

Review

Crises and Their Effects on Freight Transport Modes: A Literature Review and Research Framework

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Abstract: Learning from the effects of past crises allows the transport sector to handle future crises effectively and proactively. The goal of this paper is to identify and classify types of crises that have hit Europe in the previous 20 years and to identify the effects of these crises on the freight transport modes. Moreover, further research on each transport mode is derived. To reach this goal, we conducted a systematic literature review by using five well-known databases, which resulted in 296 search results, of which 29 references were relevant. We identified four crises that hit the freight transport modes in the previous 20 years in Europe: the 2008 financial crisis, the 2015 migration crisis, the 2020 COVID-19 crisis, and the ongoing climate crisis. However, the effects of the different crises on the transport modes can be both positive (e.g., the introduction of a new maritime slow-steaming service) or negative (e.g., a reduction in safety). The insights, gaps, and future research directions identified will encourage researchers, as well as practitioners, to learn from previous crises and be prepared for proactive actions during future crises, thus contributing to more reliable and sustainable transportation systems.



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Keywords: crises; freight transport; transport modes; road; rail; inland waterway; maritime; air; COVID-19 crisis

1. Introduction

In recent years, Europe has been hit by several crises, such as the global financial crisis in 2008 and the 2015 migration crisis [1,2]. The ongoing COVID-19 virus pandemic has resulted in global impacts and has radically affected the European economy, with only initial estimates of the negative consequences of this crisis on people's health and the economy [3,4]. What we can learn from history is that crises vary in their forms and intensities [5] and can impact diverse areas of life depending on their nature. In most cases, major crises are accompanied by diverse consequences, including effects on transportation and, thus, on transport modes [6]. In general, transport represents an essential industrial sector because it is a substantial part of worldwide progress, globalisation, and, hence, welfare and economic growth. In fact, economic growth (i.e., GDP) and the volume of freight transport are generally very closely related, which means that if GDP increases, the volume of freight transport grows. From 1995 onwards, the overall transport volume of goods, as well as the GDP in the EU-28, has been steadily increasing, except for a sharp decline in 2008, which was due to the financial crisis [7], and an expected decline in 2020 due to the COVID-19 pandemic [3]. Moreover, during a crisis, the transport sector represents a major pillar for ensuring people's supply of daily needs, such as food products and medicine [8]. The panic buying during the first lockdowns of the COVID-19 crisis emphasised the enormous importance of a working supply chain and, in particular, transport system [9]. However, different crises have had varying effects on the maritime, air, inland waterway, railway, and road transport modes, with some of them being more drastically hit than other modes, such as with the sharp decline in maritime transport during the financial crisis [10,11]. According to Jerebić and Pavlin [10], the maritime

container market was hit strongly and plummeted by 35% compared to the same period in 2008. Until now, the investigation of how previous crises affected the various transport modes and what we can learn for future crises has hardly been discussed, even if the timeliness of the topic is high.

The goal of this paper is to identify the effects of crises in the previous 20 years on the road, railway, inland waterway, maritime, and air transport modes. Therefore, we provide a comprehensive overview of the current state of research and the further research needs. It is not the aim of this paper to develop a universal model in which the effects of crises on transport modes can be strictly categorised. The results will serve to disclose further research directions, support organisations in implementing more resilient and sustainable crisis management, and allow organisations to be prepared for future crises. The following two research questions guide this paper: (RQ 1) What types of crises have influenced freight transport in Europe in the last 20 years? (RQ 2) Which effects on transport modes occurred in previous crises, and in which areas is further research needed?


This paper is structured as follows. After the introduction, we continue with the theoretical framework in Section 2, followed by Section 3, which presents the methodology that was applied to carry out the literature review. Subsequently, a descriptive, a thematic, and a content analysis was performed with the identified literature. The results of these analyses are shown in Section 4. In Section 4, the results are also discussed, and further research needs for each crisis type are identified. Section 5 presents the conclusions of this paper.

2. Theoretical Framework: Definition and Classification of Crises

In this section, we provide a theoretical framework in order to clarify the term “crisis” and subsequently differentiate this term from emergencies, disasters, and catastrophes. Afterwards, we classify the term “crisis” in different types of crises. For the definition, we use the rather common definitions of Farazmand [12] and Quarantelli [13]. Farazmand [12] defined a crisis as an unwelcome event that could have natural, technological, or human-made causes. A crisis is an event with widespread negative consequences and may impact entire communities or regions. The recovery period from a crisis can be lengthy and may need coordinated international efforts. The hallmarks of a crisis are the suddenness of its occurrence and the major impact that it exerts in its sphere of influence. Rodríguez et al. [14] defined a crisis similarly to Farazmand [12], adding that crises occur when a core value or life-sustaining system of a community come under threat. These values can be, for example, security, safety, health, or wealth. An example of a crisis is the 2008 financial crisis or the current, on-going COVID-19 crisis [8,15,16].

To further review the literature, we must distinguish crises from emergencies, catastrophes, and disasters. According to Farazmand [12], an emergency is an unwelcome event that causes loss or damage to a person or property (e.g., a car with a flat tire on the motorway). If an emergency is not managed appropriately, it can lead to a disaster (e.g., the car with the flat tire is not pulled off the road and causes a chain-reaction collision). The impact of a disaster is greater than the impact of an emergency. A disaster may even cause damage to a whole region and is not an individual, but a community event. Quarantelli [13] and Farazmand [12] both emphasise that disaster relief could be provided locally, so nearby communities are able to provide help. In the event of catastrophes (e.g., the tsunami in the Indian Ocean 2004), neighbouring communities can no longer help [13]. International help is inevitably needed [12]. According to Quarantelli [13], it is often the case that everyday community functions are interrupted, and thus, local officials are not able to undertake their work. In comparison to disasters, catastrophes cause more severe damages or economic losses [12]. A crisis, in contrast, is, as defined before, an unwelcome event with widespread negative consequences, and it may impact entire communities or regions. Table 1 summarises and defines the different forms of unwelcome events according to Farazmand [12] and Quarantelli [13].

Table 1. Types of unwelcome events and their characteristics.

Degree of Impact	Type of Unwelcome Event	Characteristics
<p>local impact</p>  <p>widespread impact</p>	Emergency	Local event; causes loss or damage to person or property; appropriate management of emergency is crucial; if it is not managed appropriately, it can lead to disaster
	Disaster	The impact of a disaster is greater than the impact of an emergency; it may cause damage to a whole region; local disaster relief is possible; no international help is needed
	Catastrophe	International help is inevitably needed; everyday community functions are interrupted; local officials are not able to undertake their work; severe damages
	Crisis	Natural, social, or human-made causes; widespread negative consequences; impact on entire communities or regions; recovery period can take a long time; coordinated international effort needed; hallmarks are suddenness of occurrence and major impact; crises occur when a core value or life-sustaining system of a community, such as security, safety, health, or wealth, comes under threat

In summary, each of these terms—crisis, disaster, catastrophe, and emergency—refers to an unwelcome event, but their impacts vary. While emergencies have the least impact, this impact increases with disasters and catastrophes. Crises have the greatest influence of all, as their impact may also be global [12].

Before starting the literature review, the theoretical framework must include the definition of existing crisis types according to the literature. For this paper, we considered the rather traditional approach mentioned by Gundel [17] as the most appropriate. Gundel [17] classified three types of crisis: (1) human-made, (2) natural, and (3) social crises. According to Sawada et al. [18], the category of “human-made crises” consists of financial crises and violent crises, such as terrorism. The category of “natural crises” is divided into weather-dependent crises and biological crises, such as epidemics. A natural crisis is, for example, the humanitarian crisis in Africa, where international help is needed in order to be able to overcome the negative effects, e.g., the 2012–2014 Ebola epidemic [19]. A social crisis is defined as a crisis that affects the social lives of individuals. For example, this can be caused by a war or persecution [20]. We will use the classification by Gundel [17] for the literature review conducted here. We will identify the crises that had effects on the transport modes in the previous 20 years in Europe based on this theoretical framework and the literature that is available according to our systematic literature review.

3. Materials and Methods

We conducted a systematic literature review to identify the effects of crises on the maritime, inland waterway, railway, and air transport modes in the last 20 years. Therefore, we used the Scopus, EBSCO Business Source Elite, Google Scholar, Emerald Collections, and IEEE databases. The review was carried out between July and November of 2020. This methodology follows the approach of Liberati et al. [21]. The identified crises were

classified using the classification by Gundel [17]. The search was limited to metadata, which included the abstract, the keywords, and the title. Because the filtering possibilities are somewhat different depending on the database, Table 2 shows the metadata searched in each database and presents the search strings used for each database.

Table 2. Databases, metadata searched, and search strings used.

Database	Searched Metadata	Search Strings
EBSCO Business Source Elite	title, abstract, keywords	((TI crisis OR SU crisis OR AB crisis) OR (TI catastrophe OR SU catastrophe OR AB catastrophe) OR (TI disaster OR SU disaster OR AB disaster)) AND (TI transport * OR SU transport * OR AB transport *) AND ((TI freight OR SU freight OR AB freight) OR (TI goods OR SU goods OR AB goods)) AND ((TI maritime OR SU maritime OR AB maritime) OR (TI navigation OR SU navigation OR AB navigation) OR (TI road OR SU road OR AB road) OR (TI rail OR SU rail OR AB rail) OR (TI air OR SU air OR AB air)) AND ((TI influence * OR SU influence * OR AB influence *) OR (TI impact * OR SU impact * OR AB impact *) OR (TI effect * OR SU effect * OR AB effect *))
Emerald Collections	title, abstract	((title:crisis OR title:disaster OR title:catastrophe) OR (abstract:crisis OR abstract:disaster OR abstract:catastrophe)) AND ((title:freight OR title:goods) OR (abstract:freight OR abstract:goods)) AND ((title:transport *) OR (abstract:transport *)) AND ((title:maritime OR title:navigation OR title:road OR title:air OR title:rail) OR (abstract:maritime OR abstract:navigation OR abstract:road OR abstract:air OR abstract:rail)) AND ((title:impact * OR title:effect * OR title:influence *) OR (abstract:impact * OR abstract:effect * OR abstract:influence *))
Google Scholar	title, keywords	((intitle:crisis OR keyword:crisis) OR (intitle:disaster OR keyword:disaster) OR (intitle:catastrophe OR keyword:catastrophe)) AND ((intitle:freight OR keyword:freight) OR (intitle:goods OR keyword:goods)) AND (intitle:transport * OR keyword:transport *) AND ((intitle:maritime OR keyword:maritime) OR (intitle:navigation OR keyword:navigation) OR (intitle:road OR keyword:road) OR (intitle:rail OR keyword:rail) OR (intitle:air OR keyword:air)) AND ((intitle:influence * OR keyword:influence *) OR (intitle:impact * OR keyword:impact *) OR (intitle:effect * OR keyword:effect *))
IEEE	title, abstract, keywords	("All Metadata":crisis OR disaster OR catastrophe) AND ("All Metadata":freight OR goods) AND ("All Metadata":transport *) AND ("All Metadata":maritime OR navigation OR rail OR road OR air) AND ("All Metadata":impact * OR influence * OR effect *)
Scopus	title, abstract, keywords	TITLE-ABS-KEY ((crisis OR catastrophe OR disaster) AND (freight OR goods) AND transport * AND (maritime OR navigation OR road OR rail OR air) AND (influence * OR impact * OR effect *))

The literature search resulted in 296 studies. Table 3 shows the numbers of results for each of the databases used. Furthermore, two studies were added from additional sources, as they were considered relevant literature for the ongoing COVID-19 crisis with respect to transport modes.

Table 3. Results of the literature search in each database.

Database	EBSCO Business Source Elite	Emerald Collections	Google Scholar	IEEE	Scopus	Sum
Number of studies	108	1	7	22	158	296

As the next step, we identified 20 duplicates, which were subsequently removed, resulting in 278 remaining studies. The relevance of the studies for our future research was defined by inclusion and exclusion criteria, which are listed in Table 4. Using these inclusion and exclusion criteria, the 278 studies were analysed by revising the title and abstract.

Table 4. Inclusion and exclusion criteria for this literature review.

Inclusion Criteria	Rationale
Publication in peer-reviewed journal	Practitioner documents reflect current scientific status about the effects of crises on freight transport
Paper describes or discusses the effects of actual crises on freight transport (differentiation of crises, disasters, catastrophes, or emergencies)	The focus of our research is the identification of the effects of different crises (differentiation of unwelcome events with less impact) on freight transport
Exclusion criteria	
Paper was not written in English	English is the language that the author is able to read and comprehend
Full paper is not available	The relevance of a paper can only be ensured if the full paper can be processed
Studies published before 2000	Within our study, the crises of the last 20 years are relevant

After excluding 234 studies due to the defined inclusion and exclusion criteria, we identified 44 studies as the body of literature to be fully analysed. The flow chart in Figure 1 visualises the total review procedure, which followed the approach by Liberati et al. [21]. After the in-depth analysis of the full text of the 44 studies, another 15 studies were excluded because they were missing contextual connections to our topic. After finishing the review procedure, 29 studies were identified for further use for the descriptive and thematic analysis, which followed the approach by Treiblmaier et al. [22].

We aggregated four crises (the financial, migration, climate, and COVID-19 crises) based on the 29 identified studies by screening the papers. We focused on these four crises in accordance with a bottom-up approach that showed that those four crises had major effects on the transport modes. The whole paper is structured around these four crises.

The remaining 29 studies were subsequently analysed, and the relevant data were extracted. We used descriptive and thematic categories for extracting and analysing the 29 studies. The aim of the descriptive categories was to extract data from the literature that were useful for describing and distinguishing the studies. The aim of the thematic categories was to identify and distinguish the types of crises that were addressed in the literature. The types of crises were defined according to Gundel [17], Sawada et al. [18], and Thrimurthulu [20]. The categories for extracting and analysing the data are presented in Table 5.

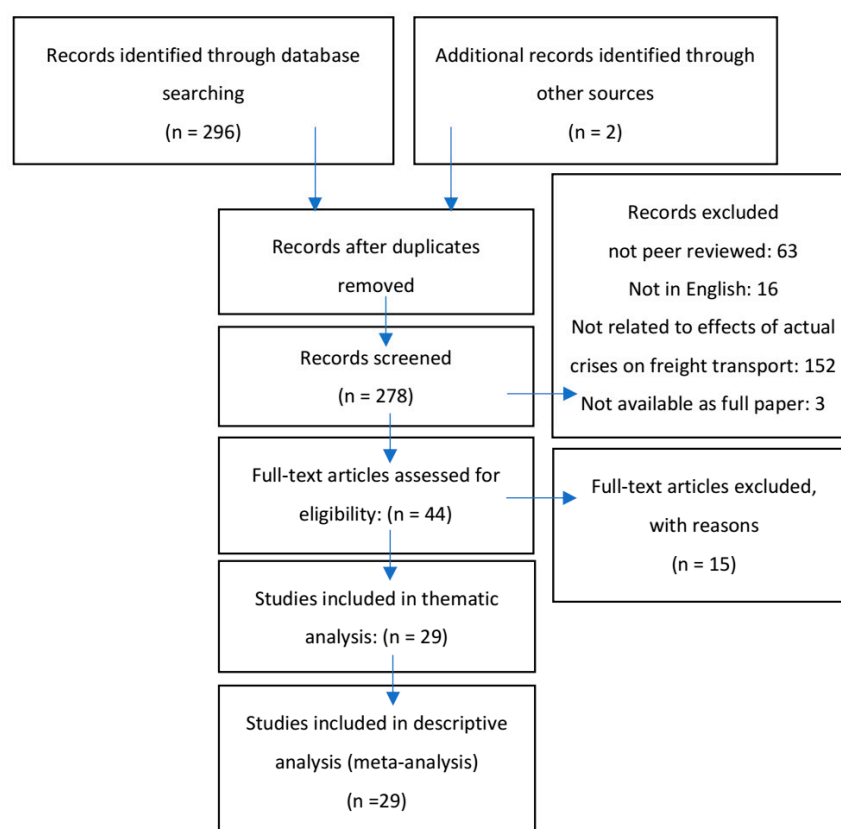


Figure 1. Review procedure within this literature review.

Table 5. Categories used for extracting and analysing data.

Area		Category	Information Obtained
descriptive		publication date	year of publication
		journal author title	name of journal authors name full title of paper
thematic	types of crises	human-made crisis social crisis natural crisis	information about the effects of these crises on freight transport

The effects of the crisis types on freight transport found in the 29 relevant studies are analysed in the next section through a descriptive and thematic analysis. Within the quantitative analysis, we investigated the availability of studies per crisis and the distribution of the literature on the rail, road, inland navigation, maritime, and air transport modes. Subsequently, we carried out a qualitative analysis, in which we focused on distinguishing and comparing the effects of different crises on the transport modes.

4. Results, Discussion, and Further Research

In this chapter, we discuss the 29 identified studies regarding the effects of the types of crises on freight transport and the road, rail, inland waterway transportation (IWT), maritime, and air transport modes. The four crises were identified by screening the 29 studies and aggregating the topics of the studies according to a bottom-up approach that assumed that those four crises are the most relevant for the transport sector because there is existing literature. First, we analysed the frequency of studies related to crises in Europe. Second, we analysed the described effects of the identified crises on the different transport modes. Third, we compared the effects of the crises among the different transport modes.

4.1. Types of Crises

Based on the literature review, 29 studies were considered as relevant for an in-depth analysis. In this step, we examined how often we encountered different crisis types within the identified literature. These results are presented in Table 6.

Table 6. Relevant literature for each type of crisis.

Crisis Types	Relevant Literature
Financial crisis 2008 (human-made crisis)	1; 2; 4; 5; 7; 10; 11; 12; 13; 14; 15; 16; 17; 19; 22; 23; 24; 26; 27; 28
Migration crisis 2015 (social crisis)	18; 21; 25
COVID-19 crisis 2020 (natural crisis)	9; 28; 29
Climate crisis (ongoing) (natural crisis)	3; 6; 8; 20
References: 1. Azadian [23], 2. Balan and Balan [16], 3. Hossen and Barua [24], 4. Feier et al. [25], 5. Ferrari et al. [26], 6. Fikar et al. [27], 7. Finnsgård et al. [28], 8. Fournier Gabela and Sarmiento [29], 9. Gray [8], 10. Iordanoaia [30], 11. Islam [6], 12. Jerebić and Pavlin [10], 13. Jing Xu and Yip [31], 14. Chi and Baek [32], 15. Papoutsis et al. [33], 16. Moschovou and Tyrinopoulos [1], 17. Moschovou [34], 18. Nowakowska and Tubis [2], 19. Počuča and Zanne [11], 20. Popov et al. [35], 21. Radionov and Savić [36], 22. Salter [37], 23. Tang et al. [38], 24. Grzelakowski [39], 25. Lietuvnikė et al. [40], 26. Min et al. [41], 27. Shuai and Yan [42], 28. CCNR [43], 29. Pishue [44]	

The results in Table 6 show that around two-thirds of the identified literature addressed the financial crisis of 2008 (20 out of the 29 studies). The climate crisis was the second most analysed crisis, with four out of the 29 studies. For the migration crisis, there were three studies available. The COVID-19 crisis had three entries at the time of this literature review. Due to its relevance to the current situation, more literature on the effects of the COVID-19 crisis and its effects on the transport modes is expected.

4.2. Types of Crises and the Transport Modes

In this section, we focus on the analysis of crisis types with respect to each transport mode (i.e., IWT, maritime, road, rail, and air). We investigated which transport modes were examined in the context of which crises within the identified literature. The results are shown in Table 7.

Table 7. Crisis types and transport modes.

Crisis Types	Transport Modes				
	IWT	Maritime	Road	Rail	Air
Financial crisis 2008 (human-made crisis)	1	11	3	3	3
Migration crisis 2015 (social crisis)			3	1	
COVID-19 crisis 2020 (natural crisis)	1	1	2	1	
Climate crisis (ongoing) (natural crisis)	1	1	1	2	
sum *	3	13	9	7	3

* Multiple transport modes per study are possible.

The studies about the financial crisis and maritime transport clearly outweighed studies about other crises. Table 7 shows that 11 of the 20 studies dealt with the financial crisis and its effects on maritime transport. Maritime transport was also mentioned once concerning the COVID-19 crisis and once concerning the climate crisis, which makes it the most examined transport mode (13 out of 29) of all. With nine out of the 29 studies, road transport was the second most examined transport mode. Seven out of the 29 studies dealt with rail transport, three of the identified studies investigated IWT, and three studies

examined air transportation. In the next section, we discuss the effects of the identified crises on the different transport modes.

4.3. Geographical Distribution of Identified Literature Regarding Crisis Types

In this section, we analysed the geographical distribution of the identified literature. To do this, on the one hand, we examined, the continents in which the studies were conducted, and, on the other hand, we divided the geographical results for the different crisis types in order to demonstrate which crisis types were investigated on which continents. This representation is relevant for revealing the crises that attracted the most scientific attention in each continent. The results are presented in Table 8

Table 8. Geographical distribution of the identified literature (by study environment).

Region	Financial Crisis 2008	Migration Crisis 2015	Climate Crisis	Covid-19 Crisis	Sum
Europe	12	3	2	1	18
North America	2			2	4
Asia	5		2		7
Australia					
Africa					
South America					

By far, most of the studies were conducted in Europe (18 out of 29). In Asia, seven out of the 29 studies were realized, and only four studies were conducted in North America, of which one was in Canada and three were in the US. It is noticeable that no studies had South American, Australian, or African origins. Exactly two-thirds of the European studies were about the financial crisis (12 out of 18), only three about the 2015 migration crisis, two about the climate crisis, and one about the COVID-19 crisis. The literature in North America focused on the financial crisis (two out of four) and the COVID-19 crisis (two out of four). In Asia, the focus was on literature about the financial crisis (five out of seven) and the climate crisis (two out of seven).

4.4. Effects of the Crises on the Different Transport Modes and Further Research

In this section, we investigate the effects of the crises on the different transport modes. For greater transparency, a separate section was created for each crisis.

4.4.1. Financial Crisis 2008 (Human-Made Crisis)

The financial crisis started in 2008 with the housing bubble in the United States and rapidly spread to Europe. In order to overcome the crisis, many governments took severe austerity measures, which drastically affected economic activity [34]. Twenty of the 29 studies investigated freight transport and the financial crisis of 2008, representing around two-thirds of the identified studies. This shows the major impact of the financial crisis on the different transport modes. Moreover, the impact of the financial crisis was more logically aligned with the effects on transport volumes than, for example, the more diffuse climate crisis. We analysed the studies about the effects on the volumes transported by the road, rail, inland waterway, maritime, and air transport modes. More than half of the studies focused on maritime transport (11 out of 20), followed by road (4 out of 20), rail and air (in each case, 3 out of 20), and IWT (1 out of 20).

Maritime Transport and the Financial Crisis

Maritime transport was the most examined transport mode during the financial crisis, representing eleven out of the 20 studies. A total of 80% of goods worldwide are shipped by sea, and the financial crisis had an enormous impact on the worldwide shipping volumes [10,11]. According to Jerebić and Pavlin [10], after international trade plummeted in 2008, the demand for maritime transportation simultaneously dropped in 2008, leading

to a drop of 35% in container transport in 2009 compared to the same period in 2008. The drastic decrease in demand resulted in overcapacity and a collapse of the freight rates. Tang et al. [38] attempted to create a model that predicted that freight rates would continue decreasing from 2008 to 2009. In addition to studies about the decrease in demand and plummeting freight rates, other studies were carried out about the financial crisis and maritime transport that dealt with investigations of the link between crude oil prices and tanker rates [25], as well as on the course and consequences of the crisis, which will be described in the following paragraphs.

In addition to the missing demand, another reason for the overcapacity was the growth of the fleets. Before 2008, many new ships with increasing capacities were ordered—particularly container ships. The construction of the ordered ships was completed between 2008 and 2010, resulting in even more overcapacity [41]. From 2008 to 2012, the world fleet expanded by 36%, while world trade only expanded by 9% in the same period. A major imbalance was created, which could not be compensated for, even through increased scrapping of ships [37,39]. According to Jerebić and Pavlin [10], the imbalance is still visible. Overcapacity and low rates still prevail. In addition to the shipowners, the shipbuilding industry also suffered from the financial crisis. Shipbuilding orders are mainly dependent on three variables: world fleet size, world trade volume, and spot freight rates [31]. Because there was already overcapacity and freight rates had collapsed, orders for new ships plummeted as well [10,11], which caused huge financial distress for shipbuilders [31].

Some measures were taken to counteract the negative effects of the financial crisis. These measures included laying up, selling, or scrapping ships [37]. Another method was the implementation of blank sailing. Blank sailing was first introduced in the course of the crisis. It creates artificial demand and thus increases the freight rates by keeping the ships of a certain line idle for about a week [10]. Another measure that was introduced during the financial crisis is slow steaming. This method was also investigated in detail. Ferrari et al. [26] and Finnsgård et al. [28] analysed the effects of slow steaming. Slow steaming means reducing the sailing speed of vessels in order to minimize bunkering costs [28]. By reducing the sailing speed by 7.5 km/h, a ship can save up to 30% of its fuel costs on main routes [10,26,28]. Furthermore, slow steaming creates new services. According to Ferrari et al. [26], some ship owners tried to differentiate their services by speed. They started to offer express services, which are more expensive than the regular ones, with a difference of up to 30% in speed. Slow steaming also has a positive impact on the environment, as less fuel is used; therefore, it also contributes to increased sustainability [26]. Although slow steaming was originally conceived as a short-term strategy, it also results in advantages for shipowners as a long-term strategy. As ships become increasingly large, the savings in fuel costs also increase. Slow steaming can thus be a competitive advantage [26]. The creation of new alliances was also a measure for handling the financial crisis. With the help of alliances, shipowners wanted to increase the volume of business while reducing operating costs [10]. Despite these measures, some shipping companies have not managed to stay in business. This may be due to the fact that many have overlooked a key factor besides cost reduction and other measures: looking for new customers instead of just trying to minimize financial losses [30].

Although negative effects dominate, there were also positive effects from the financial crisis, such as an increase in research and measurements regarding fleet capacity optimization and the improvement of operation efficiency, cost control, and cost reduction, which also helped to improve the sustainability of this transport mode in general. Some lessons learned from this crisis, such as cost optimization techniques, will be beneficial in future crises [10].

Road Transport and the Financial Crisis

We found three studies about the effects of the financial crisis on road freight transport [1,33,34], with all of them focusing on the geographical area of Greece. According to Papoutsis et al. [33], after six years of growth of road freight transport, the financial

crisis led to a sharp decrease in volumes. Moschovou [34] found a clear linear relationship between transport performance and GDP for Greece's national and international transport. Moschovou and Tyrinopoulos [1] limited their investigations to the effects of the financial crisis on urban road freight transport. The results show that Greece has a particularly high dependence between transport performance and GDP compared to other European countries. However, Papoutsis et al. [33] argued that the financial crisis also resulted in positive effects and opportunities for the road freight sector. The crisis led to less competition in the sector, as the number of companies decreased due to an increase in bankruptcies. The reduced competition had a positive effect on the remaining companies in the sector, which were able to obtain a higher market share. This statement needs to be analysed critically because the reduced competition resulted from the insolvency of smaller logistics companies and the acquisition of small companies by the few large ones. This resulted in positive effects for some companies in the road freight sector, but hardly for the sector itself, as having fewer companies in the sector also means that there are fewer alternatives for customers [33].

Air Freight Transport and the Financial Crisis

In total, three studies discussed air freight transport and the financial crisis, with two of them covering the geographical area of the United States [23,32] and one study covering Europe [6]. Chi and Baek [32] found that economic growth has clear effects on air traffic expansion from a long-term perspective. The financial crisis hit air freight transport because the recession and the decreasing GDP caused a drop in air freight demand. However, in the short-term, air freight transportation is hardly sensitive to economic growth. Azadian [23] investigated the domestic air freight transport in Florida. Similarly to Chi and Baek [32], Azadian [23] found that the economic recession due to the financial crisis had long-term negative effects on air freight transport. He also discovered that the recovery from the crisis was very slow, which Islam [6] confirmed.

Rail Freight Transport and the Financial Crisis

The effects of the financial crisis on rail freight transportation were investigated in three studies [6,16,42]. All of the studies concluded that the financial crisis had a major impact on railway freight demand. Balan and Balan [16] added that Western and Eastern Europe had similar declines in transport performance due to the financial crisis, but Eastern Europe was more financially affected by this decline. This might have been caused by the weak financial situation of Eastern European railway companies even before the crisis. Shuai and Yan [42] carried out a SWOT analysis, with the results showing that the decline in transport performance was also caused by the higher competition among the different transport modes. This is an interesting aspect because Papoutsis et al. [33] claimed that there was less competition within the road transport sector. Both statements can be correct and would be a logical consequence of the crisis and the accompanying decline in demand—the various transport modes need to attract new customers, including those from other transport modes [30]. This leads to increased competition between the transport modes. To point out different approaches, we compared those of Shuai and Yan [42] and Islam [6]. While Shuai and Yan [42] stated in their SWOT analysis that the expansion of the railway infrastructure in China is an opportunity, Islam [6] found that many European countries have introduced austerity measures as a result of the financial crisis. As a consequence of these austerity measures, the investment in railway infrastructure decreased.

Inland Waterway Transport and the Financial Crisis

Islam [6] was the only author who examined the effects of the financial crisis on inland navigation. An increased investment in IWT infrastructure was noticeable. These investments should contribute to more sustainable transport in Europe, as IWT is considered as one of the most sustainable transport modes [45,46]. As far as Islam [6] is concerned, the effects of the investments on IWT were doubtful because IWT is currently insufficiently

used for freight transport on some European rivers [6,47]; e.g., in 2019, only around 6% of all transports in Europe were carried out by inland navigation, with huge regional differences in usage. In fact, some countries, such as Malta and Cyprus, do not have an IWT infrastructure, while other countries, such as the Netherlands or Belgium, have an above-average share of inland waterway transport, with up to nearly half of all of their products transported by inland waterways [47]. For the future, it is essential to define measures for strengthening inland navigation as a mode of transport in order to promote the modal shift towards the most sustainable transport mode, IWT, as requested by the Green Deal [46,48].

Future research on financial crises should focus on the lessons learned that can be drawn out of the 2008 financial crisis, which might be applicable for a future crisis. This would be particularly important for transport modes that have hardly been investigated until now, such as IWT or railway transport.

Impacts and Further Research for the Financial Crisis (Human-Made Crisis)

In complex situations, such as during a crisis, it is essential to know the strengths and weaknesses of a transport mode in order to overcome the crisis without major losses and to be able to adapt strategies and measures for an increased resilience. Moreover, it is generally important to analyse the freight demand of the different transport modes with respect to the increases and decreases during a crisis. Future research areas are presented in Table 9.

Table 9. Effects and future research for the financial crisis.

Transport Mode	Effects Based on the Literature	Further Research
Maritime	<ul style="list-style-type: none"> negative effects of the crisis: freight rates collapsed due to overcapacity imbalance between demand and supply is still visible shipbuilding orders also plummeted in 2008 the crisis was counteracted by laying up, selling, scrapping, blank sailing, or slow steaming positive effects of crisis: fleet capacity optimization, cost control, and reduction some companies did not survive, as they concentrated too much on minimizing financial losses, rather than looking for new customers 	<ul style="list-style-type: none"> further research on predictability of freight rates in maritime transport [25] for different types of vessels, cargo, and lines [38] investigation of cost optimization techniques and further research on sustainable and renewable energy [10] examination of how to increase customer retention during a crisis [30] further research on the impacts of slow steaming on different stakeholders [26] investigation of strengths and weaknesses of maritime transportation in financial crises
Road	<ul style="list-style-type: none"> linear relation between transport performance and GDP in Greece, higher dependency between transport performance and GDP compared to other European countries the crisis also brought opportunities: less competition within the road freight sector (the competition among different transport modes increased during the crisis) 	<ul style="list-style-type: none"> long-term study about the effects of the economic crisis on road freight demand and GDP in Greece [1] investigation of the impact of potential economic recovery measures on road transport [34] investigation of strengths and weaknesses of road freight transportation in financial crises

Table 9. Cont.

Transport Mode	Effects Based on the Literature	Further Research
Air	<ul style="list-style-type: none"> • economic growth affects air traffic expansion in the long run; in the short run, it is hardly sensitive to economic growth • the recovery from the crisis is very slow 	<ul style="list-style-type: none"> • expanding the study of Azadian [23] from domestic traffic to import/export traffic regarding the long-term negative effects of the financial crisis on air freight transport demand • investigation of measures for policymakers and airline managers to cope with periods of changes in economic activity [32] • investigation of strengths and weaknesses of air transportation in financial crises
Rail	<ul style="list-style-type: none"> • impact on demand was high, not only because the general demand was lower, but also because of increased competition with other transport modes • expansion of railway infrastructure in China and stagnation in Europe 	<ul style="list-style-type: none"> • investigation of how to establish and improve marketing systems in order to promote rail transportation (in times of crisis, customer retention is essential) [42]
IWT	<ul style="list-style-type: none"> • increasing investments in infrastructure 	<ul style="list-style-type: none"> • investigation of strengths and weaknesses of IWT in financial crises

4.4.2. Migration Crisis 2015 (Social Crisis)

At the peak of the migration crisis in 2015, over 1.39 million initial applications for asylum were made across the EU [40]. People from Northern Africa, Syria, and Libya, but also from other Asian and African countries, such as Afghanistan, Iraq, and Eritrea, fled from war, persecution, and harsh economic situations in their home countries [36]. The European countries that most of the illegal immigrants desired to reach were Germany, Hungary, Sweden, Austria, and Great Britain [40]. As there are still border controls between non-Schengen (e.g., Croatia and Great Britain) and Schengen states (i.e., most countries of the European Union), many illegal immigrants tried to break into trucks or trains to pass the borders secretly, resulting in negative consequences for companies, drivers, and supply chains [36].

We found three studies about the migration crisis in 2015 and its effects on freight transport [2,36,40]. All three studies dealt with road transport; Radionov and Savić [36] additionally examined rail transport. Each study investigated routes or countries that were highly effected by the crisis. Lietuvnikė et al. [40] and Nowakowska and Tubis [2] examined the route from Calais (FR) to Dover (UK); Radionov and Savić [36] investigated the situation in Croatia with a focus on border-crossing points. The significant relevance of border-crossing points is undoubtable, as all three studies focused on these. One study investigated border crossings from a non-Schengen state (Croatia) to Schengen states and two studies from a Schengen state (France) to a non-Schengen state (UK). The border-crossing point between France and the UK is apparently more dangerous for drivers than the border-crossing points on the border of Croatia. One reason for why it could be more dangerous on the route from France to England could be the weak security at the port in Calais [40] and the accumulation of refugees because a large refugee camp is located near the port [2]. The effects of the migration crisis on drivers, companies, and supply chains are summarized in Table 10.

Table 10. Effects of the migration crisis on drivers, companies, and supply chains.

Affected Areas	Effects
drivers	Danger to life and limb [2,40] Incitement to commit a crime (to deliberately hide immigrants) [36] Lower salary due to low efficiency caused by longer waiting times [36] Fines (in case refugees are discovered at the border) [2]
Transport companies	Increasing costs due to damage to vehicles or goods [2,40] Incentives for drivers (because of danger on routes) Increased insurance rates [2] and personnel costs (more security and loading personnel needed [36]) Fines (in case refugees are discovered at the border) [2] Additional personnel for loading/unloading and security personnel [36] Decreasing competitiveness of the transport mode due to longer, mostly unpredictable delivery times [36] Less space utilization in trucks/wagons (rows must be kept free to facilitate controls at borders) [36] End of service of particularly dangerous routes [2] End of collaborations because companies are not able to protect goods from threats [40]
Supply chains	Loss of efficiency within the supply chain [36,40] Prolonged delivery times [2,36,40]

Transport companies suffered large economic losses due to the migration crisis because they had to pay additional costs, such as costs for material and vehicle damages, increased insurance premiums, and personnel costs—for example, for more detailed security checks. Radionov and Savić [36] even claimed that there were special security personnel hired to accompany the freight trains on their journeys. Companies took preventive measures to minimize interruptions caused by illegal immigrants, such as using other routes to cross the border (Rotterdam (NL) to Hull (UK) instead of Calais (FR) to Dover (UK)), but these were hardly effective, resulting in 20–30% higher operating costs and also leading to a negative impact on sustainability due to the longer transport routes [2].

In addition, the drivers suffered from negative economic effects because they earned less due to their reduced efficiency as a result of long waiting times at the borders [36]. According to all three studies, crossing the border became much more dangerous due to attacks on or robberies of drivers since the migration crisis (i.e., danger to life and limb) [2,36,40]. Nowakowska and Tubis [2] even reported drivers who died due to attacks by illegal immigrants. The reduced salary did not compensate for this enhanced risk.

Within the supply chains in general, a loss of efficiency could be observed. This might have been caused due to the prolonged and unpredictable delivery times, as well as the fact that damage to goods increased since the migration crisis [2,36,40]. This means that a consignee can never be sure that goods arrive in a good condition, which causes uncertainty within the supply chain [2].

As migration will increase in the following years, with around 1.5 million refugees arriving per year in Europe, the effects of migration on the transport modes are of particular relevance for future developments in the freight transport sector. Major research is needed to examine the variations (i.e., increases and decreases) in freight demand in times of crisis. This is useful in making the courses of different crises more transparent with regard to freight demand and, thus, being able to respond better to crises. Table 11 summarizes the current results in the literature and identifies further research needs regarding the topic of the migration crisis.

Table 11. Effects and further research for the migration crisis.

Transport Mode	Effects Based on the Literature	Further Research
IWT	<ul style="list-style-type: none"> the migration crises did not have a significant impact on IWT because refugees on IWT were not common [40]. 	<ul style="list-style-type: none"> the issue of illegal migration by inland waterways is hardly present, but this does not exclude its future relevance
Rail	<ul style="list-style-type: none"> high economic losses, safety losses for companies, train drivers, and supply chains 	<ul style="list-style-type: none"> investigation of measures to improve procedures and processes of the police, the customs, and the operators, especially for cross-border processes [36]
Road	<ul style="list-style-type: none"> high economic losses, safety losses for companies, drivers, and supply chains 	<ul style="list-style-type: none"> research about human migration risk assessment models in order to minimize the negative effects caused by refugee migration [2,40]
Maritime	n/a	<ul style="list-style-type: none"> research on illegal migration by sea would be interesting with regard to the effects on maritime shipping
Air	n/a	<ul style="list-style-type: none"> illegal migration by air is generally of minor importance and, therefore, requires hardly any further research

4.4.3. Climate Crisis (Natural Crisis)

In this study, the term “climate crisis” is used to describe extreme weather phenomena caused by climate change. Humans and their activities create pressure on the environment, which leads to climate change. This climate change is able to provoke different extreme weather phenomena, such as heavy rainfall, floods, or winds, which result in disasters and catastrophes [35]. According to Farazmand [12], most weather phenomena are defined as disasters. In this study, we summarize these individual disasters and consider the climate crisis. It is important to mention that the climate crisis is more diffuse than, for example, the COVID-19 crisis or other crises, which allow the alignment of the effects in a more direct way.

Four studies that can be aligned with the climate crisis were identified [24,27,29,35]. Fournier Gabela and Sarmiento [29] investigated the effects on road freight transportation of the 2013 floods that occurred in Germany, and they created the first study to enable the quantification of climate-related variations in road traffic. One major result was that variations (e.g., route shifts) occurred on 23% of all main roads during the 2013 floods. Popov et al. [35] examined the shifts in train routes due to extreme weather phenomena in Russia and provided a method of risk assessment for traffic accidents resulting from the impact of different extreme weather phenomena. With the aid of this method, the safest route of transportation of goods can be chosen in order to reduce the probability of an accident. Fikar et al. [27] created a decision support system for railway interruptions that were mainly caused by extreme weather phenomena due to climate change. In contrast to Popov et al. [35], Fikar et al. [27] analysed a very short section of railway infrastructure—

namely, the Brenner Pass between Austria and Italy. Popov et al. [35] examined a larger area with several possible railway connections in Russia and focused on route selection processes rather than analysing the effects of interruptions, as Fikar et al. [27] did.

Hossen and Barua [24] discussed extreme weather phenomena in Bangladesh and found effects for crew members in IWT. They found that pilots and masters need special education and training in order to navigate vessels properly in adverse weather conditions. Further research should focus on IWT in Europe in order to establish the knowledge of masters and pilots in Europe as well, particularly for the Rhine region and the Danube corridor, as they are the most economically valuable rivers in Europe [49]. However, it is primarily essential to investigate the actual implications of climate change for inland navigation during extreme weather phenomena, such as floods and low water, as the literature is divided on this issue. Some studies, such as Hossen and Barua [24], clearly assumed a connection between climate change and extreme weather phenomena. Other studies, such as that of the CCNR [50], questioned this. At this point, further research would be of urgent value for future transport planning. Further research for all transport modes is described in Table 12.

Table 12. Effects and further research for the climate crisis.

Transport Mode	Effects Based on the Literature	Further Research
IWT	<ul style="list-style-type: none"> special education and training needed for crew members 	<ul style="list-style-type: none"> implications of climate change for IWT, assessment of knowledge of masters and pilots in Europe
Rail	<ul style="list-style-type: none"> changes in routes depending on weather decision support system for railway interruptions 	<ul style="list-style-type: none"> further research on risk- and cost-sharing mechanisms in order to decrease the economic losses due to railway disruptions [27]
Road	<ul style="list-style-type: none"> traffic variations on 23% of all main roads during the 2013 floods in Germany 	<ul style="list-style-type: none"> more disaggregated investigations in traffic variation (on day level) caused by extreme weather phenomena [29]
Maritime	n/a	<ul style="list-style-type: none"> effects of extreme weather phenomena on maritime transportation traffic and how to approach them effectively
Air	n/a	<ul style="list-style-type: none"> effects of extreme weather phenomena on air transportation traffic and how to approach them effectively

4.4.4. COVID-19 Crisis (Natural Crisis)

At the time of this research, we identified three studies that dealt with the COVID-19 crisis, which was caused by the accompanying pandemic of the COVID-19 lung disease [8,43,44] and put the whole world in a sudden shock [4]. In these three studies, all transport modes except for air transportation were covered. The study of Gray [8] was about the transportation of agricultural goods in Canada. He claimed that the volume of non-food traffic decreased due to the pandemic. The food sector, except the restaurant industry, is likely to be more resilient than the general economy [8]. As the transport of agricultural and food products constitutes an important market for inland navigation, it could be the reason that IWT suffered only a small decline in demand at the beginning of the crisis. Nevertheless, the demand for IWT decreased later as the automotive producers in

Germany stopped their production for a few weeks. The transport of automotive parts and steel as a raw product dropped away [43]. Furthermore, IWT and maritime transportation were affected by the travel restrictions and quarantine regulations. These regulations caused problems in staffing inland vessels and ships [8,43]. Maritime transportation was confronted with another problem. Because production in China stopped for several weeks, imports from Asia also plummeted, which resulted in a shortage of maritime containers for export to Asia [8].

Pishue [44] investigated road transportation in the United States at the beginning of the pandemic. He found out that freight transportation increased by 1% at the very beginning of the lockdown measures in the United States. During the lockdown, demand decreased by 13%. Truck drivers are still affected by the impacts of the pandemic; for example, many toilets at rest places are closed. In Canada, mobile toilets were therefore set up for the drivers [8]. Nevertheless, there was also a very positive effect on road transportation. Fewer traffic jams lead to lower congestion costs and increased efficiency and sustainability in road transportation [44]. Gray [8] found that the demand for non-food traffic decreased significantly for rail transportation. Moreover, he found that the crews that operate trains are very specialized. Therefore, this sector could be vulnerable if the crew fell ill with COVID-19.

As this crisis only started at the beginning of 2020 and is still ongoing, there are many topics that require further research. On the one hand, it is essential to investigate the best way of dealing with the crisis and what advantages might even be able to be drawn from it. On the other hand, it is important to examine the weaknesses of each mode of transport with respect to the crisis in order to be able to cope with them. A SWOT analysis is a suitable tool for identifying internal and external influencing factors, and it can show the positive and negative sides of a specific situation at a glance. SWOT analysis provides a good first overview of a specific situation, and is therefore an ideal starting point for further research and in-depth analysis. These investigations must be performed separately for each mode of transport because each mode of transport has particular strengths and weaknesses. Future research needs are listed in Table 13.

Table 13. Effects and future research for the COVID-19 crisis.

Transport Mode	Effects Based on the Literature	Further Research
IWT	<ul style="list-style-type: none"> demand for IWT decreased (automotive companies stopped producing—transportation of steel and automotive parts paused) travel restrictions and quarantine measures caused problems in staffing inland vessels and ships 	<p>The following points should be investigated for each transport mode separately:</p> <ul style="list-style-type: none"> SWOT analysis of how to use strengths advantageously and how to cope with weaknesses examination of modalities for getting out of the crisis without major losses; investigation of the different transport modes from other stakeholders' point of view—for example: What are the needs of the shippers in times of crisis? freight demand for IWT/maritime/road/rail/air during the COVID-19 crisis
Rail	<ul style="list-style-type: none"> demand decreased crew are very specialized; due to this, the vulnerability of the sector increased (if the crew fell ill with COVID-19) 	
Road	<ul style="list-style-type: none"> demand increased slightly in the first week, then decreased a positive effect was that there are lower costs of congestion and higher efficiency due to fewer traffic jams 	
Maritime	<ul style="list-style-type: none"> shortage of containers for export to Asia demand decreased; travel restrictions and quarantine measures caused problems in staffing inland vessels and ships 	
Air	n/a	

4.4.5. Summary of the Effects of the Crises on the Transport Modes

The results of the literature review show that some crises (i.e., the financial crisis) were analysed more often than other crises (i.e., the migration crisis). Moreover, we found that crises frequently offer both positive and negative effects on the transport modes. Table 14 summarizes the results and shows if literature is available for a transport mode and a certain crisis type or not (n/a). For crisis types with available literature, we evaluated the directions of the effects on the respective transport modes, with positive effects marked with an upward pointing arrow and negative effects marked with a downward pointing arrow.

Table 14. Summary of the positive and negative effects of the crises on the transport modes.

Crisis Types	(Positive or Negative) Effects on				
	Maritime	IWT	Road	Rail	Air
financial crisis	↓↑	↓↑	↓↑	↓↑	↓
migration crisis	n/a	n/a	↓	↓	n/a
climate crisis	n/a	↓	↓	↓↑	n/a
COVID-19 crisis	↓	↓	↓↑	↓	n/a

The financial crisis was investigated most often, particularly in the context of maritime transport, leading to a clarification of both the positive and negative effects. A key finding from the financial crisis is that the demand decreased for each mode of transport, and the recovery was very slow; some literature even claims that it is still ongoing. Due to the worldwide recession and the drop in the GDP during the financial crisis, the transport volumes decreased equally. This effect of the financial crisis emphasises the strong relation between GDP and transport volumes. Another major finding is the fact that a crisis may lead not only to negative effects, but also to positive effects. In the case of the financial crisis, cost optimization and control tools were implemented, and slow steaming was established as a new service, which is still a common practice in the maritime shipping industry; it contributes not only to the shippers' competitiveness, but also to the increasing sustainability of maritime transportation.

The 2015 migration crisis, which mostly affected Europe, was examined far less in connection with its effects on the transport modes than the financial crisis. The key finding from this crisis is that it had major impacts on the road and railway transport modes because the refugees used these two transport modes to travel clandestinely from A to B. This caused great losses for train and truck drivers, logistics companies, and the whole supply chain, and it increased external costs due to societal losses. The identified literature shows that there are hardly any proper solutions for overcoming this kind of crisis without negative effects for drivers, companies, and supply chains (e.g., danger to life and limb, additional costs for vehicle damage, loss of efficiency throughout the supply chain).

The main finding from the climate crisis is that additional decisions (e.g., spontaneous route changes due to the occurrence of extreme weather phenomena), as well as additional training for the employees, are needed in order to cope with the climate crisis. Considering these key findings, there is one critical aspect missing that still needs to be explored, and that is the question of who bears the additional effort/costs that are caused by the negative effects of the climate crisis. Thus, further research on cost-sharing mechanisms, which Fikar et al. [27] mentioned for the railway mode, is also important for the other transport modes and requires further research.

The key finding from the COVID-19 crisis so far is that the demand decreased for each transport mode. There were positive effects as well, e.g., less congestion on the roads facilitates road freight transportation and a sharp decrease in worldwide emissions, which leads to an increase in sustainability. Nevertheless, the key findings of this crisis remain open due to its contemporary nature, and they need to be revealed through future research, which is already in progress.

5. Conclusions

The goal of this literature review was the identification of the effects of crises in the previous 20 years on the road, rail, inland waterway, maritime, and air transport modes. Therefore, we used the classification of the three general crisis types from Gundel [17], which are (1) human-made, (2) natural, and (3) social crises. We focused on the effects of crises, such as economic, sociocultural, or ecological ones, on transport modes and identified future research needs.

As a result of the literature review, we identified 29 relevant studies, which we classified according to the three general crisis types: (1) human-made (e.g., 2008 financial crisis), (2) natural (e.g., climate and COVID-19 crises), and (3) social crises (e.g., 2015 migration crisis). Two-thirds of the identified studies dealt with crisis type (1) (human-made financial crisis of 2008), followed by crisis type (2) (natural crisis) and crisis type (3) (social crisis). Regarding the geographical distribution of the reviewed papers, the majority of the papers dealt with effects in Europe or Asia, with two dealing with effects in North America. None of the reviewed papers dealt with effects in Africa, Australia, or South America. Regarding the transport modes, we found that maritime freight in general, but particularly in combination with the financial crisis, was the most frequently examined. In contrast, the crises' effects on IWT, rail, and air freight transportation were hardly investigated.

The studies regarding the financial, migration, and COVID-19 crises mainly concentrated on the decrease in transport demand as a consequence of the crises. We concluded that a crisis could have both positive and negative effects on transport modes, e.g., the implementation of cost optimization and control tools in maritime transportation. In some cases, measures that were implemented to counteract a crisis had such a positive impact that they were also applied for the long term. An example is the introduction of slow steaming in maritime transport during the financial crisis. Vessels were operated at a slow speed, which saves costs on the one hand and is environmentally friendly on the other. Slow steaming was maintained by some companies even after the financial crisis, and it is offered as a standard service. As a consequence, higher-speed trips are offered as an extra service and are charged at a higher rate for the customer. In addition to the dramatic drop in cargo volumes, the COVID-19 crisis also showed positive sides, e.g., less congestion on the roads and less pollution. The studies about the climate crisis explored the reactions that transport modes can have on extreme weather phenomena. The climate crisis requires a high level of flexibility from the supply chain, leading to spontaneous route changing and a need for additional training in order to cope with the challenges. A finding from the studies about the 2015 migration crisis is that rail and road transportation were predominantly affected by this crisis, as these two transport modes were the most often used by refugees to travel clandestinely from A to B. These illegal and clandestine journeys caused losses equally to drivers, companies, and supply chains.

5.1. Practical and Theoretical Contribution

Our paper creates a valuable contribution as a lesson on how to proactively steer transport modes based on historical crises and apply this to ongoing and future events, such as the COVID-19 pandemic or the climate crisis. The main strength of this paper is that we provided a new approach to investigating the impacts of previous crises on transport modes. We created transparency about the available literature on the effects of crises over the last 20 years on the various transport modes with the aim of providing insights for both the scientific community and the logistics and shipping industry. This study helps to understand the effects that past crises had on transport modes, which can be used to strengthen their ability to better anticipate or assess the effects of future crises. The identified insights, gaps, and future research needs should encourage practitioners to learn from previous crises and be prepared for proactive actions during future crises.

Through the derivation of the strengths and weaknesses of transport modes in times of crisis, considerable potential arises for practitioners, such as the possibility to create a crisis

management approach. Proper crisis management will help to exploit the strengths and use them to their advantage in times of crisis, as well as to compensate for the weaknesses in order to minimize the negative impacts of the crisis on their company. The knowledge gathered through our paper should serve as a cornerstone for more detailed elaboration and further development of research regarding past crises.

This paper demonstrates that research about the effects of crises on transport modes is scarce. It allows researchers to learn from past crises and provides a solid overview of the effects of different crises in the past on transport modes. The further research needs identified may be used by researchers in order to find research topics for more detailed, in-depth studies, as the knowledge generated shows very clearly the crises (in combination with the modes of transport) on which there is already plenty of research and the areas in which research is still lagging behind.

5.2. Limitations and Further Research

Several limitations exist in our systematic literature review, and they offer an area for further research. First, although we did our best to make the search, selection, and validation processes as transparent as possible, a certain amount of subjectivity exists. Our research findings are limited to the search strings and the relatively low number of relevant journal publications. We did not consider the synonyms among the keywords. The main reason for this was our focus on our research questions. Nevertheless, such synonyms are worth researching, and may thus become a research direction. Second, we focused on crises after the year of 2000 due to the transparency and accuracy of the literature. Third, the effects of the climate crisis are particularly difficult to differentiate, align, and relate because the climate crisis has various and extensive implications. Fourth, we derived the four crises based on the results of the literature review (following a bottom-up approach). Further crises may exist, but were not included in this research because we focused on the crises found in the literature.

This systematic literature review has demonstrated that the findings from previous crises for the transport modes are still barely understood topics that offer a broad area for future research. This literature review shows the need for a broader coverage of the literature in order to investigate the area of crises in connection with freight transport. The literature has been focused on some transport modes and regions, while wide-spread investigation and derivation of findings for future or ongoing crises are missing. Thus, we suggest that it is of utmost relevance to analyse the variations in transport demand during each crisis for each transport mode in order to be able to identify the strengths and weaknesses of the individual transport modes. Examples such as the COVID-19 crisis show that there is significant value and need for properly learning from past events in order to establish a resilient and sustainable supply chain that is prepared for unexpected future crises. It might be of interest to use statistics to analyse the effects of crises together with general GDP or economic data. A challenging idea for further research would be to develop a model of the influences of different types of crises on freight transport modes. Finally, further research could be done by taking a closer look at specific other crises.

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References

1. Moschovou, T.; Tyrinopoulos, Y. Exploring the effects of economic crisis in road transport: The case of Greece. *Int. J. Transp. Sci. Technol.* **2018**, *7*, 264–273. [\[CrossRef\]](#)
2. Nowakowska, M.; Tubis, A. The impact of illegal population migration on the risk assessment of freight transport carried out by polish carriers. *Logist. Transp.* **2018**, *40*, 121–128.
3. Loske, D. The impact of COVID-19 on transport volume and freight capacity dynamics: An empirical analysis in German food retail logistics. *Transp. Res. Interdiscip. Perspect.* **2020**, *6*, 100165. [\[CrossRef\]](#)
4. Maliszewska, M.; Mattoo, A.; Van Der Mensbrugghe, D. *The Potential Impact of COVID-19 on GDP and Trade: A Preliminary Assessment*; World Bank: Washington, DC, USA, 2020.
5. Kondybayeva, S.K.; Yarkin, N.A. The New Silk Road–Economic Belt policy: The great chance for the rejuvenation of Europe. *Cent. Asian J. Soc. Sci. Humanit.* **2019**, *4*, 55–58.
6. Islam, D.M.Z. Prospects for European sustainable rail freight transport during economic austerity. *Benchmarking Int. J.* **2018**, *25*, 2783–2805. [\[CrossRef\]](#)
7. Eurostat. Volume of Freight Transport Relative to GDP. Available online: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tran_hv_frtra&lang=en (accessed on 13 November 2020).
8. Gray, R.S. Agriculture, transportation, and the COVID-19 crisis. *Can. J. Agric. Econ. Can. Agroekon.* **2020**, *68*, 239–243. [\[CrossRef\]](#)
9. Islam, T.; Pitafi, A.H.; Aryaa, V.; Wang, Y.; Akhtar, N.; Mubarik, S.; Xiaobei, L. Panic buying in the COVID-19 pandemic: A multi-country examination. *J. Retail. Consum. Serv.* **2020**, *59*, 102357. [\[CrossRef\]](#)
10. Jerebić, V.; Pavlin, S. Global Economy Crisis and its Impact on Operational Container Carrier’s Strategy. *Promet Traffic Transp.* **2018**, *30*, 187–194. [\[CrossRef\]](#)
11. Počuča, M.; Zanne, M. The impact of global economic crisis on the dry bulk shipping industry. *Pomorstvo* **2009**, *23*, 477–493.
12. Farazmand, A. *Global Encyclopedia of Public Administration, Public Policy, and Governance*; Springer International Publishing: Berlin/Heidelberg, Germany, 2018; ISBN 978-3-319-20927-2.
13. Quarantelli, E.L. *Emergencies, Disaster and Catastrophes are Different Phenomena*; Disaster Research Center, University of Delaware: Newark, DE, USA, 2000.
14. Rodríguez, H.; Quarantelli, E.L.; Dynes, R.R. *Handbook of Disaster Research*; Springer Science and Business Media LLC: Berlin/Heidelberg, Germany, 2007.
15. Wu, S.; Sun, Y.; Yang, Z. Analyzing the trade transportation and its demand on multimodal transportation system between China and Korea. *Marit. Bus. Rev.* **2020**, *5*, 84–98. [\[CrossRef\]](#)
16. Balan, G.-S.; Balan, M. Economic and financial crisis impact on rail sector. *Intern. Audit. Risk Manag.* **2010**, *19*, 1–9.
17. Gundel, S. Towards a New Typology of Crises. *J. Contingencies Crisis Manag.* **2005**, *13*, 106–115. [\[CrossRef\]](#)
18. Sawada, Y.; Bhattacharyay, R.; Kotera, T. Aggregate Impacts of Natural and Man-made Disasters: A quantitative comparison. *RIETI Discuss. Pap. Ser.* **2011**, *11-E-23*, 1–42.
19. Babatunde, S.; Oloruntoba, R.; Agho, K. Healthcare commodities for emergencies in Africa: Review of logistics models, suggested model and research agenda. *J. Humanit. Logist. Supply Chain Manag.* **2020**, *10*, 371–390. [\[CrossRef\]](#)
20. Thrimurthulu, V. Social crisis and its management. *J. Educ. Res. Ext.* **2016**, *53*, 35–39.
21. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gøtzsche, P.C.; Ioannidis, J.P.A.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Med.* **2009**, *6*, e1000100. [\[CrossRef\]](#) [\[PubMed\]](#)
22. Treiblmaier, H.; Mirkovski, K.; Lowry, P.B.; Zacharia, Z.G. The physical internet as a new supply chain paradigm: A systematic literature review and a comprehensive framework. *Int. J. Logist. Manag.* **2020**, *31*, 239–287. [\[CrossRef\]](#)
23. Azadian, F. Assessing the effect of urban socioeconomic factors and the financial crisis of 2008 on domestic air cargo traffic in Florida. *Transportation* **2020**, *47*, 223–241. [\[CrossRef\]](#)
24. Hossen, M.M.; Barua, P. Assessment of the knowledge level of masters and pilots of ships in coastal Bangladesh: Perspective of climate change and navigational management. *IUP J. Knowl. Manag.* **2017**, *15*, 39–53.
25. Chen, F.; Miao, Y.; Tian, K.; Ding, X.; Li, T. Multifractal cross-correlations between crude oil and tanker freight rate. *Phys. A Stat. Mech. Appl.* **2017**, *474*, 344–354. [\[CrossRef\]](#)
26. Ferrari, C.; Parola, F.; Tei, A. Determinants of slow steaming and implications on service patterns. *Marit. Policy Manag.* **2015**, *42*, 636–652. [\[CrossRef\]](#)
27. Fikar, C.; Hirsch, P.; Posset, M.; Gronalt, M. Impact of transalpine rail network disruptions: A study of the Brenner Pass. *J. Transp. Geogr.* **2016**, *54*, 122–131. [\[CrossRef\]](#)
28. Finnsgård, C.; Kalantari, J.; Roso, V.; Woxenius, J. The Shipper’s perspective on slow steaming—Study of Six Swedish companies. *Transp. Policy* **2020**, *86*, 44–49. [\[CrossRef\]](#)
29. Gabela, J.G.F.; Sarmiento, L. The effects of the 2013 floods on Germany’s freight traffic. *Transp. Res. Part D Transp. Environ.* **2020**, *82*, 102274. [\[CrossRef\]](#)
30. Iordanoaia, F. Maritime market crisis is the lack of charterers. *Ovidius Univ. Ann. Econ. Sci. Ser.* **2012**, *12*, 778–785.
31. Xu, J.J.; Yip, T.L. Ship investment at a standstill? An analysis of shipbuilding activities and policies. *Appl. Econ. Lett.* **2012**, *19*, 269–275. [\[CrossRef\]](#)

32. Chi, J.; Baek, J. Dynamic relationship between air transport demand and economic growth in the United States: A new look. *Transp. Policy* **2013**, *29*, 257–260. [CrossRef] [PubMed]
33. Papoutsis, K.; Basbas, S.; Bouhouras, E.; Sdoukopoulos, E. Impact Investigation of the Economic Crisis to the Road Freight Sector in Thessaloniki, Greece. In *Urban Transport XIX*; Brebbia, C.A., Ed.; WIT Press: Southampton, UK, 2013; pp. 547–557.
34. Moschovou, T.P. Freight transport impacts from the economic crisis in Greece. *Transp. Policy* **2017**, *57*, 51–58. [CrossRef]
35. Popov, V.; Sukhov, P.; Bolandova, J. Safe Train Route Options. In *VIII International Scientific Siberian Transport Forum*; Popovic, Z., Manakov, A., Breskich, V., Eds.; Springer International Publishing: Berlin/Heidelberg, Germany, 2020; pp. 899–908. ISBN 978-3-030-37918-6.
36. Radionov, N.; Savić, I. The Impact of Irregular Migrations, Smuggling and Human Trafficking on the Land Transport Industry: The Croatian Case. *Pored. Pomor. Pravo* **2019**, *173*, 103–149. [CrossRef]
37. Salter, I. The impact of economic crisis on maritime transport. In Proceedings of the IAMU AGA14, Constanta, Romania, 23–26 October 2013; International Association of Maritime Universities: Tokyo, Japan, 2013; pp. 197–202.
38. Tang, L.; Sun, J.; Qi, S.; Wang, Q.; Li, Y. Econometrics Model Analysis of the Shipping Market Considering the Financial Crisis Influences. In Proceedings of the International Conference on Management and Service Science (MASS 2009), Beijing, China, 20–22 September 2009; IEEE: Piscataway, NJ, USA, 2009; ISBN 978-1-4244-4639-1.
39. Grzelakowski, A. Global Container Shipping Operators' Strategies and their Impact on Logistics Supply Chains. *J. Posit. Manag.* **2019**, *9*, 34–50. [CrossRef]
40. Lietuvnikė, M.M.; Vasilienė–Vasiliauskienė, V.; Vasilis–Vasiliauskas, A. Core problems the road freight transport companies face due to the refugee crisis. *Innov. Infotechnolog. Sci. Bus. Educ.* **2017**, *2*, 3–9.
41. Min, D.; Fengqing, W.; Shibing, Z. Impact Analysis of the Global Financial Crisis on Global Container Fleet. In Proceedings of the 6th International Conference on Service Systems and Service Management, 2009: ICSSSM '09, Xiamen, China, 8–10 June 2009; Ji, G., Ed.; IEEE: Piscataway, NJ, USA, 2009; pp. 161–166, ISBN 978-1-4244-3662-0.
42. Shuai, B.; Yan, H. Development strategy of rail freight transportation under financial crisis. *5th Adv. Forum Transp. China* **2009**, 10–14. [CrossRef]
43. CCNR. Market Insight: Inland Navigation Europe, Strasbourg. 2020. Available online: <https://www.ccr-zkr.org/13020800-de.html> (accessed on 19 May 2021).
44. Pishue, B. COVID-19's Impact on Freight: An Analysis of Long-Haul Freight Movement During a Pandemic; INRIX Research: Washington, DC, USA, 2020.
45. European Commission. Inland Waterways. 2020. Available online: https://ec.europa.eu/transport/modes/inland_en (accessed on 24 November 2020).
46. Hofbauer, F.; Putz, L.-M. External Costs in Inland Waterway Transport: An Analysis of External Cost Categories and Calculation Methods. *Sustainability* **2020**, *12*, 5874. [CrossRef]
47. Eurostat. Freight Transport Statistics—Modal Split—Statistics Explained. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Freight_transport_statistics_-_modal_split#Modal_split_in_the_EU (accessed on 24 November 2020).
48. European Commission. *The European Green Deal: COM (2019) 640 Final*; European Commission: Brussels, Belgium, 2019.
49. Viadonau. *Manual on Danube Navigation*, 4th ed.; Via Donau—Österreichische Wasserstraßen Gesellschaft mbH: Vienna, Austria, 2019.
50. CCNR. “Act Now!” on Low Water and Effects on Rhine Navigation. Available online: https://www.ccr-zkr.org/files/documents/workshops/wrshp261119/ien20_06en.pdf (accessed on 24 November 2020).