation; i.e. it is seen as very relevant and accepted KDSA by the vast majority of respondents.

10. Analysing clusters of respondents: holism rules

The last research question aimed at identifying how the respondents cluster in groups when a hierarchical cluster analysis is performed using the following three variables: (1) mean and (2) standard deviation of the rates given by each respondent to all KDSAs, and (3) the value given to the relevance of materials science. The mean of the rates of each respondent was selected as a variable for conducting the analysis because this is a good indicator of the extent to which the respondents generally rated the KDSAs as having high or low relevance. Indeed, some respondents might have the tendency to rate the KDSAs as 'very relevant' while others might display the tendency to rate them as having low relevance. The standard deviation of each respondent is also important because it indicates whether the respondents give very similar rates to all KDSAs, or find it better to use the full range of the scale. These two variables used together give important information about the views of the respondents regarding what general shape the knowledge profiles should have. The last variable for the cluster analysis was the relevance of materials science. This is the most contested KDSA and it gives some contextual information about whether the respondents located themselves ideologically as advocates of quantitative-technological KDSAs.

The first cluster had 35 of the 71 participants (49.3%). Comparatively quite numerous, it includes participants from the majority of countries, academic positions, and universities. Figure 6 presents the shape of this knowledge profile and how

different KDSAs were ranked in terms of relevance. As shown in this figure, research methods is the most relevant KDSA and materials science is the least relevant one.

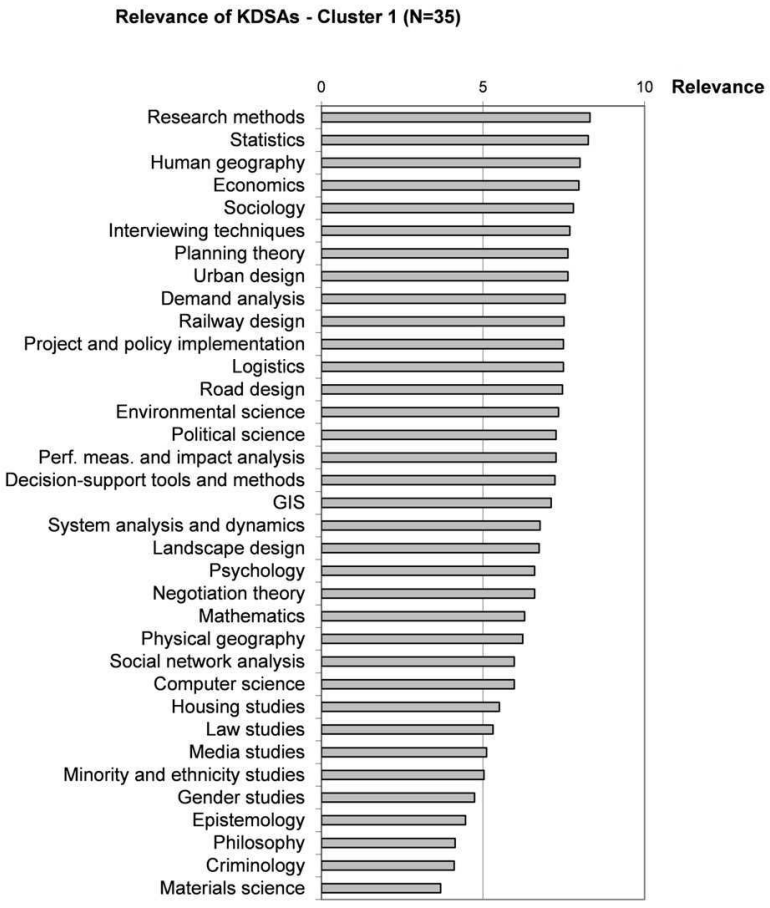

Figure 6: Knowledge profile supported by Cluster 1

A close analysis of Figure 6 leads to the conclusion that the cluster's profile follows the basic shape of Profile 1 (holist curriculum): the differences between KDSAs are generally smooth and there are no KDSAs deemed as fundamentally non-relevant. In terms of the relevance given to KDSAs, only five have a mean relevance scoring smaller than five points. Note that in this cluster the KDSAs are ranked similarly to what can be seen in Table 1 (where the aggregate results for all respondents are shown). This cluster represents the mainstream trend.

The second cluster is the smallest one, comprising only thirteen individuals (18.3%). Quite a few countries and institutions are not represented, because it is a relatively small cluster. Research methods continues to be the most important KDSA and materials science the least important (see Figure 7). Fifteen KDSAs had a mean value for relevance smaller than five, in contrast to Cluster 1 where only five KDSAs were given such rates. This cluster is very similar to the previous. The key difference is that the knowledge profile corresponds to a less intensely holistic curriculum. However, in its general shape this is clearly a Profile 1 (please compare Figure 7 with Profiles 1 and 2 to see why).

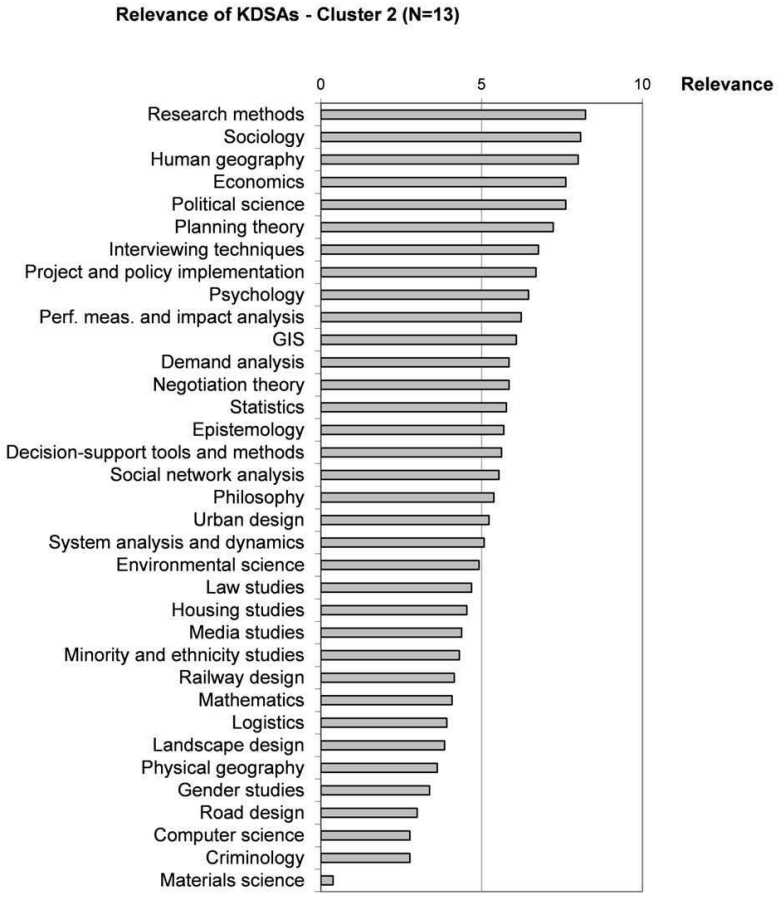

Figure 7: Knowledge profile supported by Cluster 2

The third cluster has 23 individuals (32.4%) and is the second largest. In this profile research methods is not the most relevant KDSA anymore; that position was taken by environmental science. Materials science, instead of being the least relevant KDSA, is now the third most relevant. The least relevant KDSA is philosophy, followed by social network analysis, minority and ethnicity studies, and gender studies. Note, however, that the differences between many KDSAs are so small that one cannot argue that a real hierarchy exists between them. The last profile therefore corresponds to a relatively technical, but extremely holistic, curriculum.

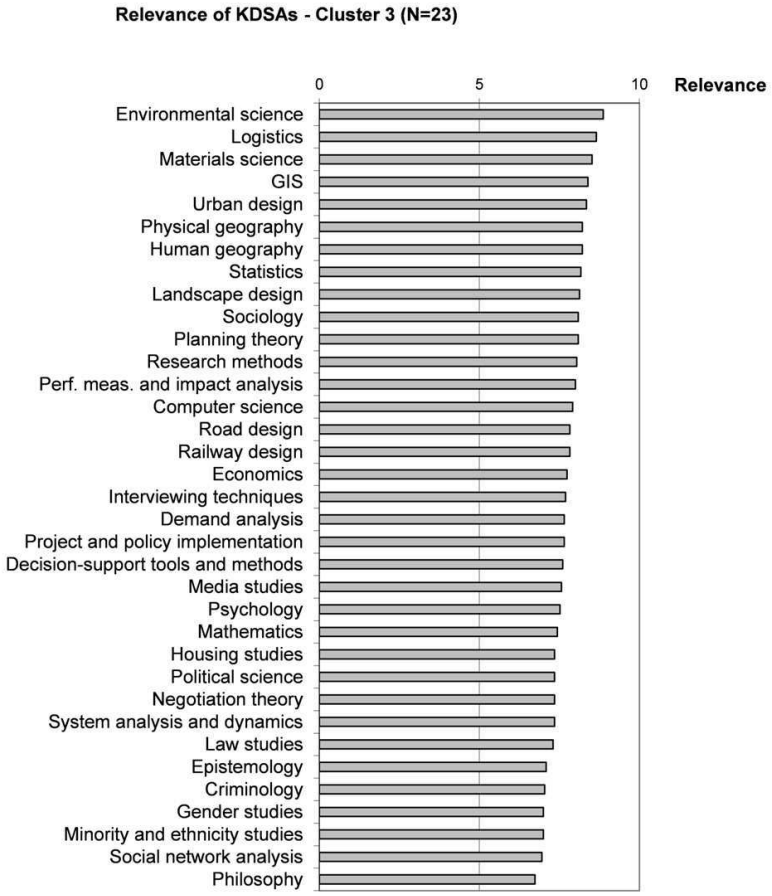

Figure 8: Knowledge profile supported by Cluster 3

11. A brief discussion: holism vs. specialism

The previous sections have suggested that MTS has developed beyond a stage where the central concern was fundamentally transport infrastructures and systems (Allsop, 2006). It has become an 'interstitial' field (Abbott, 2001) generally devoted to holism and concerned with a large variety of technological, methodological, social, behavioural, governance-related, and political topics. This trend might be explained by the principle of 'performativity' applied to higher education (Barnett et al., 2001; Cowen, 1996; Lyotard, 1984). This principle supports that students leaving the university should be able to perform well as professionals and be a valuable asset for employers. Education goals are therefore directly aimed at facilitating commercial practice, and not at developing and acquiring knowledge as an end in itself. MTS scholars might then be adopting a performative logic when they cherry-pick the most useful ideas, methods and tools from a vast variety of disciplines to prepare students for an increasingly more competitive job market.

Holism has some drawbacks though. Without attempting a full evaluation of what is the best choice, some of the pros and cons of adopting holistic curricula in a given field will be discussed in this section. However, before that, one should mention that the empirical data does not necessarily support the view that all future MTS professionals should be trained as generalists. One can interpret these results in another way: it is necessary to train experts in multiple topics so that all areas of expertise are covered, and make sure that they will be managed by insightful generalists capable of maintaining a holistic view on the issues at stake and articulating the conflicting views and values of the experts (as described by Forester, 1999). Leighninger's work (1980) leads one to conclude that the critical question is not so much whether specialists or generalists should be trained, but the extent to

which a right balance between the two types of professionals is somehow achieved in a given profession, field, or institution. This author argues that increasing technological and methodological complexity requires specialist knowledge. However, this is a type of disjointed knowledge that needs to be coordinated and that requires generalists. So the first point to be made is that perhaps MTS needs both generalists who manage and experts who do the technical work.

Note one detail though: in this perspective, experts are those who 'are managed', generalists those 'who manage' – a hierarchical principle is implicit here. So one might argue that both generalists and experts are necessary, however – in this line of thinking – one might argue as well that generalists are likely to find themselves higher in the hierarchy of the institutions. Supporting further the view that holism is a desirable choice for individuals willing to succeed, empirical research has suggested that academics developing research in a specialised topic (within sociology) have less chances of being rewarded with a tenured position than those who have developed several research topics (Leahey et al., 2010).

In contrast to the above, some research on contemporary professions has suggested that within a given field those who 'exercise the profession's knowledge in its most pure form' (Abbott, 2001, p. 145) are those who enjoy most prestigious reputations within the profession. Using historical insights Wilkinson (1970) has alerted that lack of specialism can lead individuals to insufficient levels of interest for technological development and be associated with a poor capacity to challenge the establishment. As previously stated, Lynch and Rodwin (1958) have actually argued that generalist knowledge leads to general incompetence.

It is important to distinguish what type of specialism is being considered as there are many types. Indeed, specialisms can be based on a theory, subject matter,

technique, or method (Law, 1976 – cited by Becher, 1989, p. 48). There are therefore different views and details to be considered on this nuanced discussion on specialism vs. holism applied to curriculum development, and the flavour of this discussion is likely to change with the culture of the field (or even sub-field) under scrutiny. In his famous study on 'academic tribes', Becher (1989) has argued that the institutional arrangements and professional requirements of a certain academic field are fundamentally interconnected both with the nature of the knowledge produced in the field and the modes of enquiry used to produce that knowledge. This means that future research on this intriguing topic is needed so that better clarity is achieved on how MTS curricula should be designed. This takes us to the final section.

12. Conclusions and future research

This research was aimed at promoting a debate about which KDSAs (knowledge, disciplines, skills and abilities) are the most relevant for MTS (mobility and transport studies) as assessed by academics based at a variety of schools. We have argued that this is an important debate because it will lead to higher levels of self-reflection in this increasingly more complex and vast field of research and practice. It is an important debate also because today universities are under strong pressure to become more competitive, to be more capable of achieving tangible economic results, and to have improved capacity to deliver effective teaching (Parker and Jary, 1995; Schimank, 2005; Whitley and Glaser, 2007). Academic curricula might end up being designed in an environment excessively influenced by such managerial circumstances, and not by careful academic reflection. That would be problematic because the role and 'goodness' of mobility are being questioned. Hopefully, this paper will boost this important discussion on curriculum design for MTS.

We invite reactions and criticisms to this study and its results. This paper aimed at making explicit what KDSAs academics believe to be relevant for practitioners in MTS. We find particularly important that practitioners will be approached in future research, as one can easily hypnotise that academics and practitioners have very distinct views on what is relevant. Citizens should be approached as well as lay people might have important remarks to make regarding what kind of professionals they would like to see managing and planning the transport systems which they use. Perhaps future studies could conduct in-depth interviews to understand better how certain skills and forms of knowledge contribute more than others to professional proficiency.

It is equally important to reflect on who should design the curriculum for MTS, in particular if there are meaningful disagreements between different actors about what should be taught and how. Should curriculum design be mainly undertaken by academics or should the industry take the lead? This is a complex issue that claims for a dedicated study, in particular because curricula for some degrees within MTS require professional certification (e.g. transport engineering and urban planning degrees). Using insights from actor-network theory (for a review of this theory see Law, 1992), Lau (2001, p. 38) argued that 'curriculum planners, regardless of their identities, are the people who grasp the most power'. This shows the extent to which this is an important debate. This author also claimed that scholars should become more active in designing curricula as she assessed politicians and industrialists as too influential in this matter. If MTS academics decide that they should have more agency in curriculum design against powerful forces, it is then necessary to approach the problem with a good sense of strategy and with abundant sensibility. A possibility is to make concrete steps towards the consolidation of an academic network which will

have a sound and coherent voice, and political weight. But how can such network be built in an interstitial field with such incredible variety of disciplinary backgrounds and in which there are a significant number of contested KDSAs? This is a stimulating topic for reflection and future research could usefully provide further understandings about it.

It is important to critically analyse whether the knowledge profiles identified in this study should be accepted as representative. Was the methodology selected to identify the profiles the right one, or should other approach have been adopted? What impact different approaches have in the evaluation of certain KDSAs as very relevant? Indeed, if instead of using a Likert scale we have used a hierarchical method for ranking the KDSAs, what knowledge profiles would have been obtained then? These are important methodological questions that require the attention of future research. It is very important to study whether all MTS practitioners should be trained holistically, or – if not – what is the best combination of expert vs. generalist training to be adopted so that professional teams can perform holistically even though they are mainly constituted by experts.

A key conclusion from this study was that the majority of the respondents were reluctant to dismiss any KDSA as being irrelevant, which suggests that people believe that most KDSAs have possible contributions to make. A possible extension for this study would be to conduct interviews and to gather the opinions of academics about why they rated the majority of KDSAs with such high levels of relevance. Was it because the online questionnaire used a scale and therefore the respondents did not have to create a hierarchy from the most relevant to the least relevant KDSA? Or was it because, indeed, they judge holistic knowledge profiles as the best? Future research needs to critically analyse whether holism is the best way forward and what are the

traps hidden in this path. Some KDSAs have received relatively low relevance marks though. If this study would be seen in normative terms media studies, minority and ethnicity studies, epistemology, gender studies, philosophy, criminology, and in particular materials science should receive the least attention in curriculum design. We do not necessarily share this view but see the results of this study as an invitation for further discussion on the relevance of different disciplinary fields and technical tools for MTS.

The most contested KDSAs were identified, i.e. those rated as very relevant for some respondents and not relevant for others. These include materials science, physical geography, epistemology, philosophy, gender studies, road design, logistics, and media studies. These probably are the KDSAs that are more likely to promote intense debate and perhaps some emotional arguments among people from different 'tribes' (Becher, 1989) within MTS. In relation to this, respondents seem to be divided in two tribes. One is concerned with subjects such as materials science, physical geography, infrastructure design, and logistics. The other is more concerned with epistemology, philosophy, gender studies, and media studies. The way to lead these two tribes to work in a complementary fashion should be strategically developed and discussed.

It is important to mention the very high relevance given to research methods by the participants. This seems to be a subject held in high regard, about which there is a very small divergence of opinions. However, there are good reasons to be somewhat sceptical about this. Using insights from urban planning, Baum (2005) provided an extensive (and fascinating) critique on curricula for applied professions which place excessive emphasis on research methods.

We hope that this paper will foster an enhanced debate about how future practitioners in the transport sector should be trained. We also propose some research questions that could be addressed by those interested in the topic. We are aware that the present paper actually formulates more questions than provides answers, but this is actually its strength. Addressing these questions and challenging our answers might facilitate a vibrant debate, which can only serve to advance MTS curricula. These questions might be particularly difficult to answer, however the real benefit does not necessarily derive from finding the answers or to prove who is right or wrong. The benefit is to engage people in a shared effort to understand how to improve mobility and transport studies and its capacity to serve our societies.

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Appendix 1: Introductory text of the survey and definitions of KDSAs as shown in the survey (by alphabetical order)

Introductory text:

Thank you for accepting participating in this study and answering this questionnaire.

The questionnaire will allow us to understand what are the disciplines and tools that academics in different schools judge as the most relevant for practitioners in the transport and mobility sector (henceforth 'mobility practitioners'). A discipline or tool will be 'relevant' if you think that mobility practitioners should have a detailed understanding about its fundamental assumptions, paradigms, concepts, methods, and ways of putting it into practice.

Using your own judgment, please mark the following disciplines and tools according to its 'relevance'. The mark 0 means that the discipline or tool is considered by you as irrelevant; the mark 10 means that you consider that the discipline or tool has the highest relevance. You can use any number between 0 and 10 to express varying levels of relevance.

Definitions of KDSAs as presented in the survey:

1. Computer science studies the process of designing and maintaining the source code of computer programs, and how to use software applications.

2. Criminology studies deviant/illegal behaviour, the individuals who commit it and the environmental, cultural, and psychological aspects that influence the emergence, increase, or reduction of behaviour classed as such.

3. Decision-support tools and methods study and develop instruments/procedures aimed at promoting the quality of decision-making processes and its results.

4. Demand analysis studies the perceptions and needs of individuals, their behaviour as consumers of a certain service or good, and how to influence their choices regarding consumption.

5. Economics studies the production, distribution, and consumption of goods and services.

6. Environmental science is the study of ecosystems and how human interventions affect them.

7. Epistemology is the branch of philosophy directly concerned with the nature of knowledge, what is knowledge, and how knowledge is acquired.

8. Gender studies analyses the concept of 'masculinity' and 'femininity' and the importance of these concepts in the organisation of society.

9. Geographical Information Systems (GIS) studies how to store, analyse and display data that is associated with geographical locations.

10. Housing studies analyses the relationships between tenants, homeowners and landlords, and the properties they own and/or dwell in.

11. Human geography is the study of human activity patterns and how they are influenced by the physical landscape of the places where they occur.

12. Interviewing techniques analyse how to systematically conduct interviews and how to analyse/interpret the results.

13. Landscape design studies the layout of areas classified as rural and the layout of green areas located in urban areas.

14. Law studies analyses how legal reasoning and legal systems operate and develop.

15. Logistics is the study of how to manage the flows of goods from the place where they are produced to the place where they are consumed.

16. Materials science studies the physical and chemical properties of materials and the application of materials in technological developments.

17. Mathematics is the study of the logic of quantity, shape, and arrangements.

18. Media studies analyses the social and psychological effects of means of communication (e.g., the television, films, and the internet), their contents, historical development; and the reasons why individuals, companies, parties and other groups use them.

19. Minority and ethnicity studies analyses social groups that because of their country of origin, race, health condition, sexual orientation, or other factors have dissimilar behaviour, needs, image, and ideologies from the majority of the population.

20. Negotiation theory is the study of how decision-making processes can be systematically improved through dealings undertaken by the participants involved in these processes.

21. Performance measurement and impact analysis studies how to measure the positive and negative outcomes resulting from the implementation of a project or policy (ex-post evaluation) and how to forecast these impacts before the project is implemented (ex-ante evaluation).

22. Philosophy is the study of the fundamental problems of existence.

23. Physical geography studies the physical phenomena and patterns that shape the landscape.

24. Planning theory is the study of the fundamental hypotheses of planning and how planning should develop as a discipline.

25. Political science studies the governing of international political organisations, states, regions, cities and other political entities.

26. Project and policy implementation is the study of how to put into practice the resolutions of a decision-making process that aims to solve an identified problem or a set of problems.

27. Psychology is the study of human behaviour and cognition of individuals, and of the ways in which these can be changed.

28. Railway design studies the layout of railways, railway stations, and other elements of the railway network.

29. Research methods study how to systematically gather and analyse information to be used in the investigation of people, places and phenomena.

30. Road design studies the layout of roads, crossroads, streets, roundabouts and other elements of the road network.

31. Social network analysis studies the relationships between the attributes of individuals and the characteristics of their social interactions.

32. Sociology is the study of activities, artefacts, beliefs and values of human cultures; and what connects individuals to, or separates them from, groups.

33. Statistics studies how to collect, analyse, and interpret quantitative data.

34. System analysis and system dynamics studies phenomena and organisations by conceptualising them as a group of interdependent components that maintain interactions for the achievement of one or several purposes.

35. Urban design studies the layout of the city in general and, in particular, the layout of streets, buildings, squares, parks and other elements of the city.

Appendix 2: List of contacted institutions

Department, Faculty, Institute or School	University	Country
Department of Human Geography	Lund	Sweden
Department of Sociology	Lancaster	UK
Transport Studies Unit	Oxford	UK
Institute Traffic Planning and Transport Systems	Federal Institute Tech.	Switzerland
Department of Human Geography, Planning and IDS	Amsterdam	Netherlands
Institute for Transport Studies	Leeds	UK
Laboratory of Urbanism and Transport	Coimbra	Portugal
Research Centre Territory, Transport and Environment	Oporto	Portugal
Urban and Regional Planning Department	Technical Madrid	Spain
Department of Civic Design	Liverpool	UK
School of City and Regional Planning	Cardiff	UK
Department of Development and Planning	Aalborg	Denmark
School of Spatial Planning	Dortmund	Germany
Department of Planning and Architecture	West of England	UK
School of Geography, Planning, Environmental Policy	College of Dublin	Ireland
Department of Geography and Planning	Paris-Sorbonne	France
Urbanism Unit, Depart. Art, City, Territory	Palmas Gran Canaria	Spain
Institute Socio-Econ. Geog. and Spatial Management	Adam Mickiewicz	Poland
Department of Arch., Urban Design and Reg. Planning	Catholic Leuven	Belgium
Faculty of Architecture	Princeton	USA
Department of Humanities	Curtin	Australia
Faculty of Architecture and Urbanism	Brasilia	Brazil
Department of Town and Regional Planning	Johannesburg	South Africa

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