Context-Adapted Urban Planning for Rapid Transitioning of Personal Mobility towards Sustainability: A Systematic Literature Review

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Context-Adapted Urban Planning for Rapid Transitioning of Personal Mobility towards Sustainability: A Systematic Literature Review

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Abstract: Sustainability related challenges in mobility planning have been recognised at the international level, and the urgency for change has been widely discussed among scholars. However, there seems to be no general agreement on the best ways to pursue such change. To seek answers to the question of how to pursue change, this study analysed the development of the broad research fields of mobility, urban planning and transitions, and the overlap of these bodies of literature. Both academic and non-academic literatures were covered. By means of a systematic literature review, as well as bibliometric studies, several prominent research themes that address change from planning and transition perspectives were identified. Moreover, these themes describe different viewpoints and challenges in mobility planning. These include planning and policy for sustainable mobility and accessibility, backcasting and scenario planning, indicators in planning, modes of transport, decision-making, studies of global North and global South, as well as overarching themes of equity, equality and justice, roles of institutions, and co-production of knowledge. Strategies for staying up to date with these fields were also identified. In the literature covered, the temporal dimension in mobility planning was described in four different ways, but little was found about how accelerated transitions towards sustainable mobility can be achieved. Further knowledge gaps were identified in relation to behavioural change, policy development, institutionalisation of planning capacity, and social sustainability in mobility planning. This created an outline for possible future studies.

Keywords: systematic literature review; personal mobility; sustainability; planning; rapid transition; urban

1. Introduction

The transport sector significantly contributes to the sustainability challenges of today. According to Eurostat [1], 23.5% of emissions of greenhouse gas equivalents in the European Union countries come from this sector. The distribution of different modes of transport, though, is highly context-specific. For many cities, the 'peak car' period has passed [2–4]. Newman and Kenworthy [3] have suggested that we are entering a new age of more sustainable mobility that could be called 'a new golden age of rail'. This could be true, but it is debatable to what extent it will be rail and/or new integrated multimodal solutions that could overtake the private car. It is important that changes are taking place anyhow and that decisions we make today will pave the way for future development. In addition, decisions and plans for future development are largely affected by the Sustainable Development Goal (SDGs) and the New Urban Agenda. The SDGs were adopted by all United Nations Member states in 2015 and represent

a call for urgent action in a global partnership (see: https://sustainabledevelopment.un.org/sdgs). The New Urban Agenda serves as a vision for a sustainable future and connects to the SDG11 [5] (see: http://habitat3.org/the-new-urban-agenda/). Many stakeholders are trying to incorporate them into existing goals and targets but they are often failing to do so since they are being tied to everyday tasks of individual organisations [6]. It therefore seems clear that incremental steps in planning are not enough and that a more radical approach is necessary.

Other issues, such as questions of social sustainability, are gaining wider attention in the planning discourse. Equity, equality, and justice are important in transitioning towards sustainable mobility [7–12]. The same applies to different categories of passengers and the adaptation of the planning process in relation to societal changes, particularly demographic transition, migration, and "floating population" (those who live in rural areas, but work in urban areas). By demographic transition we mean the situation when first mortality, then fertility is declining, leaving an increase in the aging population [12–14]. Often, these challenges are seen and addressed one by one, leading to sometimes controversial outcomes and new problems. For example, prioritisation of motorised over non-motorised transport is unfair for the poorest of the poor [8,9]. Therefore, it is necessary to understand better which issues are important to account for as well as which approaches are being used in planning to be able to identify one or more approaches to address the issues.

Finally, climate change, the IPCC reports (the most recent is the IPCC Special Report on the 1.5 degree world issued in October 2018 [15]), the Paris Agreement (signed in 2015 [16], bringing together all nations to address climate change) and other international agreements create additional time pressure to make a change towards sustainability as soon as possible. The recent IPCC Special Report [15] specifically acknowledges transport as a challenge and urges a fast radical change overall. However, there seems to be a lack of understanding regarding the extent to which planning studies and transition studies address the need for rapid changes, as well as to what extent transition studies are integrated with planning studies. This is important to investigate further, as a combination of the two would likely be necessary to bring about sufficiently rapid and extensive changes.

1.1. Research Goal and Research Questions

Based on the general overview described above, the study aims to provide a systematic inquiry into the relevant publications, analyse to what extent studies of urban planning, mobility, and transition studies overlap in the cited literature, what main themes have been discussed to date, and what the "organisation of the field" is.

The main research question for this systematic literature review (SLR) is: "What is the current status of research on context-adapted urban planning for rapid transitioning of personal mobility towards sustainability?". This question is split up into four sub-questions as follows:

- RQ1: What are some prominent research themes within context-adapted urban planning for rapid transitioning of personal mobility towards sustainability?
- RQ2: How did the identified themes evolve during the past 10 years?
- RQ3: What are the main related bodies of literature and to what extent do they overlap?
- RQ4: What is the 'organisation of the field'?

To answer these questions, we used systematic literature review methodology and qualitative analysis, as well as a number of bibliometric methods to assist in systematising the data. The combination of research methods allowed us to classify and analyse the literature, using both algorithm-based approaches and our own understanding of the subjects.

Below we first describe some key concepts and say more about the methods and tools used in this study. Later, we interpret and analyse the results of the SLR. Finally, we discuss past, present, and likely future research.

1.2. Key Concepts

Here *mobility* is defined as "the ability of an individual [...] to move about" [17] freely and easily. It contrasts the definition of transport—moving people (or goods) by different means of transport [18]. This definition of mobility opens up for a possibility to consider other ways of moving people around than by means of different modes of transport. 'Freely' in this context means that people have the freedom to move about, whereas 'easily' refers to accessibility to people, places, spaces, work, and other necessary services and facilities. In this way mobility is closely related to *accessibility* [9,19]. In a broader sense, mobility can be understood not only as movement of people or objects, but also as communication, flows of meaning, and the sharing of ideas [20–22]. However, in this paper, we still focus more narrowly on the movement of people.

In this paper, *urban planning* is defined as "an important tool for city leaders to achieve sustainable development. It helps to formulate medium- and long-term objectives that reconcile a collective vision with the rational organization of the resources to achieve it" [23]. Urban planning traditionally involves tasks, such as land use distribution, built environment design, infrastructure development, and communications. In some places transport planning forms part of urban planning, while in others transport or mobility planning have their own authorities and respective plans.

Context adapted planning implies the importance of local context considerations in the planning processes.

We did not define the terms *transition* and *transformation* in this paper, because there is no agreement on definitions among scholars and we wanted to be open to any interpretation.

There are also many definitions of sustainability and many stakeholders understand it differently, which creates a challenge for the direction in planning [24]. Using the idea of a systems approach in planning [25], sustainability was suggested by some to be a policy end-point (or sustainability as a vision [26,27]), instead of sustainability as a pathway, where an outcome is not defined and the state would become progressively "more sustainable" [25]. Another way to understand the term is as a lens through which to look at social realities [28]. Sustainable mobility is intentionally not defined in this paper because the purpose was to explore the literature related to the research questions and not to impose or identify publications that use specific definitions of sustainable mobility and then analyse them.

2. Methods

Guidelines for systematic literature review suggest to use a time restriction to scope the study [29] (p. 48). The main focus of this study was on the publications of the past decade (2008–2018) but the literature analysed starts from 1993, when the oldest book included in this SLR was published. The year 2008 was selected due to Banister's publication "The Sustainable Mobility Paradigm" [30] that became a reference point for many future studies around sustainable mobility, suggesting that conventional planning should be reconsidered based on the sustainability perspective.

2.1. Systematic Literature Review

A systematic literature review was performed, mainly based on the combination of recommendations of two studies. The first of these studies, Pickering and Byrne [31], helped to identify the process (15 steps of SLR, p. 539), whereas the second study, Petticrew and Roberts [29], provided general guidelines on when to perform SLR, what types of studies to include, how to assess them, and how to address possible biases. The general flow of the SLR is illustrated in Figure 1.

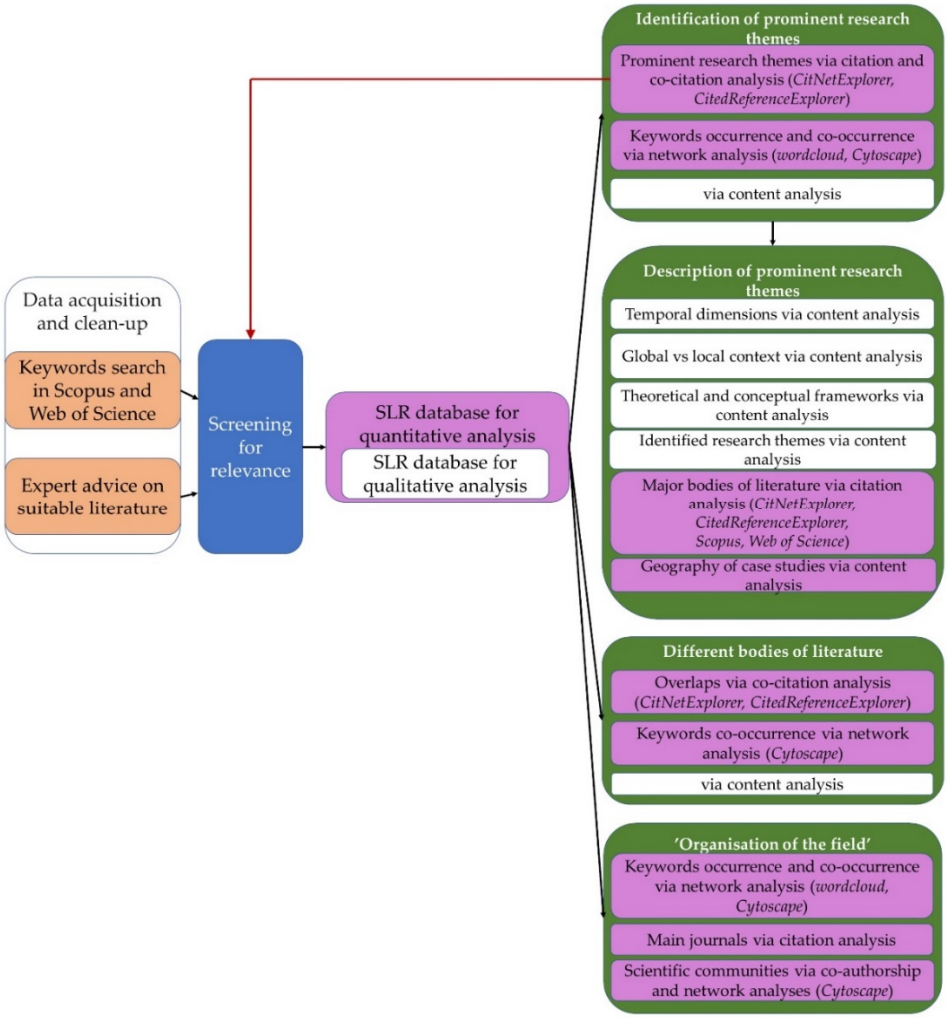

Figure 1. Process flow of the systematic literature review (white boxes on the right relate to the white box with the SLR (systematic literature review) database for qualitative analysis while purple refer to the SLR database for quantitative analysis; bibliometric research tools are written with *italics*).

Performing an SLR gives a comprehensive approach to assessing relevant literature using a defined methodology, identifying the criteria for selection of the published work, assessing relevance of the scholarly publications to the research questions, structuring the data extraction and analysing the results.

To address the Research Questions outlined above, several strategies for data acquisition and clean-up have been used. They consist of keywords identification, databases identification and keywords search, and expert advice on suitable literature.

To systematise and interpret the data, both quantitative and qualitative methods have been utilised. The selected quantitative methods (some of them are bibliometric methods: citation, co-citation, co-authorship and network analyses) are described in Section 2.2 and research tools in Section 2.3. From the obtained data, prominent research themes have been identified and described, followed by analysis of different bodies of literature and "organisation of the field" that suits the research aim. Moreover, to better understand the fields and bodies of literature, we quantitatively analysed the geographies of case studies, as well as theoretical and conceptual frameworks utilised in the publications of the SLR.

The systematic literature review has a transdisciplinary character—meaning that both academic and non-academic literatures are included—and incorporates publications' findings from mobility, urban planning, and transition studies.

2.1.1. Data Acquisition and Clean-Up

2.1.1.1. Keywords Identification

Keywords were identified through an iterative search process starting from a few terms inspired by the research questions. After some iterations this expanded into 19 keywords: "mobility", "transport", "accessibility", "urban", "city", "$sustainable" (symbol $ refers to stemming search technique and returns all the words with the same word stem [32]), "local context", "context adapted", "plan", "fast transition", "rapid transition", "accelerated transition", "indicator", "criteria", "principle", "success factor", "decision*making" (character * refers to wildcard [33] that retrieves all the variations of the word(s)), and "decision maker*". The number of keywords was then reduced through a quick combinations test where synonyms were identified in a series of searches (Figure 2). The test searches showed that "fast", "accelerated" and "rapid transitions" were covered in "transitions"; "indicator", "criteria", "principle", "success factor", "decision*making", and "decision maker*" were covered in the literature on planning; and "context adapted" did not give any results, so a synonym term "local context" was selected for the search.

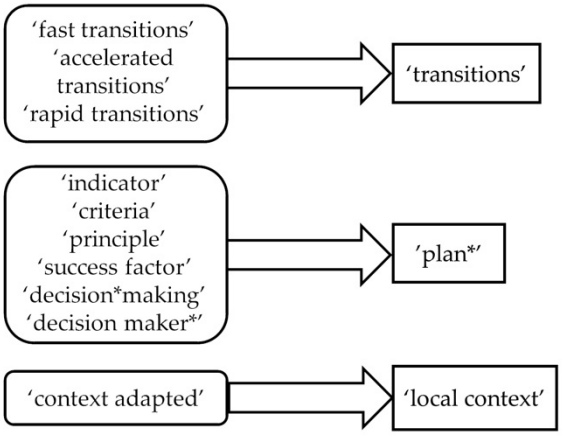

Figure 2. Reduction of keywords scheme.

Finally, the following keywords were selected for the keywords search of this SLR: "mobility" ("transport", "accessibility"), "urban" ("city"), "$sustainable" in combination with either "local context", "plan*' or 'transition'. The scheme is illustrated in Figure 3:

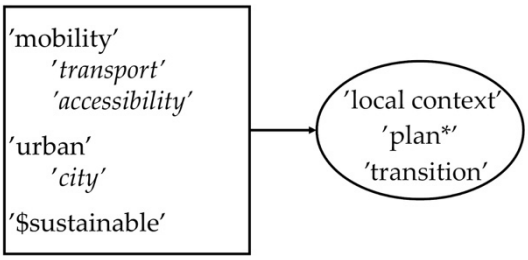

Figure 3. Key words scheme for search strings.

In the search strings, each word from the rectangle on the left in Figure 3 was used in combination with each term from the oval on the right. It created 18 search strings.

We are aware that the terms *transition* and *transformation* are sometimes used interchangeably, both referring to a radical change, and sometimes very differently, with transition referring to incremental change as opposed to more radical change by means of transformation. However, the concepts that these terms point to come from different schools of thought, with their own underlying assumptions and distinct approaches, where transition has been said to focus more on concrete changes

within societal subsystems (e.g., energy and mobility) while transformations rather deal with the link between society and ecological externalities [34]. In this study we focus on the transition term, because it is closer to our research focus.

2.1.1.2. Databases Identification and Keywords Search

The databases Scopus and Web of Science have been used to search for publications from January 2008 to April 2018. The subject areas covered were social sciences, engineering, earth and planetary science, multidisciplinary, decision science, economics, econometrics and finance, environmental science, business, management and accounting, energy, computer science, agricultural and biological sciences, decision sciences, mathematics, arts and humanities, and psychology. Although we used both databases, our primary study showed that most of the publications from Web of Science are present in Scopus too (four publications were found in Web of Science only).

2.1.1.3. Expert Advice on Suitable Literature

A systematic approach to keyword searching of databases in SLR has its advantages, allowing consideration of publications that might have been missed otherwise. At the same time, it has its limitations related to the selected publications, as they become the starting point of the analysis. Examples of such limitations are the publications by Robinson [35,36], one of the founders of backcasting. They were not on the resulting list of keyword searches of the SLR due to their publication dates (before 2008, namely 1982 and 1990). In addition to that, a co-citation analysis was performed, and its result did not show these publications either, because they were not cited at least four times within the selected publications. To address this limitation, expert advice [29] (pp. 104–105) on suitable literature was collected. It was done through informal consultations with experts in the field. This added 21 publications in total and ten of these were neither in Scopus, nor in Web of Science, as they were recently published books and articles.

2.1.2. Screening for Relevance

The main inclusion criteria for the publications were publications being original research papers written in English and published in peer-reviewed journals (including articles in press), as well as peer-reviewed books and book chapters. Language restrictions created limitations by excluding publications written in other languages (some of them were published in Chinese, Spanish, German, and Polish). It could be seen as restricted science in transdisciplinarity [37]. However, including them in the analysis could have been difficult and risky, as content could have been lost in translation or misinterpreted. Given that the lead author had a proficient command of Russian, Ukrainian, and Czech, some additional publications that were identified through the bibliographic studies and written in these languages could also be assessed for their relevance to the Research Questions. Review papers, conference papers and reports were not included into the search.

2.1.3. SLR Databases

There were two SLR databases formed for the analysis: an SLR database for quantitative analysis and an SLR database for qualitative analysis. The first one consists of the results from the primary SLR search in the Scopus and Web of Science databases and from the expert advice. In addition, citation and co-citation analyses were performed to identify further literature that could have been missed throughout the primary SLR process. These publications were added to the SLR database for quantitative analysis. To better understand the fields, the other SLR database for qualitative analysis was identified within the SLR database for quantitative analysis. The publications from the qualitative database were fully read and analysed in-depth. This enabled viewing the field from the systems perspective, identifying possible biases and knowledge gaps.

Specific methods and research tools used for the bibliometric studies are further described below.

2.2. Bibliometric Methods

For bibliometric studies, we extracted the following information: authors, publication metadata, references, and citations. Several tools were used to clean-up the data. We used Microsoft Word and Excel for primary fixes such as removing blank spaces/cells and refining the consistency of language (for example, from "decision making" into "decision-making") as well as refining the names and titles (for example, from "Gossling" to "Gössling"). In addition to that, we used OpenRefine (see: http://openrefine.org/) to go through the words and names that are slightly different, for example "city" and "cities". OpenRefine is an open source software to work with messy data, which is available in several languages. It is important to process data in this way to avoid duplicates in the analysis. Having duplicates in the networks would make it more complex and the relative importance of a particular keyword, author or publication would be decreased.

2.2.1. Citation Analysis

One of the common methods of bibliometrics, citation analysis [38], has been performed for this SLR. Scientific literature is based on the arguments that are supported by relevant cited publications and in that way creates relationships between publications in the field. The usefulness of citation rankings in research evaluation is being debated [39]. Firstly, metrics do not fully reflect the overall contributions of researchers towards institutional mission and the wider public good. Secondly, studies show that women and interdisciplinary research become disadvantaged due to lower citation frequency than what is typically the case for men and disciplinary research [40]: "Evidence suggests that men are reluctant to cite women" and "interdisciplinary research . . . tends to be cited less often than papers in the mainstream of disciplines". Thirdly, hyperprofilic authors might have limited involvement in the research process and "do not meet traditional authorship criteria" [41]. As suggested, the best way to address the potentially limited usefulness of citation ranking is to publish in peer-reviewed journals to supplement the ranking evaluation with a peer-review process by the experts [40].

In case of systematic literature reviews, bibliometric studies give an overview of what publications had an effect on the subsequent articles and books. Moreover, citation analysis allows the identification of main journals, research institutions and other types of data for bibliometric analysis. We used citation analysis to identify the most cited publications and the main journals within the SLR database for quantitative analysis. In addition, citation analysis helped identifying complementary literature (red arrow in Figure 1). This resulted in 69 publications, however, after removing duplicates, only 22 publications remained, and of those, ten did not meet the eligibility criteria (see Figure 4).

2.2.2. Co-Citation Analysis

Co-citation analysis, in contrast to the citation analysis, shows the relationships between publications, as well as how strong those relationships are. This can be illustrated in networks of related literature (with two or more publications cited together in the same article) that would show the links between the publications and their relative proximity to one another [42]. Such an analysis can visualise groups/clusters of literature with the most relevant content [38] and lead to the identification of core themes [43] and schools of thought [42]. Moreover, co-citation analysis can show development of the field over time as interests of the researchers change [38]. In this SLR, we have analysed publications', co-citations', and keywords' occurrence and co-occurrence to describe the development of the field.

2.2.3. Co-Authorship Analysis

To illustrate social networks among researchers who share similar interests, co-authorship analysis has been performed. In contrast to citation and co-citation analyses, co-authorship analysis shows what groups of researchers collaborate [44]. Co-authorship analysis can therefore be used to identify

schools of thought. We used this method to depict collaborations formed to publish works selected in the SLR database for quantitative analysis, as well as to focus on the most published authors' networks.

2.2.4. Network Analysis

Network analysis illustrates the relations and interactions among the elements of the system. In social sciences network analysis is used to identify network properties, for example formation clusters in the system or allocation of node centrality [45]. In our SLR we used network analysis to map the keywords and authors of publications. Moreover, we calculated node size, node centrality, and how many links each node has, illustrating each node's importance within a system [42]. With that we identified the main keywords, authors and their respective networks within the SLR database for quantitative analysis.

2.3. Bibliometric Research Tools

Open source software CitNetExplorer (see: http://www.citnetexplorer.nl/) has been used to analyse citations based on the data from the Scopus and Web of Science databases. First, we created a list of selected publications on Scopus; the publications not available in Scopus were searched and added to another list on Web of Science. Ten of the 21 publications recommended by the experts were not found in either of the databases and they were excluded from the co-citation analysis. Using an intermediate open source software called CitedReferencesExplorer (see: http://andreas-thor.github.io/cre/) we saved the data from Scopus into the suitable for CitNetExplorer format (the same as in Web of Science by default). Later, it was combined with the data from Web of Science. The compiled file was imported into the CitNetExplorer [46] that allows creating and analysing citation networks, clusters of publications and core publications. To analyse citation networks, we retrieved the reference lists from the SLR database for quantitative analysis. Only the 40 most cited publications were visualised in the network. To avoid excessive amounts of linkages between publications on the graph, the minimum number of citation links selected was two. This also excluded the intermediate publications in the paths [46] (p. 805). Then, we used the "clustering" function to identify publications that are closely connected based on their citation relations [46] (pp. 820–821). Using given parameters, the software identified three distinct clusters (blue, purple and green). Clusters are usually interpreted to represent a topic in the literature. Finally, we used the "Core Publications" function to identify those that have at least four citation relations.

To visualise data networks we used the Cytoscape open source software [47]. We created graphs that depict network layout, degree centrality, and clustering. The size of nodes represents degree centrality: the larger the node, the more times it was mentioned within the SLR database for quantitative analysis. In addition to that, the thickness of edges represents the number of times the two connected nodes were mentioned together, indicating their relevance to each other. By default, the networks were distributed from the largest to the smallest on the graph. We used this tool to analyse two sets of data—keyword co-occurrence and co-authors co-occurrence—in two stages: first, to illustrate the full network, and second, to narrow it down for further analysis. In case of keywords, we filtered out those combinations that occur only once in the network. The bigger the size of a node, the more frequently the keyword is used. The thickness of the links between the nodes represents a number of times pairs of keywords occur (the thicker the line, the more often the pair of words is used). With respect to co-authors, we focused on the seven largest networks. The same idea applies there: the larger the node the more publications the author has (within this SLR database for quantitative analysis); the thicker the line is between two authors (thickness of the line represents the number of publications they have together), the more often they collaborated within the timespan of the SLR, the more research interests they thereby likely have in common.

Finally, we used a 'word cloud' to illustrate keywords occurrence [48] using WordClouds open source software (see: https://www.wordclouds.com/). The font size of the words represents the frequency of occurrence of the keyword in the literature selected for the SLR.

3. Results and Interpreting Analysis

3.1. Overview of the Gradual Refinement of Identified Publications

A flow chart adapted from the so-called Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [49] was used to illustrate the process of creation of SLR databases for quantitative and qualitative analyses (Figure 4).

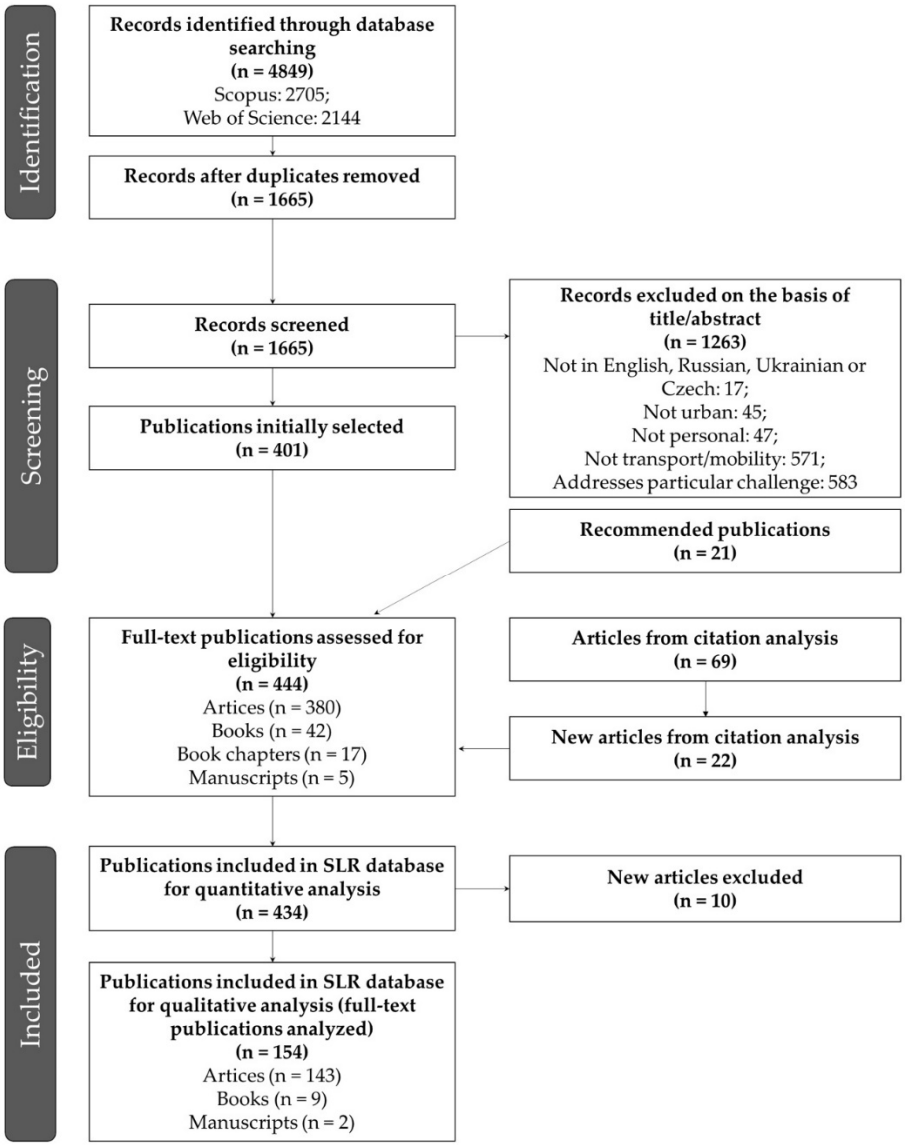

Figure 4. Adapted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow chart based on Moher et al. [50].

In total, 444 publications (380 articles, 42 books, 17 book chapters and 5 manuscripts) were assessed for eligibility. Ten of the articles were excluded due to their narrow focus and the remaining 434 publications were analysed using bibliometric methods. The SLR database for quantitative analysis was created based on the relevance of the literature to the Research Questions, partly identified by the authors and experts, and partly through the citation analysis. Within that database, the SLR database for qualitative analysis was determined. It consists of 154 publications: 143 articles, 9 books and 2 manuscripts dated from 1993 to April 2018.

3.2. Identification of Prominent Research Themes

3.2.1. Citation and Co-Citation Analyses

For this analysis, the SLR database for quantitative analysis was used, which consists of 434 publications (see Sections 2.2.1, 2.2.2 and 2.3). Of those, ten publications were recommended by the experts and not available in the Scopus and Web of Science databases. In total, 424 publications were analysed.

As described in Section 2.3, the 40 most cited publications within the SLR [46] (p. 807) are illustrated in Figure 5 where each bubble represents a publication that is identified by the primary author's last name(s).

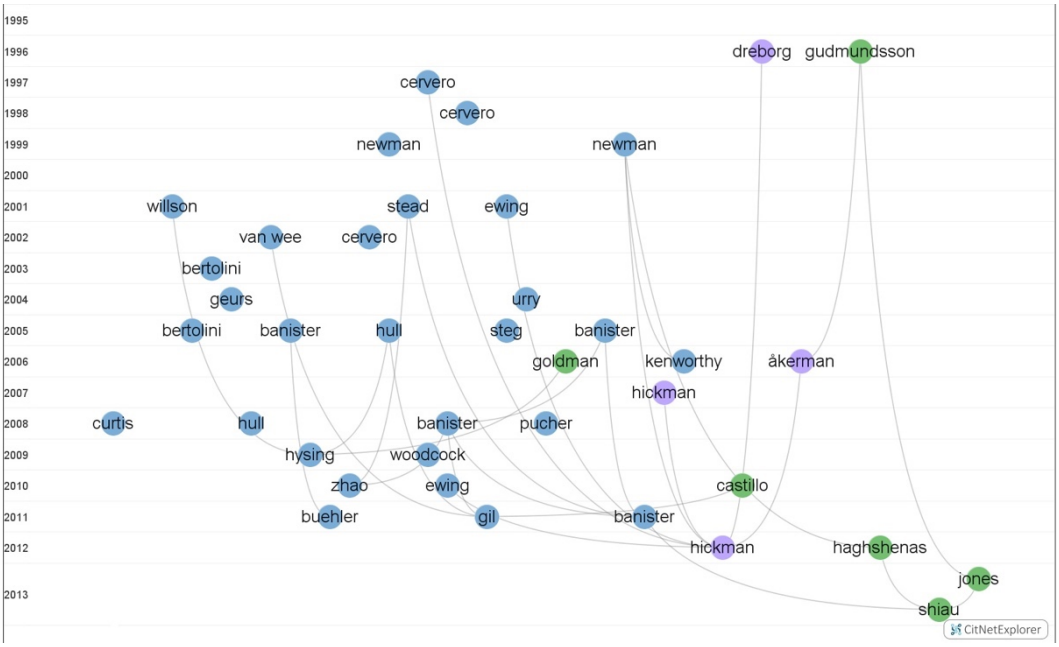

Figure 5. Citation nets. Three clusters of the literature: green represents the *indicators* cluster; purple represents the *backcasting and scenario analysis* cluster; blue represents the *planning and policy for sustainable mobility and accessibility* cluster.

This figure shows citation interrelations (connecting lines) between the selected publications: for example, Åkerman [51] and Jones [52] both cited Gudmundsson [53]. Colours represent different clusters in the selected literature. Three clusters were identified by the software (see Section 2.3). Based on our interpretation these clusters got the following names: *indicators* (green cluster), *backcasting and scenario analysis* (purple cluster), and *planning and policy for sustainable mobility and accessibility* (blue cluster). The clusters are not illustrated as separate entities as they are interlinked through some publications cited by several researchers from different clusters. Moreover, their distribution reflects the proximity of themes. For example, Kenworthy [27] and Hickman [54] from the blue and purple clusters respectively, share some citations, which places them close to each other, while Curtis [55] is depicted outside the network, which means that her work differs from the others in this graph.

A closer look showed that planning and policy for sustainable personal mobility and accessibility should be seen as two separate clusters. They correspond to two distinct fields and two groups of people that deal with their own respective questions—planners and policymakers. That is why we suggest that the blue cluster, identified by the software, should be split up into two—*cluster A* and *cluster B*. The publication by Curtis [55] in this graph is an illustration of the need to distinguish between these two themes as it is located distantly from the other publications.

Details of what publications in each cluster were analysed are described in Section 3.3. More publications for each cluster we retrieved through the "Drill Down" function of the software. They were not displayed in Figure 5 due to the limitation of the 40 most cited publications.

3.2.2. Occurrence and Co-Occurrence of Keywords

In total, 775 different keywords were analysed, most of which related to planning for mobility (transport) in urban contexts. The results of the keywords occurrence analysis are presented in a word cloud (Figure 6). A word cloud depicts the frequency of terms related to planning for transitions towards sustainable personal mobility, creating a ranking list. The top five terms identified here were "sustainability" (51 occurrences), "sustainable transport" (42), "transport" (31), "sustainable development" (26) and "sustainable mobility" (24) which is in line with the keywords search.

Figure 6. Keyword occurrence related to planning for transitions towards sustainable personal mobility.

For keywords co-occurrence analysis, we removed these five terms that were the keywords of the primary search and illustrated a network of remaining keywords that occurred at least three times (Figure 7). Those terms show up as nodes and the bigger the node is the more times it was used in the publications (see Section 2.3). They represent research themes in this SLR. The biggest nodes in this network are "public transport" (22 occurrences), "travel behaviour" (13), "transport policy" (12), "accessibility" and "governance" (11 each). The term "transition" occurred three times, which means that publications on mobility transitions are represented to a minor extent in this SLR and planning for transitions is not represented. However, transition is often part of the larger discussion, for example "energy transition" or "socio-technical transition". Although, these words are also not commonly used in this SLR as the analysis shows. Moreover, sometimes the studies are about transition towards sustainability but do not use transition theory and are not associated with the field. That is why we analyse fields of mobility and urban planning alongside the field of transition studies.

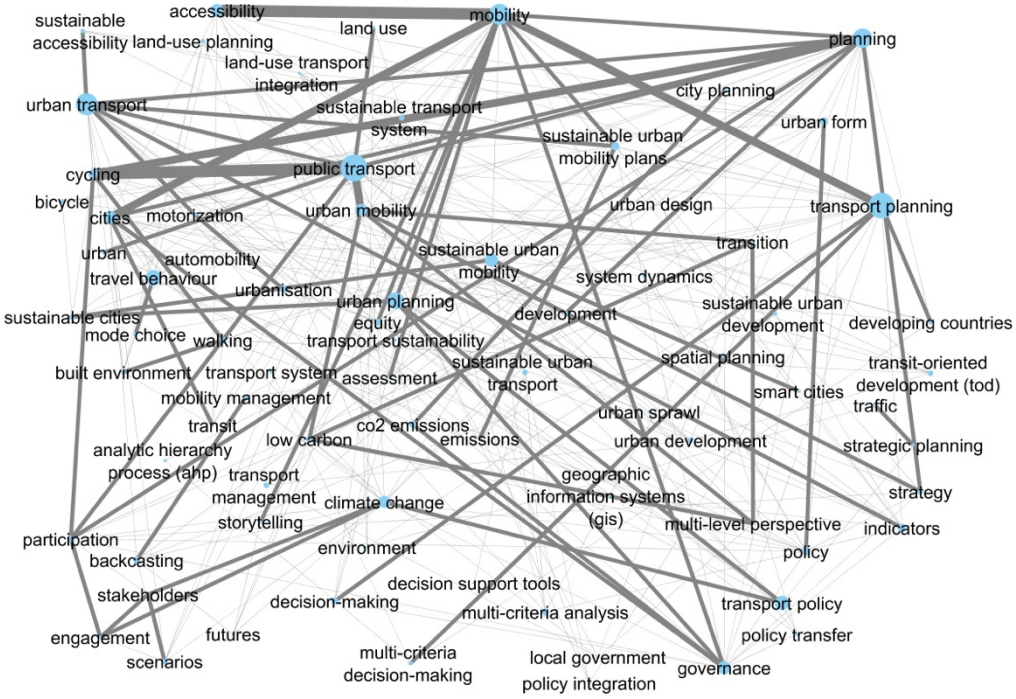

Figure 7. Keyword network. Keywords co-occurrence related to planning for transitions towards sustainable personal mobility.

The connections among the research themes identified through keywords co-occurrence are also shown in Figure 7 (for detailed method explanation see Sections 2.2.4 and 2.3). As citation nets (Figure 5) suggest, some articles were assigned to the respective categories but had weak links with the other publications in the SLR selection. The same is seen in the keywords' co-occurrence analysis: there is a large interconnected network of keywords, as well as several small groups of keywords that occur together in individual articles. They were filtered out to better represent the network as they were mentioned less than three times. The thickness of the connecting lines between the keywords reveals the keywords that are commonly used together. For example, the most common combinations of keywords are: "accessibility"-"mobility", "cycling"-"public transport" and "mobility"-"cities". This seems to represent the discussion between two discourses—accessibility and mobility. In some publications of this SLR it was suggested that cycling should be included in the public transport system (see Section 3.3.4). Finally, mobility in cities corresponds to the main theme of this SLR. Among those pairs of keywords that got removed in filtering were "public transport"-"sustainable transport", "developing countries"-"sustainability", "sustainability"-"transport policy", "public transport"-"sustainable mobility", "governance"-"transport", "mobility"-"sustainable development", and "sustainable development"-"transport". They mainly show the importance of sustainability in mobility planning in different contexts and that governance plays a key role in the process.

This analysis shows that, in addition to our four main clusters (indicators, backcasting and scenario analysis, planning for sustainable personal mobility and accessibility and policy for sustainable personal mobility and accessibility), one can identify a cluster of modes of transport and another one for mobility planning in the global South. In the literature the term 'developing countries' appears frequently but we prefer the term global South.

3.3. Description of Prominent Research Themes

This section is focusing on identification and description of prominent research themes. Four of them (Sections 3.3.2–3.3.5) were identified through quantitative analysis (Section 3.2), the other eight themes (Sections 3.3.6.1 to 3.3.6.8) were identified through qualitative analysis. Moreover, in

Section 3.3.1 we analysed theoretical and conceptual frameworks used in the literature to get a better understanding of research directions.

3.3.1. Theoretical and Conceptual Frameworks

Theoretical and conceptual frameworks help us understand the world and ourselves (ontology). We all use them, explicitly, such as is often done in the social sciences or implicitly as often occurs in the natural sciences [56]. Being aware of one's own frameworks is especially important in qualitative inquiries as it provides direction of research goals and outcomes, creates the scope for studies and creates a basis for evaluation of research-related criteria [56]. To evaluate what theoretical and conceptual frameworks that are used in the existing literature, we included this aspect into our analysis.

Based on the SLR database for qualitative analysis, we have identified that 43% of all sources explicitly use theoretical frameworks. All 121 theoretical frameworks determined were categorised in 17 groups. From Table 1 one can see the diversity of fields and disciplines the theoretical frameworks come from. The largest category is planning theories (12% frequency of use), followed by economic theories (11%) and behavioural theories (9%).

There is no one planning theory that is adopted by everyone, instead there are many different versions of planning theories, which also develop over time. However, as mentioned by Tennoy et al. [57], the works most referred to are those by Friedmann [58], Healey [59], Flyvbjerg [60], Hull [61,62], and Stead and Meijers [63] in Tennoy et al. [57]. The difference in the theories comes with an evolving view on possibilities in planning and governance, questions related to democracy, and perceived challenges at the time. That is why it was difficult to distinguish one particular theoretical framework to present here.

The two most utilised theoretical frameworks in this SLR were (socio-technical) transition theory from the theories of change category, and utility theory from the economic theories' category.

Transition theory, sometimes referred to as socio-technical transition theory or multi-level transition theory was developed by Geels [64]. The purpose of it is to facilitate radical change using multi-level perspective in the transitions of the present time, to analyse those transitions that happened in the past, and to assist in the identification and formulation of the pathways to move forward.

The utility theory belongs to the category of economic theories. It deals with choices of individuals by ranking the available options [65]. In transport planning, it is often used in relation to modes choice.

Mobility planning in urban contexts is a complex task and requires a combination of theoretical approaches. Table 1 shows the diversity of theoretical and conceptual frameworks utilised in the publications of the SLR. Several patterns can be observed as researchers utilise theories on planning economy, behaviour, and change. These patterns correspond to the gaps often mentioned in the literature; that we need a change that would not lead our economy to collapse, that planning should be focused on people and their needs, and, finally, that people themselves need to change their habits.

Theoretical and conceptual frameworks outline the direction of the prominent research themes determined in Section 3.2. It is important to understand the fields selected for this analysis and their overlaps to answer present and future overarching questions.

Table 1. Theoretical frameworks used in the publications.

Category	No. of Theories	% of Occurrence	Theoretical Frameworks	Publications
Social Theories	7	7%	General sociological theory, assemblage theory, social innovation theory, social practice theory, theories of structuration, grounded theory, Southern theory	[9,12,66–71]
Learning Theories	2	2%	Learning theory, social learning theory	[72,73]
Complexity and Organisation Theories	2	3%	Complexity theory, organisational theory	[12,61,74,75]
Systems Theories	9	5%	Socio-technical system theory, complex systems theory, ecological systems theory, social system's theory, systems theory, systems theory, network theory, actor-network theory, social network theory	[12–14,76–78]
Theories of Change	10	8%	Theory of change, evolutionary theory, theory of scientific revolutions, critical theories of transformation, theory of socio-ecological transformability, transformative social innovation theory, theories of transformation of cities, transition theory, multi-level transition theory, theories of socio-technical transition	[12,14,66,68,77,79–83]
Development Theories	4	5%	Development theory, theories of sustainable development, Western development theories, resilience theory	[9,12,14,84–86]
Urban Theories	10	7%	Social theory on urban development, urban development theories, urban theory, contemporary urban theory, critical urban theory, Western urban theory, theories of urban governance, urban fabric theory, sustainable cities theory, theories of cities	[3,4,12,24,73,76,87–89]
Spatial Development Theories	5	6%	Theories of spatial development, central place theory, location theory, space syntax theory, spatial configuration theory	[13,76,81,85,88,90,91]
Planning Theories	10	12%	Transport planning theory, modernist urban planning theories, theory of backcasting, theory of ecosocialisation, C.A. Doxiadis Ekistics theory, urban planning theories, classic planning theory, collaborative planning theory, rational planning theory, planning theory	[6,9,12,57,68,74,75,92–99]
Policy and Governance Theories	6	4%	The theory of environmental policy, policy mobilities theory, policy transfer theory, theories on policy change, theories on the state and its policy instruments, evolutionary governance theory	[70,78,100–102]
Political Theories	1	1%	Theories from political science	[62]
Institutional Theories	6	6%	Institutional theory, theories of empowerment, social justice theory, justice theory, theory of the just city, feminist theory	[7,9,13,78,101,103,104]
Community-Oriented Theories	3	2%	Participation theories, community-based operations theory, theory of community	[73,105]
Psychological Theories	11	7%	Psychological theories, conventional choice theory, consumer choice theory, multi-attribute utility theory, rational decision theory, material possession theory, sociocognitive theory, gender theory, escape theory, flow theory, prospect theory	[13,14,30,68,74,96,106–108]

Table 1. *Cont.*

Category	No. of Theories	% of Occurrence	Theoretical Frameworks	Publications
Behavioural Theories	10	9%	Travel behaviour theory, theory of planned behaviour, behaviour theories, theories of communicative action, covering-law theory, discourse theories, theories of discursive constructions, meta-theory of critical realism, value-belief-norm theory, cognitive dissonance theory	[57,66,69,76,79,81,88,94,96, 101,109]
Economic Theories	17	11%	Neoclassical economic theory, economic location theories, theories of path dependencies, economic theory, Piketty's theory, exogenous theories, theories of political economy, decoupling theory, theories of competitive advantage, theory of externalities, utility theory, utility-based theories, bid-rent theory, financial restraint theory, path dependence theory, modern management theory, public choice theory	[4,12,57,65,68,76,81,88,94, 95,110–112]
Data Science Theories	8	6%	Control theory, game theory, Dempster-Shafer theory, fuzzy theory, analytic hierarchy process theory, rough sets theory, theory for measuring urban material and energy flows, graph theory	[12–14,108,113–115]

3.3.2. Indicators

As was illustrated in citation networks (Figure 5), there are six publications in the green cluster; however, the "Drill Down" function of the software helped us identify 14 more publications that belong to this cluster. The main characteristic of this cluster is the focus on methodology development to utilise indicators according to their diverse purposes.

The earliest publication in this cluster focused on four innovative directions for urban transport [25], derived from sustainable development principles: limitation of human throughput, efficient technological progress, extraction of renewable resources without exhausting them, extraction of non-renewables at the rate of substitution by renewables [53]. These articles further influenced the SLR selection of publications as they were cited in the later publications.

Several methodologies were designed to assess sustainability in urban transport [114,116–119] and perform ecological footprint assessment [120]. Another example of indicators used for evaluation of sustainability was developed by Bulkaen et al. [121], where they combined multi-criteria analysis (MCA) and multi-actor MCA (MAMCA) to involve stakeholders into the assessment process. To have a holistic approach to transport planning and assessment of sustainability, a systems approach was proposed by Ngossaha et al. [102].

Evaluation was identified as another purpose for indicator use. Indicators can be used to perform comparative studies of transport in urban context through analysing transport systems [122]. Projects for transport planning can be evaluated focusing on different contexts, such as countries of global South, where a corresponding set of indicators should be utilised [52]. Strategies for sustainable mobility can also be analysed using indicators [113,123].

In case of monitoring and evaluating cities, three generations of indicators can be identified [12,124]: classical economic indicators (first generation), end use indicators based on understanding of development (second generation), and holistic and comprehensive indicators (third generation). However, most of the indicators, even of the third generation lack "geo-localized" and people-centred approaches, as well as fail to account for urban dynamics [12,85,86,124].

Articles in this cluster are mainly focused on the development and application of methods for the selection and application of indicators for planning for sustainable mobility.

3.3.3. Backcasting and Scenario Analysis

Another relatively small cluster of publications is devoted to studies of a backcasting approach and scenario-making as tools for sustainable mobility planning. There was no intention to go into detail with different types of backcasting, however some main points related to the approach are outlined below.

The main influence in this cluster was provided by the backcasting approach [66]. Dreborg [66], who focuses on the envisioned future and possible pathways of getting there (the "debate and decide" process [27] (p. 81)) contrasting to extrapolating trends into the future as it is done in forecasting (the "predict and provide" process). Involvement of the general public and a diverse group of stakeholders would raise awareness and build up commitment to the cause. Moreover, the focus in the temporal dimension of planning would change from short-termism to long-termism by creating vision and goals. A general trend in the approach is that it should have a place for "strategic conversation" [125,126], in other words to be participatory, inviting stakeholders to a dialogue. Backcasting can also be part of a co-production approach (having an input from researchers and practitioners) through a dynamic process [127,128].

Using a backcasting approach and scenario development allows seeing the situation from a new perspective, coming to non-conventional conclusions and posing new questions. For example, using this approach in the UK, transport planning led to the creation of two scenarios of possible future and policy packages for meeting a 2030 target [54]. Additional behavioural and technological changes would be necessary to implement these policy packages [129]. "What-who" interaction helped to create scenarios, relating actions to responsible stakeholders and in that way identifying power relations [79].

One of the interesting conclusions for urban planning in Sweden was that leisure travel can be increased by 30 % without stepping outside of the sustainable pathway by having multinuclear urban planning combined with implementation of IT solutions instead of structurally enforcing travelling (for example, commuting or shopping) [51]. Finally, new questions were asked [130]: "what is the direction of the policy development over a long period of time? Where can new funding sources be found and how can funding power be devolved? How can land acquisition and its value uplift be monitored and regulated?"

A backcasting analysis through utopian thinking proved to have provided additional value in planning processes as it helps to define the ideal future [92,99].

A generic community planning process model developed by Robèrt and colleagues [26] is based on another type of backcasting; backcasting from boundary conditions for sustainability. This approach supports transitions in a pragmatic, systematic, and strategic way.

The book linking the three clusters, backcasting and scenario analysis (purple) and planning and policy for sustainable mobility and accessibility (blue clusters A and B), was authored by Hickman and Banister [68]. The book covered a range of topics, from scenario development and participatory backcasting, to emerging approaches in mobility planning and transitions towards sustainable mobility with several examples in different contexts. They also brought up the concept of time and the lack thereof to make effective change. It was also the first time when these authors talked about planning for transitions.

3.3.4. Planning for Sustainable Mobility and Accessibility

This is the largest cluster within this SLR that corresponds to the main theme—planning for sustainable mobility in an urban context. Several themes appear here in this group: urban form, modes of transport and multimodality, planning for accessibility, as well as local context.

Urban form discourse was broadly researched by Cervero and his colleagues. To achieve traditional urban planning with its transit-oriented development, Cervero and Kockelman [65] argued that the following three dimensions (3Ds) need to be taken into account: density, diversity and design. High density, land-use diversity alongside pedestrian-oriented design are favourable for non-motorized travel. In the following study in 2002, Cervero [107] developed a normative framework, where he included generalized cost and travellers' socio-economic attributes to the core 3D dimensions. Parallel to Cervero, Stead [131] analysed the relationship between land-use, socio-economic factors and travel patterns in the UK, and came to the same conclusion that socio-economic factors play a major role in travel patterns, even larger than land-use characteristics. In 2010, 13 years after the original paper, the number of D dimensions increased to seven, by adding destination accessibility, distance to transit, demand management and demographics [132], highlighting the importance of the local context.

In 2006, Kenworthy presented a framework for decision-making that to a large extent combined the 3D dimensions, critical responses that were later presented as principles of the sustainable mobility paradigm [30] and a vision-oriented approach (similar to backcasting). Kenworthy's framework consisted of ten critical eco-city dimensions that, in addition to the above-mentioned parameters, included the protection of natural urban areas and food-production capacity. Moreover, the sustainability definition in this framework had a fourth, cultural, dimension, contrary to the common triple bottom line definition (that describes sustainability with three pillars: economic, social and ecological) [133].

Multimodality as part of sustainable solutions was presented by Bertolini and le Clercq [134], who also talked about a supply-demand relationship that could be maintained through land-use patterns. The way of integrating public transport and sustainability can be illustrated as a ladder [61], where barriers can be found on each step. This proved to be the case in the UK. Cycling is often seen as part of such an integrated transport system. Examples described here show the importance of integration of cycling into the transport system, supported by suitable policies, as well as raising awareness and education among the traffic participants [135,136]. Another side of integration relates

to transport planning and land-use. Many researchers approach it through the concept of accessibility, "what and how can be reached from a given point in space" [137] (p. 207), [9,19,55].

The sustainable mobility paradigm presented by Banister in 2008 [30] brought another perspective to mobility planning: two principles of conventional planning; namely, derived demand and travel cost minimization. These were suggested to be reconsidered based on the sustainability perspective. Moreover, reasonable travel time was recommended to replace travel time minimization. Banister brought ideas of decreasing the need to travel as well as transport and land-use policy measures and technological innovation that would facilitate a change in planning towards more sustainable mobility. On the social sustainability side, the issues of public awareness and acceptability, health, as well as stakeholder involvement were discussed. Finally, four principles of the sustainable mobility paradigm were identified: "making the best use of technology; regulation and pricing; land-use development; clearly targeted personal information" [30] (pp. 78–79). In the following study, Banister [138] developed the concept of sustainable urban mobility further, accentuating the urgency of change, and posing a question regarding leadership and commitment on the way to achieving a paradigm shift. Moreover, he brought up a rebound effect: when increased individual welfare might lead to increase in kilometres travelled. The interrelation between travel distance, speed and time was discussed the same year [106]. The author argued that the conventional paradigm of minimizing the travel time, thus increasing the speed, is unsustainable, therefore the changes in land-use planning should be applied by reducing the need to travel.

A small number of articles focused on the contextualisation of the planning. Zhao [139], using the example of Beijing, described how urban sprawl occurred and its consequences for mobility. He suggested that increased local autonomy can lead to unsustainable solutions. In a very different context, on small islands, stakeholder participation proved to be useful for the planning process [140].

The transport system is complex and cannot be seen in isolation from infrastructure, energy systems, built environment, and the people who are using it. A number of studies suggest methodologies for integration of transport with the built environment, land-use and energy [91,112,141–144]. However, there is no single methodology that is accepted by everyone. There is an expressed need for a systemic transdisciplinary approach that would include stakeholders with different backgrounds coming both from academia and practice [26,69,91,105,110,145]. In our interpretation, a transdisciplinary approach means interactive knowledge production that is happening in the context of application and provides socially robust knowledge. This stands in contrast to the North American approach, where a "boundary organisation" is seen as a mediator between politics and science [146]. Using our terminology, the North American approach would be considered as 'interdisciplinary'. The literature suggests that in the future, mobility planning should be people-oriented and place-based, and an institutionalisation of practice could be helpful in the process [147,148] that is subject to evaluation [93]. The combination of urban fabric theory and economic assessments is argued to make the acceleration in urban planning possible [4]. However, behavioural change and policy development would still remain a challenge and require additional measures.

The previously mentioned term "accessibility" was often defined as the ability to access places, spaces, labour market, knowledge and experiences. However, a broader definition complements with the allowance of social equity and the use of power and justice systems to achieve it [9,19]. It gives a space to address social challenges through the concept of accessibility.

Several studies of this SLR were devoted to the development of tools to assess accessibility, give planning an alternative view on mobility, and enable comparative analysis based on accessibility [76,95,149]. In all, they enrich the toolkit for work with accessibility.

3.3.5. Policy for Sustainable Mobility and Accessibility

This cluster is the smallest in this SLR and its main focus is directed towards governance and policy making. Co-citation analysis suggests several publications to be the most cited within this selection.

At the same time as Banister published his sustainable mobility paradigm article, Hull [62] published her work on sustainable mobility from the governance perspective. She argued that achieving sustainable mobility requires an agreement on definitions and direction of development among all public sectors that should be involved in the process, followed by equality in decision-making, incentives for the general public to use sustainable mobility modes of transport, and legal and financial support for joint projects among the sectors and authorities.

Policy change was another widely discussed topic. One example is from Örebro, Sweden, described by Hysing [101]. There, three important factors for change were identified: new policy ideas, reorganisation of local administration and entrepreneurs that created a pressure. However, what actually made the change possible was politicians. Another positive example of policy change towards sustainable transport in Freiburg, Germany was described by Buehler and Pucher [150] using the historical view perspective. There, a principle of carrots and sticks was a success factor: car-restrictive measures were put in place while incentivising cycling, walking and public transport.

Literature within this SLR underlines the importance of challenging current prevailing policies and the way they are designed [7,151]. A case in Canada shows that policies are often developed and implemented in a non-integrated way, which challenges their effectiveness [70]. Policy can be seen as an instrument to assist change, which would also affect politics at the local and global levels [13,14].

Based on the evidence of sustainable accessibility studies [137], Bertolini et al. argued that policy measures in the Netherlands should be revised. They suggested getting away from the sharp limits of 30 minutes to reach the destination and to replace it with gravity-based accessibility measures: "considering, instead of the sharp limits of a contour (e.g., more or less than 30 min), a more gradual decrease in travel time or cost utility" (p. 219). Bertolini et al. recommend assessing travel costs instead of the travel time. They also distinguished two types of competition among spatial opportunities: at origins (probability of other destinations to be chosen) and at destinations (related to the number of travellers going to competing destinations).

Urban governance is complex and comprises institutions, socio-technical elements, and networks [89]. There are at least three ways of understanding such a system: vertical (laws, regulations), horizontal (informal flows of knowledge), and infrastructural (related to the built environment and infrastructure) perspectives.

A systems approach in planning [25], as suggested by Goldman and Gorham, helps to see sustainability as a policy end-point, instead of sustainability as a pathway. A similar approach was observed in studies by Kenworthy [27], who suggested to consider sustainability as a vision, as suggested above. Moreover, the authors identified and described four areas of innovation: the "New Mobility" (dealing with "how individuals plan their daily activities"), the "City Logistics" (addressing "the business of goods movement"), the "Intelligent System Management" (infrastructure—public institutions relationship), and the "Livability" (society—transport systems interactions) [25]. Each of these areas can be described through complex systems that require development of new policies and innovation.

3.3.6. Other Identified Themes

In addition to qualitative analysis of bibliometric studies, this section aims to address the concepts included into the SLR database for qualitative analysis that might have been missed above. To follow up on the themes identified in Section 3.2.2 (Figures 6 and 7), the *modes of transport* and *global South mobility planning* themes will be described below. Moreover, there are some other identified themes that are presented in the literature to a minor extent: *temporal dimensions in mobility planning*, *global vs local context*, *decision-making in mobility planning*, *equity, justice and equality in mobility planning*, and *the role of institutions in planning and co-production of knowledge*.

The need for behavioural change was expressed throughout most of the studies in this SLR. Planners and decision makers cannot achieve a transition towards sustainable mobility without involving the end users into the process [13,152]. An aging population (or demographic transition)

starts becoming a concern in many places across the world too when advancement in medicine and longer life creates new challenges for mobility planning [12–14].

3.3.6.1. Modes of Transport

The transport modes discourse often focuses on the land-based means of transport, specifically on the discussion of public transport replacing private cars. Electrification is argued to be the future, however, only replacing fuel-based vehicles with electric ones does not lead to fully sustainable solutions [2,4,115,153] as it will not improve some sustainability related problems like lack of urban space and traffic jam-induced stress.

Coverage of different modes of transport was another widely discussed topic. Several studies argued for some specific means of transport [4,154,155], while others argued for integrated multimodal transport systems that include private vehicles, public transport, shared services and mobility on demand [71,77,156–158].

The passenger perspective was addressed through studying mode choice between public transport and private cars [94,96,109,159]. It has been identified that location, socio-demographic parameters, psychological and cultural traits, as well as space allocation for modes of transport, are the major factors affecting the mode choice.

3.3.6.2. Global North and Global South Mobility Planning

A majority of the literature in this SLR studied and analysed cases in the global North. Relatively few studies focused on the global South have been captured through the selections done in this SLR. This can be explained by the selection of journals in Scopus and Web of Science databases as they do not include journals edited in the global South. This paper therefore does not claim to provide a full picture of the studies, but rather to touch upon several issues identified within the scope of this SLR.

When talking about the global South, local context plays a crucial role in the planning for mobility as the solutions might be very different from those in the global North. Lahore's example (Pakistan) claims that insufficient institutional capacity led to a change from a more sustainable to a less sustainable transport system that even less meets the needs of the citizens [160]. International investments can change power relations and affect the planning process by changing the direction of development of a target country [67,160]. For example, in this way technical solutions can be enforced in a way that was not initially planned by the local government.

Several criteria/indicators were developed to support planning for sustainable mobility in the global South that were different from those for the global North [84,85]. Finally, based on the experience from Singapore, policies that enabled sustainable development in fast developing cities were outlined [161].

3.3.6.3. Temporal Dimensions in Mobility Planning

The concept of time was often discussed within this SLR in different contexts. Four different ways of talking about time were identified: in terms of travel time, in terms of planning goals and strategies, in terms of short- or long-term thinking, and, finally, in terms of urgency for change.

Many studies were devoted to travel time and time budgets (how much time can be spent on traveling on average) [67,84,90,162]. First, mobility planning was aimed to have faster and more efficient transport systems, however, with the introduction of sustainability into the mobility discourse [30], the dialogue shifted towards slow and safe mobility [106], with additional benefits of health and other activities that can be done while traveling. In a broader picture, the discussion shifted towards slow and fast lifestyles [129].

Another perspective on time was brought up within the planning process. Trends, targets, and strategies are tied to the time plan. They affect the pace of adaptation in the planning process, technology and policy innovation. In turn, this translates into the human factor: how much time decision-making and bureaucratic processes take [13,79,87,163,164].

In the literature, short- and long-term planning are naturally combined in backcasting and other processes that start with visioning. A detailed description of the body of literature devoted to backcasting and scenario analysis is provided below (see Section 3.3.3).

The indirect reference to time can be identified in discussions around urgency for change. The Brundtland Report [165] gave the first push for discussions around the need for different planning practices [30,54,68,100,106,135]. Increasing emissions, alongside other factors, added concrete reasons for change [123,138,166], and the more recent Paris Agreement's 1,5-2 degree target created additional pressure for change. Rapid urbanisation concepts, in turn, included new stakeholders in the discussion [101,125,139,140,167–169]. Finally, the need for transition towards sustainable mobility was underlined [26,80].

3.3.6.4. Global VS Local Context

We are part of the global societal system and our local context identifies our challenges and possibilities, giving advantages and disadvantages for implementation of a rapid change. Globalisation comes with shared technologies and knowledge; however, it brings along goals (e.g., the SDGs), agendas (e.g., the New Urban Agenda) and recommended plans (e.g., Sustainable Urban Mobility Plans [170]). While this can be seen as a push towards sustainable development at the global level, one of the important challenges lies in the translation of it down to the local level.

It is widely known that there is likely no solution for everything and that just transferring knowledge and solutions between countries and contexts is not likely going to be enough. Many studies concluded that there is no universally suitable mechanism for the integration of goals at different levels and translation of them into everyday tasks [6,12]. At the local level, the process is often constrained by barriers of rebound effects, conflicting visions at different levels, lack of consensus among stakeholders, path dependencies (when decisions made in the past could affect solutions in the future), diverse needs of passengers, and institutionalisation of policies [74,87,171,172]. For example, in China rapid urbanisation brought increased private transport, relocation of residents and inadequate service provision [88,173]. Even within the same geographic and political context, there could be difference in mobility patterns (mobility cultures) [171]. Thus, local context creates a core for planning processes [6,9,12,74,87,88,141,156,171–175].

3.3.6.5. Decision-Making in Mobility Planning

Emberger and colleagues [176] identified three approaches to decision-making in Europe (vision-led, plan-led and consensus-led) and five levels of public participation (provision of information, consultation, making decisions together, acting together, and supporting independent stakeholder groups). Later, taking a plan-led approach as a base, the researchers developed a process for decision-making. Finally, they tested the transferability of this approach in the context of South East Asia, where four elements were identified as transferable (objectives, policy instruments, barriers and strategies) while others had to be changed.

The other literature in this SLR has described several methods for decision-making processes for mobility planning [72,177,178].

3.3.6.6. Equity, Justice, and Equality in Mobility Planning

Questions of urban equity (rights, opportunities, accessibility and affordability [8,9]), justice (electoral, procedural, distributional justice as well as enforcement [8,9]), and gender are often framed as part of social sustainability [14]. In the context of the global South, justice and gender equality are often neglected in planning processes [10,67,74,83,179].

As mentioned before, social justice and equity are emerging concepts in social sustainability of cities [7,11,12]. They can be analysed through the concepts of accessibility [9,19], utilisation of justice theory [104], or frameworks such as the one described by Boisjoly and Yengoh [73].

3.3.6.7. The Role of Institutions in Planning

In many publications within this SLR, institutions were mentioned as important factors for achieving the change. Planning always depends on space and time, and decisions made in the past could affect solutions in the future, creating path dependencies. Institutional change is necessary for stepping out of the path dependency [12,78,94,160]. Five groups of institutional barriers can be identified: financial, cultural, legislative, political, and technical [13] and a systemic approach is required to overcome them.

3.3.6.8. Co-Production of Knowledge in Planning

The final theme of research in this SLR is about co-production of knowledge in planning processes. Lack of knowledge on co-production among transdisciplinary researchers and practitioners has been emphasised throughout this SLR [9,12,75,145,180]. The studies from the global South underline the importance of co-production between different thought collectives, attention to the existing social organisation in the local context, and the diversity of stakeholders to be involved in the planning process to enable learning, experimentation and creation of adaptive transport systems [181].

3.3.7. Major Bodies of Literature

We know that the number of citations in itself may not show the relative influence of a certain publication. Still, as a complement to other analyses, we think it is important to identify the most cited publications. We expected this to further help to analyse the prominent research themes identified above (see Section 3.2).

In the process of SLR as described in Section 2.1, 434 publications were selected (this refers to the SLR database for quantitative analysis, see Section 2.1.3). Firstly, to determine the publications that had been cited the most, a search for the most cited of the selected publications was conducted using the Scopus and Web of Science databases. This search was limited to publications that had been cited at least 100 times. This resulted in 16 of the publications being highlighted. Within those 16, it was found that Cervero and Kochelman [65] was the most cited with 1190 citations globally. Secondly, a search for citations within the initial 434 publications was conducted to compare results. It was found that 13 publications of the previous 16 were still among the most cited, with the article by Banister [30] being the most cited with 51 citations. The results of this process are shown in Table 2.

The articles in Table 2 were already described above (see Sections 3.3.4 and 3.3.5) suggesting coherence in the results from two types of analyses. These articles do not represent the key concepts in the field, but they are rather major bodies of literature and it is useful to be aware of them when outlining the field and making one's own judgements.

Table 2. List of the most cited publications (SLR—systematic literature review).

Author(s)	Year	Publication Title	Publisher	No. of Citations (Scopus & Web of Science)	No. of Citations (within the SLR)
Cervero, Robert, and Kara Kockelman	1997	Travel Demand and the 3Ds: Density, Diversity, and Design	*Transportation Research Part D: Transport and Environment*	1190	30
Ewing, Reid, and Robert Cervero	2010	Travel and the Built Environment: A Meta-Analysis	*Journal of the American Planning Association*	1040	22
Banister, David	2008	The Sustainable Mobility Paradigm	*Transport Policy*	562	51
Pucher, John, and Ralph Buehler	2008	Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany	*Transport Reviews*	534	13
Woodcock, James, Phil Edwards, Cathryn Tonne, Ben G Armstrong, Olu Ashiru, David Banister, Sean Beevers et al.	2009	Public Health Benefits of Strategies to Reduce Greenhouse-Gas Emissions: Urban Land Transport	*The Lancet*	452	12
Dreborg, Karl H.	1996	Essence of Backcasting	*Futures*	305	10
Cervero, Robert	2002	Built Environments and Mode Choice: Toward a Normative Framework	*Transportation Research Part D: Transport and Environment*	302	10
Kenworthy, Jeffrey R.	2006	The Eco-City: Ten Key Transport and Planning Dimensions for Sustainable City Development	*Environment and Urbanization*	165	below 5
Stead, Dominic	2001	Relationships between Land Use, Socioeconomic Factors, and Travel Patterns in Britain	*Environment and Planning B: Planning and Design*	143	14
Bertolini, Luca, Frank le Clercq, and Loek Kapoen	2005	Sustainable Accessibility: A Conceptual Framework to Integrate Transport and Land Use Plan-Making. Two Test-Applications in the Netherlands and a Reflection on the Way Forward	*Transport Policy*	132	11
Goldman, Todd, and Roger Gorham	2006	Sustainable Urban Transport: Four Innovative Directions	*Technology in Society*	125	below 5
Zhao, Pengjun	2010	Sustainable Urban Expansion and Transportation in a Growing Megacity: Consequences of Urban Sprawl for Mobility on the Urban Fringe of Beijing	*Habitat International*	121	below 5
Hickman, Robin, and David Banister	2007	Looking over the Horizon: Transport and Reduced CO_2 Emissions in the UK by 2030	*Transport Policy*	114	10
Banister, David	2011	Cities, Mobility and Climate Change	*Journal of Transport Geography*	107	5
Åkerman, Jonas, and Mattias Höjer	2006	How Much Transport Can the Climate Stand? - Sweden on a Sustainable Path in 2050	*Energy Policy*	105	8
Hull Angela	2008	Policy Integration: What Will It Take to Achieve More Sustainable Transport Solutions in Cities?	*Transport Policy*	104	15

3.3.8. Geography of Case Studies

The final type of analysis helpful to describe prominent research themes is the geographical distribution of case study locations across the world (where the case studies were conducted). The selected 434 publications have a wide geography of case study locations. This is illustrated in Figure 8, spanning 72 different countries, with the largest number of publications from China and the UK (31 publications each), followed by Sweden (23) and Spain (20). Several publications had a broad focus on Europe, global South and Asia. They were not included in Figure 8, as only studies related to individual countries are counted there. The largest number of studies has been conducted in Europe 56% (230 case studies) and Asia 23% (96 case studies). Some other publications that do not show up in Figure 8 are those that do not have a geographical focus since they are conceptual, methodological or describing various models.

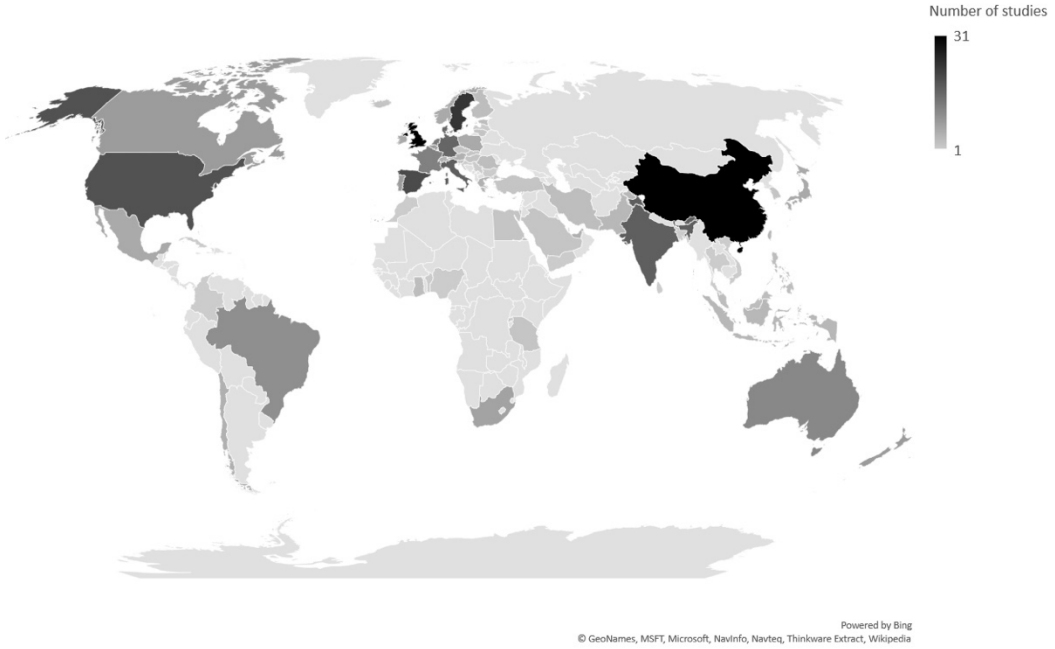

Figure 8. Number of case studies per country.

Figure 8 illustrates some limitations of the geographical scope of case studies in this SLR. This includes a low representation of studies in the global South. Several reasons for this limitation can be suggested. First of all, as suggested above, in Section 3.3.6.2, journals edited in the global South are not part of Scopus and Web of Science databases. Language could be seen as another explanation to a limited geographical scope. As was mentioned in Section 2.1.1, publications written in languages other than those that the authors' have a sufficient level of understanding of were excluded. Some of them could have had case studies of the local contexts. Finally, research finance plays a big role in where the research is done: often money is allocated for local projects to address the issues there. Establishing new partnerships, especially with places of different culture, are time and resource consuming processes with many bureaucratic barriers and often seen as too demanding for pursuing.

3.4. Different Bodies of Literature

In this SLR we had an inquiry into the three bodies of literature that were related to mobility, urban planning and transitions. Keywords occurrence and co-occurrence analyses (Figures 6 and 7) showed that mobility and urban planning are closely related. Prominent research themes of these two fields were outlined above in Section 3.3. Transition studies, though, have not yet been characterised. A brief summary of transition studies related to mobility are presented below.

Based on the qualitative analysis, we have identified that the need for transition is no longer a question [100,182]. Current research in transition studies is addressing levels at which transition should or could be happening and who should be involved [102,183,184]. The multiple level perspective (MLP) [185] describes three levels where the change can be happening: niche, socio-technical regime, and socio-technical landscape. It was identified that technical transition would not be enough to achieve a sustainable state. It should be happening at the socio-technical level, meaning that society has to change too. Politicians, institutions, and communities need to cooperate in such a radical change. New knowledge created through participatory approaches and comparative studies would benefit the planning process. As co-benefits, it would allow a shared understanding of the sustainability discourse, as well as a combination and reconfiguration of existing solutions and governance processes. From retrospective transition studies we know that the system expected to change should be ready (for example, infrastructure should be in place) and there should be acceptance from people. Urban transitions of today should be based on causal dynamics, comparability, and acknowledgement of differences, as well as they should be planned [12,80,82,87,94,100,102,183,184,186,187].

This brief summary shows that the bodies of literature in planning and transition studies discuss similar topics and face similar challenges, however it seems that collaboration between them is lacking. If a transition were to be successful, the literature suggests that it should be planned for, preferably in a co-production manner.

3.5. 'Organisation of the Field'

3.5.1. Keywords

In order to stay up to date with the research, it is useful to create alerts in the databases, such as Google Scholar. As outlined in Section 2.1.1, there are some keywords that are useful for the future search strategies (see: Figure 2. Reduction of keywords scheme.). Moreover, further analysis of keywords occurrence and co-occurrence (Figures 6 and 7) showed other useful keywords. Depending on what the next research questions would be, different combinations of keywords could be used.

3.5.2. Main Journals

Another way of monitoring the fields is through subscriptions to the journals. To identify what the main journals in the field are, we conducted the following analysis. Figure 9 shows the number of articles selected through systematic literature review per year published in the top journals (that have more than 10 publications within this SLR) from 2008 to 2018. It shows that on average there are articles relevant to this SLR in three to four out of five journals each year and the highest number of relevant articles was published in 2013. The total number of journals within the 434 selected publications is 147. The main journals identified in this study are *Transport Policy* (total, 22 articles), *Journal of Transport Geography* (total, 19 articles), *WIT Transactions on Ecology and the Environment* (total, 16 articles), *International Journal of Sustainable Transportation* (total, 14 articles), and *Transportation Research Part A: Policy and Practice* (total, 11 articles). One can see that the total yearly number of relevant articles (see the top of Figure 9) has approximately doubled from 17 in 2008 to about 45 in 2015–2017. This means that the academic community likely has evolved.

Interestingly, five of the most cited publications identified in Table 2 were published in the main journals identified in Figure 9. The other 11 articles were published elsewhere, which means the topic of planning for transitions towards sustainable personal mobility could be found in a diverse range of journals and, significantly, that there is no undisputed leading journal in the field.

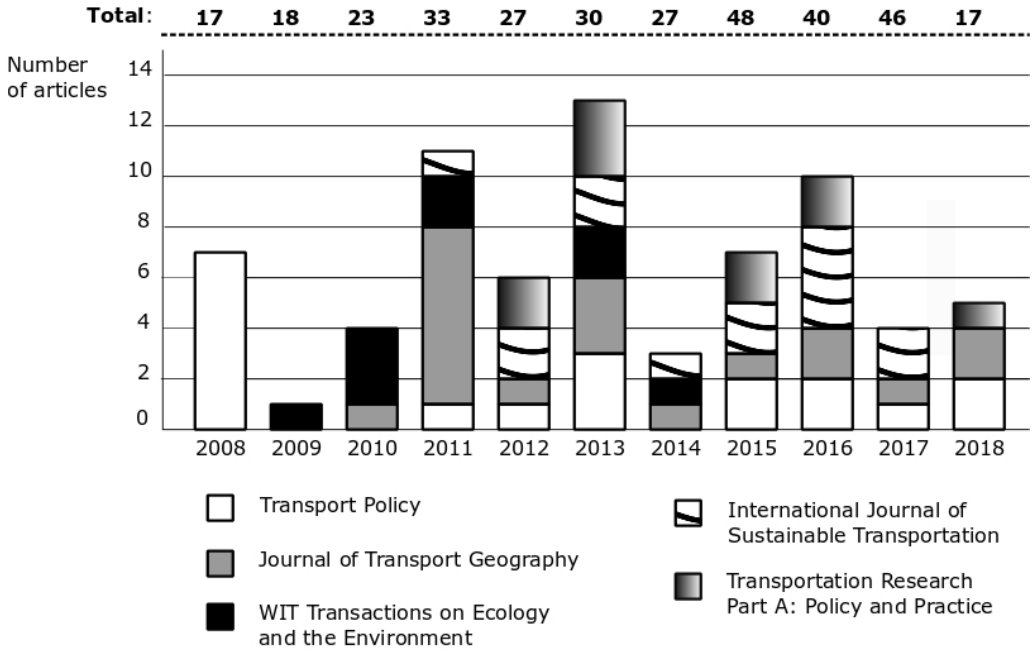

Figure 9. Number of articles about planning for transitioning towards sustainable personal mobility in total and in the top 5 relevant journals from 2008 to 2018 (WIT—Wessex Institute of Technology). Source of data Scopus and Web of Science.

3.5.3. Scientific Communities

The third way of staying up to date with research is to follow certain researchers. For this purpose, we have analysed scientific communities within this SLR. A key authors network analysis (for method description see Section 2.3) showed 215 networks in total: 90 publications were written in pairs; 51 publications were written in groups of three; 31 publications in groups of four; 12 publications in groups of five; 16 publications in groups of six; 6 publications in groups of seven; 2 publications in groups of eight and, finally, 7 publications in groups of nine or more authors. Only the largest networks are illustrated in Figure 10.

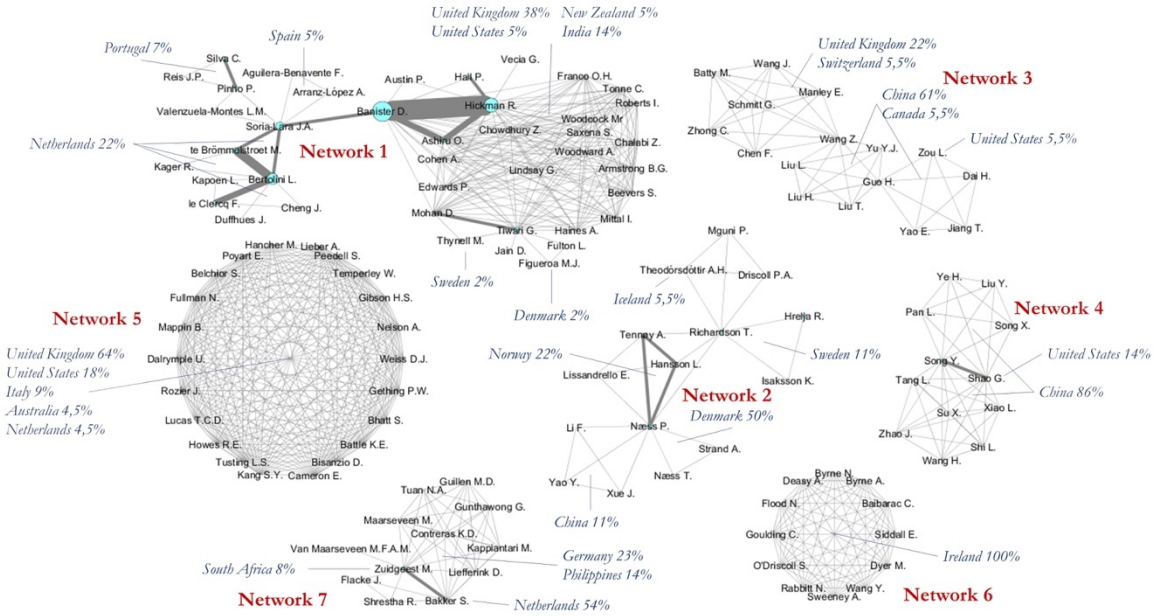

Figure 10. The largest networks of co-authorship with countries of authors' affiliations.

The three largest author nodes are David Banister (with 14 publications in this SLR selection), Robin Hickman (ten publications in this selection) and Luca Bertolini (eight publications in this selection). They belong to the same network—Network 1, the largest one (represented by 19 publications). Moreover, between 2008 and 2018, Banister and Hickman worked together tightly, and within this time published six common works. This network of authors is coming from five different countries (with the majority from the United Kingdom) and have diverse expertise: planning, geography, environmental science, social science, and transport science. All together, they create a multidiscipline thought collective that focused on topics discussed above: accessibility [188] and "mobility environments"—another way of combining land-use and mobility planning [97], planning for sustainable mobility [111], challenges of interpretation of goals into indicators [189], dialogue processes among stakeholders [190] and, related to that, integration and creation of knowledge [191]. In several articles, the researchers mention the need for behavioural change and policy implementation in order to create a modal shift away from the current dominance of private cars [192]. As for modes of transport, a combination of train and bicycle was analysed in the Dutch case [193]. Finally, researchers in this group studied the time required for decision-making in the given context [163] and developed sustainability pathways for non-OECD countries [166].

Network 2, the second largest network is based on six publications written by planning researchers from five countries and represents another thought collective. Four of the publications are about the importance of co-production of knowledge from experts and researchers to meet the goals and targets [57,81,194,195]. Two more publications in this network have a bit narrower focus. One is on radical policy change and its conflicting implications [103]. The other one is questioning the electrification of cars as a single technical fix towards sustainable mobility [153] and comes to the conclusion that it, if it would be the only focus, would not break the path-dependency of the car-based transport system, but rather take away financial and institutional resources from efforts to promote non-motorized and public transport.

Figure 10 contains two international networks (Network 3 and Network 4) that focus on quantitative analysis of urban travel in China [167,168,196–198].

Network 5 illustrates a multidisciplinary group of researchers coming from five countries working on the assessment of accessibility worldwide with the help of creation of a travel time to cities map [199]. Within this SLR these researchers have only one publication together, making it the largest network of collaborators for an individual paper. Another single article network (Network 6) was focusing on design for sustainable built environment [200].

Finally, Network 7 is international and multidisciplinary, focusing on policy for sustainable mobility in the global South [169,201].

The analysis shows the diversity of research topics and countries of affiliation. The largest network covers a broad range of topics and, as has been discussed above, has some of the most cited publications within and outside of this SLR (according to Scopus and Web of Science database analysis, see Section 3.3.7). However, most of the publications in this SLR are written by small groups of authors, often working on the local scale.

4. Concluding Discussion and Further Work

This systematic literature review has aimed to outline and map the main themes related to planning for rapid transitioning of personal mobility towards sustainability as well as their development in the past decade, analyse overlaps of different bodies of literature, and create an organised view of the field for continued information retrieval.

To sum up reflections throughout the paper, SLR as a method has its inherent limitations by not being able to identify literature outside the parameters given by the researcher. To address that, expert advice was collected (resulting in 21 additional publications) and citation analysis was performed (giving another 12 relevant publications). Although the selected articles do not cover an exhaustive list of publications in the fields of mobility, urban planning and transitions, the literature analysed here

should be seen as an initial map of these areas (up to April 2018) with observations of general trends and outlines of the main gaps in research in the respective fields and their combination.

The following paragraphs briefly answer the posed Research Questions (RQs):

- RQ1: What are some prominent research themes within context-adapted urban planning for rapid transitioning of personal mobility towards sustainability?

Four different ways of talking about the temporal dimension in mobility planning have been identified. This includes travel time, planning goals and strategies, short- or long-term thinking, and, finally, the urgency for change. However, not much literature was found that discussed how we can make change towards a sustainable state happen quickly enough to meet the goals and strategies identified on local, national and international levels, keeping in mind a long-term perspective and meeting passengers' needs to move about freely and easily.

In order to understand a large picture where rapid transitions could fit, prominent research themes were also identified. The literature that was selected in the SLR process brought up a number of themes: *planning and policy for sustainable mobility and accessibility, indicators, backcasting and scenario making, modes of transport, decision-making in planning, studies of global North and global South,* as well as overarching themes of *equity, justice, gender, the role of institutions and co-production of knowledge in planning processes*. Most of the publications were devoted to *planning*: who we are planning for, what the best solution is and what we focus on. However, not so many of them focus on the *how*: how we prioritise actions, how we make sure all the important stakeholders are included in the process, how we plan using a people-oriented, place-based approach, and how we make all of this happen fast enough to sustain present and future generations.

- RQ2: How did the identified themes evolve during the past 10 years?

The analysis also shows a shift in the planning approach as the field seems to move away from the predict-and-provide [100] to the long-term-focused visioning approach [26,92,100,127–129]. Social sustainability is underrepresented in this selection of literature, which might be indicating a minor integration of social issues in planning processes. Recent literature, though, emphasises the importance of addressing equity, justice, and equality when planning for sustainable cities. The analysis shows that there are many indicators available for different purposes. However, it was found that the main question is how to integrate them to meet all the local, regional and national requirements, as well as international agreements, such as the SDGs. Participatory approaches in planning, particularly backcasting and co-production of knowledge, are in trend, assuring a combination of academic and practical knowledge, as well as access to other types of knowledge, such as indigenous knowledge. It shows that planning is acquiring a systems approach, where needs of diverse stakeholders are addressed in relation to sustainability. So far, these approaches have not proven to bring necessary changes, but they have raised awareness among stakeholders and the general public, which is the first step to major changes.

- RQ3: What are the main related bodies of literature and to what extent do they overlap?

Planning for transitions was mentioned only once [68], and as identified above, transition and planning scholars are seemingly not collaborating with each other. In this study, it was found that this could be due to the differences in epistemic communities and perspectives taken by the scholars. We found that planners typically look forward, while transition scholars analyse the past, create pathways for transitions, and recently also started analysing the present. In all, their discussions tend to be parallel since it is not common to plan for transitions.

- RQ4: What is the "organisation of the field"?

As for "organisation of the field", in this SLR we identified that there is no undisputed leading journal. The authors' network analysis showed a clear dominance of one research group with the leading researchers David Banister, Robin Hickman and Luca Bertolini. Their research network is international and multidisciplinary and covers several topics within transport research.

To our knowledge, no SLR on the crossroad of the fields of mobility, urban planning, and transitions has been done before. The closest study that we have found that can be compared to our study was done by Wittstock and Teutenberg [202] and focused on transformations towards sustainable public transport. Their analysis can be seen as a complementing part to our analysis, as it covers one of the aspects of sustainable mobility: public transport. Our study, in contrast, has a systemic approach and analyses planning for sustainable mobility as a whole, also including, for example, walking and bicycling. Therefore, our study can likely be of value for scholars and practitioners working with questions of urban planning, sustainable mobility and to some extent, transition studies.

To conclude, the main knowledge gaps identified in the studied literature relate to the question of accelerating the transition towards sustainability. This might be an accurate reflection of a knowledge gap. It might also be related to a possible variation in terminology and approaches used to address change. Still, the many synonyms investigated and related topics investigated suggest that the gap is accurate in relation to the fields of mobility, urban planning, and transition studies.

Given the identified knowledge gaps, we have several recommendations for future studies within the overarching theme of accelerating transitions towards sustainable mobility. We see two main types of studies that could be done. One could use either a systemic perspective or do research on specific elements of mobility systems and approaches. Among the latter, more analysis is required on behavioural change, such as motivating sustainable travel habits, and what policies need to be implemented to move towards sustainability in an integrated way. Furthermore, institutionalisation of planning capacity and social sustainability in mobility planning are other questions that need to be answered. It would also be interesting to analyse the temporal dimension in mobility planning in terms of technological change and policy development and implementation, and what role institutions play in this process.

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