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Managing logistics in sport: a comprehensive systematic literature review

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Abstract

Logistics and sport management are part of the globalized economy and interdisciplinary fields of science. Sporting events necessitate enormous logistical efforts by aiming to deliver certain tasks and materials at an exact time and a specific place in suitable quantity and quality. However, sport logistics not only is involved in the precise execution of events but deals with a wide range of topics. Sporting goods are transported along the supply chain to customers with economic objectives, stadium evacuation simulations are carried out using algorithms that originate in transportation logistics, and sport clubs are confronted with logistical issues both on their game days and during the rest of the year. A systematic literature review was undertaken to provide clarity regarding previous scientific endeavors and to offer orientation for interested practitioners. The authors propose a theoretical framework—the sport logistics triangle—that draws on the academic disciplines of logistics management and sport management and allows to classify all sport logistics activities. An in-depth categorization scheme and ten topic clusters illustrate how sport logistics has been studied thus far. Implications and research opportunities are elaborated for practitioners and scholars. The survey clearly underlines both the importance of sport logistics and its neglect in academics.

Keywords Management · Logistics · Sport · Supply chain · Operations

JEL Classification L83 · M10 · R40 · Z20 · Z21 · Z29

1 Introduction

For the 2012 London Olympic Games 1.2 billion dollars were invested to plan and provide its comprehensive logistics and transportation for 6.2 million spectators (Hendy 2013, p. 9; Kershaw 2012, p. 243). Hence, the importance of logistics in modern sport should not be surprising. It is worth noting that the logistical efforts

Extended author information available on the last page of the article

(Sumner 2011, p. 55) of holding a hallmark event such as the FIFA World Cup or the Olympic Games (Ritchie 1984, p. 2) include more than public transport. At the 2008 Beijing Olympic Games, 104 hospitals were prepared for possible emergencies, and when the Games began, 400,000 volunteers were dispersed all over the city (BOCOG 2008, p. 21). Logistical considerations also play a role in the preparation of camps for athletes (Arnold et al. 2015, p. 12) and in all activities to deliver the necessary equipment to the venues (Minis et al. 2006a, b, p. 622). In July 2008, Beijing prepared 6,698,000 goods for the Games (BOCOG 2008, p. 150). The global sport market is estimated to be worth more than 600 billion dollars in 2023 (NPD Group 2019) and the revenue of the worldwide sport equipment market is expected to grow 27% between 2023 and 2027 (Statista Consumer Market Insights 2023). These figures lead to the conclusion that the demand for logistics in sport will continue to grow.

The potential consequences of poor logistics management in sport were on display, for instance, in 2019, when the Kansas City Chiefs were scheduled to play the New England Patriots. A container of player equipment had not been unloaded, and a defeat because of missing equipment was imminent (NBC 2019). Another example occurred in Formula One, where the Fédération Internationale de l'Automobile (FIA) has banned retrofitting of tires (BBC 2005b). After a devastating 150 mph accident in practice at the 2005 Indianapolis Grand Prix, Michelin pinpointed its tires as the source of the failure (Pfahl and Bates 2008, pp. 135–142). Had it been allowed to bring in new tires, it would have had to ship them from a warehouse in France to the racetrack in the United States (ESPN 2005). Consequently, all teams with Michelin tires had to withdraw from the race, leaving only six cars to finish (Pfahl and Bates 2008, p. 138) and resulting in major damage to the image of the FIA (Pfahl and Bates 2008) and a curious victory for Michael Schumacher (BBC 2005a). Due to the premise that "the consequences of operations failure have huge implications for the outcome of the on-field performance" (Bamford et al. 2015, p. 14), precise logistics operations are required to successfully orchestrate sporting events (Minis et al. 2006a, b, p. 622).

Both sport management (Brown et al. 2018, p. 75; Doherty 2013, p. 7) and logistics management (Haghani 1997, p. 250; Meng 2014, p. 137) are known as applied science disciplines. Despite the low tolerance for error in the management of large sporting events (Jones et al. 2015, p. 188), the fact that sport management researchers are entrusted with design issues related to competition venues (Slack 2014, p. 460) and the need for guidelines for successful implementation (Minis et al. 2006a, b, p. 622), researchers have been extremely reluctant to recognize the far-reaching importance of managing logistics in sport (Herold et al. 2019, p. 358). Therefore, a systematic literature review (SLR) rigorously collects all topic-related studies and provides groundwork for future regulations to which industry players can refer (Kitchenham et al. 2009, p. 8) and for the development of new research areas in management (Tranfield et al. 2003, p. 208).

Consequently, this paper defines the following leading research questions (RQ):

RQ1 What is the current state of the art in the field of sport logistics?

RQ2 Which directions for future research can be identified?

On the way to answering them, the following subordinate research questions (SRQ) are posed:

SRQ1 In which core areas of logistics and sport management does sports logistics research operate?

SRQ2 How can a framework for sport logistics look like that draws from both disciplines?

SRQ3 Which fundamental academic approaches are applied in sport logistics research?

SRQ4 Which topics does sport logistics deal with and how can the field be subdivided?

For a systematic overview of logistics management, researchers must consider intra-, extra- and interlogistical contexts (Gudehus and Kotzab 2012, pp. 439–440). Sport management must be reviewed with the understanding that its business “is not limited to leagues and competition” (Kauppi et al. 2013, p. 1369) while including its “commercial and not-for-profit forms” (Smith and Stewart 2010, p. 1). By employing the methodological procedure outlined by Kitchenham (2004, p. 3), this paper aims to facilitate the process of locating further research (Kitchenham and Brereton 2013, p. 2). Moreover, it intends to inspire researchers to further sport logistics management research.

Within the set parameters, the scope of the literature search had a range of 37 keywords, divided in accordance with the aforementioned research topic. More than 60,000 resulting publications were exported from ten scientific search engines and databases. The overall process of applying the content criteria and excluding nonfitting scientific works resulted in 202 final contributions to the categorization scheme. In the upcoming chapter, a comprehensive framework for sport logistics research is proposed and a delimitation from previous SLRs with reference to sport logistics is provided. Subsequently, the detailed review methodology is presented in chapter 3 and the results are analyzed in chapter 4. Chapter 5 discusses and outlines potential follow-up research opportunities. Finally, a conclusion that revisits the research questions is composed.

2 Theoretical background and differentiation from related surveys

In the first part of the chapter, the theoretical foundations of this paper are set by elaborating its theoretical background in the disciplines of logistics and sport management and proposing a framework for the management of logistics in sport: the sport logistics triangle. In the second part of the chapter the elaboration of this paper is distinguished from related works.

2.1 Theoretical background and the sport logistics triangle

Sport can be characterized as physical exercise determined by competition in a “nonhostile” manner (Wright 2009, p. 161). As the largest nonmilitary logistics event (Minis et al. 2006a, b, p. 621), the Summer Olympics contribute to the fact that sport has “emerged as an industrial sector in its own” with multifaceted obstacles for managerial practitioners (Chadwick 2009, p. 202). Although sport can be clearly distinguished from other sectors of the economy (Chadwick 2011, p. 122), sport management must nevertheless draw on other areas of management research in order to develop its own potential (Slack 2014, p. 462). In the current sport management literature, there is still a scarcity of contextual logistics research (Herold et al. 2019, p. 358). Logistics management has become important owing to its ability to create crucial benefits for organizations (Christopher 2016, p. 2), and an application to sport could create similar effects (Herold et al. 2019, p. 358).

Issues in sport logistics are manifold. They spread from planning car fleets (Minis et al. 2009) and forecasting transport demands (Dosunmu 2012) to the legacy of logistics infrastructures (Kassens-Noor 2013a). They include the coordination of athletes travel (Gupta et al. 2011) or spectator travel (Ceder and Perera 2014) to major events as well as its environmental impacts (Loewen & Wicker 2021) and supply chain emissions (Sampson et al. 2013). Issues of supply chain segmentation in the sporting goods industry (Roscoe & Baker 2014) are discussed from facility location (Pereira et al. 2017) to assort-packaging and distribution (Woong Sung et al. 2017). Consequently, this paper argues for a comprehensive view on sport logistics that is academically well-founded in the disciplines of logistics management and sport management. In the following, the key subjects of both disciplines will be discussed that lead to the key elements of our framework proposal that outlines the conceptual background for the systematic literature review: the sport logistics triangle (Fig. 1). Logistics management and sport management and their subfields form the professional and scientific foundation of sport logistics (gray triangle). Additionally, three triangle legs provide a classification scheme to contextualize any sport logistics activities.

As basic starting point for theory development, this elaboration regards supply chain management, which “encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities” (CSCMP 2013). Subsequently, a functional view is adopted which focuses on the core part of logistics management activities. Logistics, in a broad definition, is defined as the link between marketplace and supply base and managing logistic means to plan and coordinate all activities necessary to deliver logistics services (Christopher 2016, p. 11). The function of logistics management comprises integrative coordination as well as integrative service fulfillment inside and outside of organizations (Pfohl 2021, p. 3 ff.). The scope can be divided into four areas: procurement, operations, distribution, and reverse logistics (Arnold et al. 2008, p. 4; Christopher 2016, p. 11; Gudehus and Kotzab 2012, p. 6; Harrison et al. 2014, p. 11).

Procurement focuses the supply side of an organization and includes the sourcing and receipt of goods and services from suppliers. Procurement is also referred

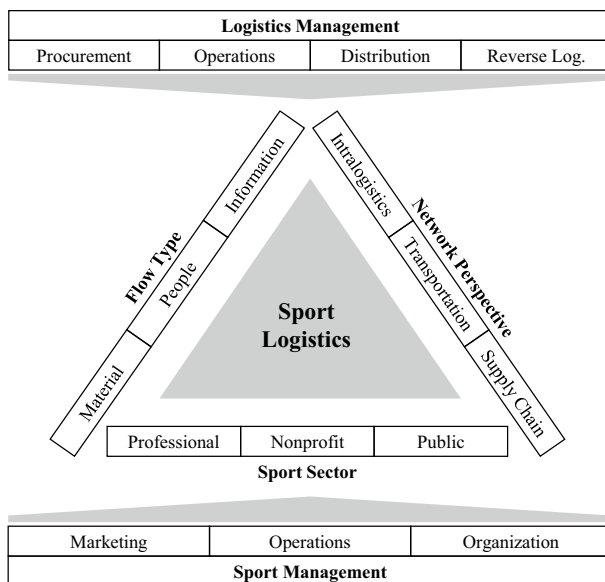


Fig. 1 The sport logistics triangle and its foundation in the disciplines of logistics management and sport management

to as inbound logistics or upstream. Operations focuses on the planning and control of flows within the boundaries of an organization. It is also referred to as internal logistics or production logistics (in the sense of producing a logistics service, e.g., order picking). Distribution is concerned with the delivery of products and services to customers. Distribution is also referred to as outbound logistics or downstream. Reverse logistics is the return of unwanted products, packaging or waste in the opposite direction, from the marketplace to the supply base. It is also referred to as returns or disposal management. (Arnold et al. 2008; Christopher 2016; Gudehus and Kotzab 2012; Harrison et al. 2014).

By the four areas of logistics management presented, all aspects of managing logistics in sport organizations can be described. Accordingly, a profound logistics management basis is provided for the sport logistics triangle.

The discipline of sport management comprises several areas of activities that are mainly derived from classic business management fields (Baker and Esherrick 2013; Beech and Chadwick 2013; Bradbury and O'Boyle 2017; Covell et al. 2019; Gillentine and Crow 2009; Hoye and Parent 2017; Robinson 2012). Of these areas, marketing, operations, and organization have large intersections with logistics.

Marketing in sport comprises all activities for the production, pricing, promotion, and distribution of a sport product to meet the needs of customers (Pitts and Stotlar 2013, p. 82). Its link to logistics is most evident in the aspect of distribution, the distribution of sporting goods from the productions site to the point of sale or the distribution of promotional articles at sporting events being specific examples. Sport marketing logistics meets the customers' needs through purchasing and supply chain management (Schwarz and Hunter 2018, p. 166). Operations

in sport is a transformational process which creates, maintains and improves the delivery of sport products and services (Piekarz 2021, p. 11). It comprises, e.g., facility and building management, merchandising and retail, or event and venue management. Operations and logistics share the input-transformation-output paradigm, Mentzer et al. (2008) identify logistics as the part of operations responsible for the transformation of time and place. Organization in sport is concerned with the structure, processes, and design of organizations and their subunits (Byers et al. 2012, p. x). With the spread of Porter's value chain approach (Porter 1998), also sport organizations have taken direction to outsource activities. As a result, the significance of thinking in processes, which is also the very approach of logistics, increases. In particular the outsourcing of activities that touch the physical value-adding structures (i.e., the physical structure of facilities to move goods Aronsson 2000; Hoekstra and Romme 1992)), e.g., sporting goods manufacturing or event organization (Andreff and Andreff 2009; Burden and Li 2009), requires a holistic perspective on value creation, along the whole supply chain and with special attention to the interfaces of subprocesses and their integration (Houlihan 1985).

The three subjects described represent the central areas of sport management dealing with logistics challenges. As such they provide a profound sport management basis for the sport logistics triangle. After the foundation of sport logistics in the academic disciplines of logistics management and sport management was now built, the sport logistics triangle is outlined next. It is composed of three legs: flow type, network perspective, sport sector. Every sport logistics activity has an intersection with each of the three legs. On the basis of these three legs, the diverse logistical activities in sport organizations can be put into context.

The first leg, flow type, follows the flow-oriented definition of logistics, which states that logistics comprises all activities to efficiently manage all flows of material (goods), people and information from a source to a sink (Christopher 2011; CSCMP 2013; Pfohl 2018). While flowing, material, services and information are subject to different transformation processes with regard to time, space, quantity, type, composition, value, shape, and handling properties (Pfohl 2018; ten Hompel et al. 2018). Particular examples for each flow type are the production supply at sport equipment manufacturers (material), the coordination of spectator travel to major events (people), or order processing for fan shop sales (information).

Depending on where the flow takes place, intralogistics, transportation and supply chain are distinguished (Gudehus and Kotzab 2012). This network perspective represents the sport logistics triangle's second leg. Intralogistics comprises flows in one location (at one site) (Günther 2006). Transportation, in contrast, comprises flows outside of buildings, often using public infrastructure (Clausen and Geiger 2013). Supply chains combine intralogistics and transportation in intercompany logistics networks of several participants (CSCMP 2013; Klaus 2012). Particular examples for each network perspective are the storage of event equipment at a sport venue (intralogistics), the shipping of a race car to the racetrack (transportation), or the distribution of sporting equipment along a sales channel (supply chain).

The third leg of the sport logistics triangle attributes the logistics activity the sector of sport. In the professional sport sector, sport organizations as professional leagues, equipment manufacturers or event managers pursue commercial interests. In the nonprofit sector, activities are on a voluntary basis (Hoye et al. 2015, p. 7; Smith and Stewart 2015, p. 19 ff.). Community based sport clubs and governing associations provide competition and participation opportunities, regulate and manage sporting codes, organize championship events (Hoye et al. 2015, p. 7; Smith and Stewart 2015, p. 19 ff.). The public sector comprises governments as well as specialist agencies that develop sport policy, provide funding, and support specialist roles, e.g., elite athlete development or drug control (Hoye et al. 2015, p. 7; Smith and Stewart 2015, p. 19 ff.). Particular examples for sport logistics activities in each sector are picking for the production of a sport shoe (professional), inventory management in a local sport club, or the transport of drug test kits between laboratories (public).

In summary, the sport logistics triangle defines sport logistics as dedicated to the management of flows in sport organizations.

2.2 Differentiation from related surveys

A first possible systematization of sport logistics management was proposed by Herold et al. (2019) who divide the field into four key pillars: venue logistics management, fan/spectator logistics management, equipment logistics management and athlete logistics management. To get to this suggestion, they regard sport logistics as a subfunction of sport event management. They draw on three event categorizations (regional, major, and mega sport events) and six typical characteristics of sport events to derive the four sport logistics pillars. Based on the SCOR model they define and discuss logistics activities in the context of their framework. The strict focus on event management is a clear limitation of the paper. Rather than a sport logistics framework, Herold et al. (2019) elaborated a sport event logistics framework. It does not offer theoretical foundation for the entire field of sport logistics management which goes far beyond requirement for sport events, specific examples being the production and distribution of sporting goods or inventory management in local sport and fitness clubs. Furthermore, Herold et al. (2019) predominantly focus the professional sport sector. This becomes most evident with regard to the athletes logistics management pillar. The nonprofit and public sectors are neglected. A comprehensive picture of sport logistics management is, thus, not drawn.

Another previous SLR with links to the management of logistics in sport was performed by Kauppi et al. (2013) and focuses operations management in sport. The authors categorize the papers reviewed in nine topics of operations management. Based on these topic areas and under consideration of four analysis units (organization, league, sector, industry) they sketch a research agenda for sport operations management. As Herold et al. (2019) the authors have a focus on sport events, as

Table 1 Related SLRs

	Kauppi et al	Herold et al	Pott et al
Focus	OM in sports	Sport event logistics	Sport logistics
Method	Pittaway et al. (2004)	Durach et al. (2017)	Kitchenham (2004) and Tranfield et al. (2003)
Search period	Not defined	2000–mid-2019	2011–2021
Keywords	37 (9 sport-KW, 28 OM/SCSM-KW)	6 (1 sport-KW, 5 logistics-KW)	37 (20 sport-KW, 17 logistics-KW)
Search in	Abstract or limited number of words in the full text	Abstract	Abstract and title
Databases	3 (ProQuest, ScienceDirect, Web of Science)	2 (Business Source Complete, SSCI)	10
Included work	Journals	Journals	Journals and conference proceedings
Peer review	Not defined	Yes	Yes (journal papers)
Additional search	1. 59 sport-KW in 15 OM/SCM journals 2. 35 OM-KW in 5 sport management journals	/	/
Checked articles (with duplicates)	12,451	403	68,360

the reliance on the specific characteristics of sport reveals. Sport equipment manufacturing and retail are excluded from the scope of the paper as well as on-field performance. Considering the sport industry as part of the service industry leaves the handling of tangible goods by definition disregarded. With respect to the sport sectors the study is comprehensive and considers the commercial, nonprofit and public sport sectors alike. But even though operations management has many links to logistics, the paper's focus is not the management of flows, the movement and storage of goods, the provision of logistics services.

In summary, it can be stated that there is no SLR that creates a full picture of sport logistics management. Table 1 compares the approaches of both papers with the approach of this contribution in order to highlight the originality of this contribution.

To map the planned scope, not only was the number of databases enlarged to 10, compared to Herold (2019) with two and Kauppi (2013) with three, but important topic-specific databases from the fields of sport management and logistics management, e.g., SportDiscus and Transport Research International Documentation (TRID), were also integrated for the first time. For multidisciplinary databases, the search areas were specially tailored where possible. Within this range of databases, in contrast to previous SLRs, conference proceedings were targeted in addition to journal papers, as recommended by Kitchenham et al. (2009). Due to the expansion of the research scope, the number of databases and the types of publications, the number of checked articles was remarkably higher. A keyword count of 37, divided into a sport and a logistics branch, further ensured the identification of all potentially relevant research. The research objective is implicit and is intended to clarify, as Denyer and Tranfield (2009) requested, what is and is not considered common knowledge about this particular management topic. From there, possible future research opportunities became recognizable.

In its analysis, unlike the previous SLRs, the paper not only offers a framework and builds topic clusters but also classifies the publications into classic fields of the sport management and logistics management disciplines and examines their scientific methodology. Moreover, not only are the findings described in writing, but the reader is also provided with visualizations (e.g., keyword cluster, word cloud) to deepen his or her understanding of the scope.

3 Methodology

The methodology used in this paper is based on the guidelines recommended for systematic reviews by Kitchenham (2004) and Kitchenham et al. (2009). Furthermore, the whole process of carrying out the research is aligned with the procedure of Tranfield et al. (2003) and Denyer and Tranfield (2009). The decision to use an SLR was made in the interest of the transparency and rigor of the research process (Fan et al. 2022, p. 4). Review planning, as Tranfield et al. (2003, p. 214) first put it, had already begun through differentiation from

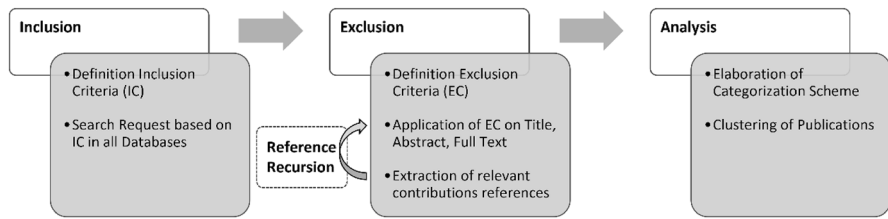


Fig. 2 Outline of the SLR process

other SLRs in sport, logistics and linked management research. Thus, mandatory scoping studies were conducted. A separation into four sections, namely, inclusion, exclusion (selection process), reference recursion and analysis, accompanied by seven inherent stages, took place. The method is shown in Fig. 2. When undertaking the systematic review, it was of great importance that only studies that complied with both the inclusion and exclusion criteria were considered (Tranfield et al. 2003, p. 215).

3.1 Inclusion criteria

At the beginning of the literature search, the criteria for inclusion were set (Table 2).

When searching in the above databases, it was determined that the results should contain at least one keyword from the world of sport and one keyword from the world of logistics. The selection of keywords was based on a consensus among more than 20 scientists collaborating with the authors. The final choice represents a series of important key terms in the two subject areas of sport and logistics. Thus, high accuracy in

Table 2 Inclusion criteria

Inclusion criteria	Description
Database	ACM, Bielefeld Academic Search Engine (Base), EconLit, IEEE Xplore, ProQuest, ScienceDirect, Scopus, SportDiscus, Transport Research International Documentation (TRID), Web of Science
Logistics keywords	Logistics, “supply chain”, SCM, transport*, warehous*, distribut*, “material handling”, procurement, production, ship*, inventor*, delivery, outsource*, storage, “information flow”, fulfillment, fulfilment
Sport keywords	Sport*, football, soccer, Olympic*, fitness, athlet*, arena, club, gym, stadium, tournament, championship, basketball, tennis, cricket, “Formula 1”, baseball, boxing, golf, hockey
Excluded keywords	“Logistic regression”
Years of publication	2011–2021
Language	English
Source type	Peer-reviewed journals & conference proceedings

obtaining articles that dealt with an interrelation of the two areas was ensured. Per database, with the help of multiple operators, the search process was performed once in the title and once in the abstract with all possible combinations of the keywords at the same time. Special cases were Base and ScienceDirect. In the Bielefeld Academic Search Engine, the abstract search was not an available option, which led to an exchange of the abstract search with the publication-internal keyword search, while ScienceDirect automatically included title, abstract and publication-internal keywords in its search. An asterisk was used to include different word endings and spellings. The term “logistic regression” was excluded because it is a mathematical method for regression analysis and has no direct relation with logistics research.

A publication period of ten years was set up front for the included papers. Because the research was finalized 2022, the review horizon was expanded to a range of Jan 1, 2011, to Dec 31, 2021. This provided an up-to-date representation of the state of the art. The supplementary articles from the recursion process were not limited in terms of the publication period because it was assumed that the reference choices of an article concerned with sport logistics remained relevant further back in time. Other inclusion criteria still applied.

The articles had to be written in English. To ensure a certain level of quality and validity, the only accepted source types were conference papers and journals with peer-reviewed status. The chosen databases were selected in reference to Gusenbauer and Haddaway (2020), who evaluated 28 databases for their subject and for suitability when planning to carry out an SLR.

First, all databases that did not allow a bulk reference download were excluded due to the lack of suitability for an SLR. Second, the databases were chosen in accordance with their given subject; therefore, health, medicine, biomedicine, nursing, psychological and education study databases were not included. All chosen databases are listed in Table 3 alongside their subjects. A logistics-related database,

Table 3 Included databases and subjects

Database	Subjects	Note
ACM	Computer science	Database removes all search results above the count of 2000
Base	Multidisciplinary	Database removes all search results above the count of 1000
EconLit	Economics	/
IEEE Xplore	Computer science, electrical engineering, electronics	29 topics were excluded
ProQuest	Business, management	6 subdatabases were included
ScienceDirect	Multidisciplinary	/
Scopus	Multidisciplinary	19 topics were excluded
SportDiscus	Sport studies	/
TRID	Transportation studies	/
Web of Science	Multidisciplinary	47 topics were excluded

a sport-related database and databases with other potentially important disciplines for sport logistics, such as management, computer science and engineering, as well as several multidisciplinary databases were chosen.

In ProQuest, six subdatabases shown in appendix B were included. The subdatabases were selected according to their deposited subject areas, e.g., economics and social sciences, and the provided source type. If the databases allowed the option of excluding certain topics and refining the search by doing so, such actions were taken only if the categories were clearly not in line with the research aim. Categories such as biology, chemistry and agriculture were eliminated. A full list of excluded topics for the Web of Science, Scopus and ACM databases is shown in appendix A. Furthermore, Base showed no more than 1,000 hits per search. In the same manner, ACM omitted any results above 2,000 hits. The retroactively added year of 2021 did not affect the results. A thorough application of the inclusion criteria to the databases resulted in potentially relevant hits, which in turn filled the created list of all contributions with possible relevance. An automatic duplicate removal based on titles was performed. Then, the list was approved for the selection process.

3.2 Selection process

To decide whether an article met the criteria for the sport logistics topic, a content criterion consisting of a link between sport and logistics was provided. Each of the studies that initially matched the inclusion criteria was examined independently and sequentially in the selection process by the authors in the areas of title, abstract and full text. Those articles had to fulfill the content criterion in all three segments. If there was a contradiction, the contribution was excluded at that point. In the event of discrepancies, discussions were held by the research panel to refine the thematic boundaries. The content criterion is shown in Table 4.

Only if the examination of the contributions' full texts within the selection process manifested the link were they approved for the deeper literature analysis. The contributions approved for the literature analysis were searched afterward for further

Table 4 Content Criterion and Definitions

	Subject	Description
Content Criterion	Sport and logistics management	Content needs a link between sport and logistics
Definition	Logistics	"Planning, implementing and controlling the flow of information and goods from point of origin to consumption" (Giunipero and Brand 1996, p. 31)
Definition	Sport	"Regarded as physical activity that is competitive, requires skill and exertion and is governed by institutionalized rules" (Trenberth and Hassan 2011, p. 3)

references matching the topic and the inclusion criteria except for the set publication period of 2011–2021. The extension of the publication period for the references was justified previously by the fact that the references of the contributions that remained at the end of the selection process were possibly so closely related to the topic of logistics in sport that these contributions should be included even if they were outside the date range. An extension of the time period beforehand in the inclusion criteria would have led to a number of hits that would have exceeded the capacities of the search. Another duplicate removal was performed within the list of all references. The identified references also had to match in all three areas of the selection process.

3.3 Literature analysis

Starting with the fourth section, analysis, a final contributions list was compiled that contained all relevant studies identified in the selection process. Additional information for each study, such as title, abstract, author names, publication date, name of journal/conference, link, link date, digital object identifier (DOI) and APA citation, were added, as there had been no full extraction of information from all databases. In the final list, duplicates were removed, and publications without a DOI were eliminated.

The final contributions were now reread and analyzed. In addition, more data were extracted in terms of the main topic area and methodology. A categorization scheme was created with reasonable categories to classify the contributions. This scheme was continuously refined throughout the process. The final scheme is shown in Table 5. Subsequently, the classification of the literature into the previously created scheme took place.

The type of work category distinguished between literature review, research article and project report. A literature review can be part of a broader methodology or can be the methodology itself (Cooper 1998, pp. 3–4). A research article could therefore contain a literature review but might have a main objective in opposition to the literature review as a focus not only on reflecting the current

Table 5 Categorization Scheme

Category	Subcategory
Type of work	Literature review, research article, project report
Network perspective	Transportation, supply chain management (SCM), intralogistics
Flow type	Material flow, people flow, information flow
Sport sector	First (1st), second (2nd), third (3rd)
Type of sport	Team, single, undefined
Academic focus	Conceptual, technological, empirical
Type of research (1)	Descriptive, analytical
Type of research (2)	Qualitative, quantitative
Type of research (3)	Basic, applied

state of the art but also on establishing a new or more in-depth state of research. Various research methods, such as data collection, were used for this purpose (Gastel and Day 2016, p. 18). This could also be done in project reports, but these reports tended to be carried out "for operational reasons" (Perneger 2004, p. 191). In such cases, the authors were directly involved in the project described; i.e., they were on site.

The network perspective describes flows in form of networks that consist of nodes and edges. Depending on the considered section of the network three parts were distinguished (Gudehus and Kotzab 2012, pp. 439–440). Intralogistics takes place exclusively in one node and describes internal processes at one location. Extralogistics refers to transportation processes, or what happens on the edges between nodes, i.e., in channels. Interlogistics is an entire logistics network that combines the two previously mentioned disciplines and, in the form of supply chain management, refers to both nodes and edges. In addition, three types of flow could be distinguished: material flow, people flow, or information flow. Some contributions also looked at a combination.

The sport sectors were also trisected, creating a division into professional (commercial organizations, e.g., equipment manufacturers or franchises), nonprofit (e.g., community-based clubs or events), and public (e.g., government funded or related to drug control) (Hoye et al. 2015, pp. 7–8). From there, the categorization distinguished between teams and individual athletes. These types of sport were supplemented by the undefined category to cover scientific work that did not explicitly deal with a particular type of sport.

To classify the publications according to their academic focus, a three-part approach consisting of conceptual, technological, and empirical aspects was utilized. Conceptual papers do not necessarily have a practical focus and deal with the development of new concepts, some of which are abstract, or the extension of existing ones. If the focus is technological, the research centers on a technology that is explained and occasionally described in terms of its application. Empirical contributions rely on data collected, e.g., through observations or experiments, and therefore are often based on the researchers' own findings (Kothari 2004, p. 4).

Following Kothari (2004) once more regarding the research orientation of the final contributions, some complementary categories of the type of research were applied. The research objective could be descriptive if facts were sought in the past and present, which made the research "ex post facto" (Kothari 2004, p. 3). Analytical research has the objective of evaluating, analyzing and providing instructions for future processes or procedures. The methodology type can be qualitative, quantitative or both. The data of qualitative studies are mostly nonnumerical, while quantitative studies use numbers or convert data into numerical values. In conclusion, the type of research distinguished between basic research, in which new knowledge is added to existing theories, and applied research, in which the analysis of empirical data is used to find solutions to problems. The solutions thus refer to the application in a practical environment such as companies.

4 Analysis

Moving on from an overview of the categorization scheme, the following presents the SLR review outcome. First, the selection process across the individual process steps is presented and underpinned with numbers. This is followed by general facts about the publications that made it to the final list. The papers of the conclusive list are presented within the categorization scheme. The categories are utilized to gather information and help to draw conclusions regarding the state of the art of sport logistics research. When the follow-up literature analysis was conducted, it

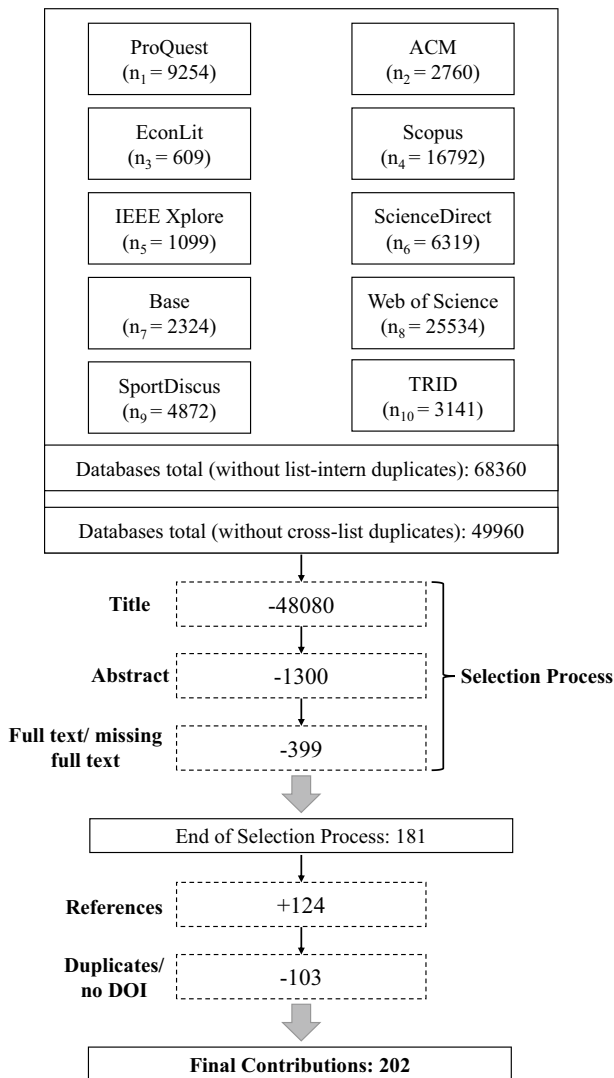


Fig. 3 Selection process with numbers

was consistent with the suggestions made by Tranfield et al. (2003, pp. 218–219) about how to report the studies: (i) descriptive statements are followed by (ii) thematic analysis. The authors present the emerging themes, and connections are drawn between them.

4.1 Reduction of publications during the selection process

Initially, the finalized selection process is described in its entirety (Fig. 3). As mentioned before, a systematic literature search was conducted in the ten databases. As a result, tables containing all exportable articles were created for each database. Up to this point, no exclusion of journal/conference papers was performed with regard to the predefined criterion. Moreover, the search results were not scanned for duplicates. Specifically, the preliminary blocks/lists ($n_1 \dots n_{10}$) contained the raw data of the initial database searches with a total of 72,704 papers.

After an intralist search for duplicates and the deletion of duplicates, a merged list of 68,360 papers resulted. The lists from all the databases were then merged, and a second duplicate removal took place, which decreased the outcome to 49,960 contributions that became the focal point of the systematic review. The lack of combined coverage of sport and logistics led to an exclusion of 44,362 publications on the basis of the title alone. Then, the participating researchers excluded 1,300 papers on the basis of their abstracts by using the same content criterion (also see (3.2) Selection Process). A total of 399 papers were not considered further because of the missing link between sport and logistics in the full text of 329, and the remaining 70 were excluded because there was no available full text. Ultimately, 181 papers remained. The recursion process for those added another 124 papers to the final entries. A final duplicate removal and an exclusion for the absence of a DOI were performed. The definitive list for the literature analysis then consisted of 202 publications. It contains the authors cited in APA citation style, the year of publication, a classification in the previously created categorization scheme and a topic cluster (Table 6).

Table 6 Categorization scheme and topic clusters

General information	Type of work		Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster								
	Literature review	Research article	Project report	Trans-shipment	SCM	Intralogistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Single	Unsifted		Conceptual	Technological	Empirical	Qualitative	Quantitative	Applied	Descriptive	Analytical
References																								
Agha and Dixon (2021)	x			x			x	x		x			x								x		x	10
Aguilera (2020)	x			x			x			x					x					x	x		x	5
Andreff and Andreff (2009)	x			x			x			x					x					x	x		x	5
Appelqvist et al. (2013)	x			x			x			x					x						x		x	5
Appelqvist et al. (2016)	x			x			x			x					x									5
Arnold et al. (2015)	x				x			x		x			x								x		x	1
Arnold et al. (2016)	x			x					x						x						x		x	7
Asian et al. (2020)	x			x			x			x					x						x		x	5
Bao et al. (2017)	x			x			x			x					x						x		x	1
Bateman and Majumdar (2018)	x				x			x		x					x						x		x	9
Beis et al. (2006)	x			x			x			x														1
Brady and Davies (2014)	x			x			x			x											x		x	2

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster									
		Project report	Trans- portation	SCM	Intralo- gistics	Material flow	People flow	Info. flow	Pub- lic	Non- profit	Sin- gles					Team	Unspeci- fied	Con- ceptual	Tech- nologi- cal	Emperi- cal	Quali- tative	Applied	Descrip- tive	Ana- lyti- cal
References	Litera- ture review	Research article																						
Browne et al. (2014) Bunds et al. (2018) Burke and Woolcock (2009) Cai et al. (2018) Ceder and Perera (2014) Chelladurai et al. (1987) Chen and Notteboom, (2012) Chen et al. (2020) Cheng and Song (2021) Cheng et al. (2020)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1
	x	x		x	x	x		x		x		x	x	x	x	x	x	x	x	x	x	x	x	7
		x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	10
	x		x		x	x	x		x		x		x	x	x	x	x	x	x	x	x	x	x	1
	x	x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	2
	x		x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	7
	x	x		x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	5
	x		x																					1
	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	6
	x	x																						1
Chersulich Tomino et al. (2020) Cho et al. (2019) Cieslinski et al. (2016)		x																						3
			x																					7
	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	6

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster										
		Literature review	Research article	Project report	Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team		Singled	Unspecified	Conceptual	Technological	Empirical	Qualitative	Quantitative	Basic	Applied	Descriptive
References																									
Clikeman (2012)	x																								
Collins et al. (2012)	x																								
Consoli et al. (2013)																									
Currie and Delbosc (2011)	x																								
Currie and Shalaby (2012)	x																								
Currie et al. (2014)	x																								
Darcy (2003)	x																								
Denicol et al. (2021)	x																								
Desbordes (2001)	x																								
Desbordes (2002)	x																								
Dolf and Teehan (2015)	x																								
Dong et al. (2012)	x																								
Dosumu et al. (2017)	x																								

Table 6 (continued)

General information	Type of work Litera-Research article review	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster
		Project Trans- report portation	SCM Intralo-Mate- gistics rial flow flow	Info- Mate- Pleo- flow flow	Pub- flow lic	Non- profit sional	Team Sngle	Unspeci- fied	Con- ceptual	Tech- nological	Empiri- cal	Quali- tative	Applied	Descriptive	
Dosunmu (2012)		x	x	x	x			x	x			x	x	x	1
Earl et al. (2014)		x		x	x		x			x		x	x	x	2
Elbery et al. (2019a, b)	x	x		x	x			x		x		x	x	x	6
Elbery et al. (2019a, b)	x	x		x	x		x			x		x	x	x	6
Emmerson (2012)		x		x	x			x		x		x	x	x	2
Enock and Jacobs (2008)	x			x	x			x		x		x			1
Fang et al. (2011a, b)	x		x	x	x			x		x		x	x	x	9
Fang et al. (2011a, b)	x		x	x				x		x		x	x	x	9
Ferranti et al. (2020)	x	x		x	x			x		x		x	x	x	2
Gallucci and Petersen (2017)	x		x	x		x		x		x		x	x	x	7
Gerke (2016)	x		x	x		x		x		x		x	x	x	10
Gerke and Dalla Pria (2018)	x		x	x		x		x		x		x	x	x	10
Gerke et al. (2018)	x		x	x		x		x		x		x	x	x	10

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1		Type of research 2		Type of research 3		Topic cluster									
		Literature review	Research article	Project report	Trans-shipment	SCM	Intralogistics	Material flow	People flow	Info-flow	Public	Non-profit	Professional	Team	Singled	Unspecified	Conceptual		Technological	Empirical	Qualitative	Quantitative	Basic	Applied	Descriptive	Analytical	
Gerke et al. (2015)	x					x		x		x			x		x		x					x				x	10
Gerke et al. (2020)		x				x		x		x			x		x		x					x				x	10
Ghaffar et al. (2011)	x					x		x		x			x		x		x					x				x	2
Giuliano (1988)	x			x				x		x			x				x					x				x	2
Gupta et al. (2011)		x		x				x		x			x				x					x				x	7
Gutierrez et al. (2021)	x			x				x		x			x		x		x					x				x	10
Han et al. (2018)		x				x		x		x			x				x					x				x	3
Harvey and Saint-Germain (2001)		x				x		x		x			x				x					x				x	5
Hecox (2013)	x					x		x		x			x				x					x				x	10
Henao and Marshall (2013)	x			x				x		x			x				x					x				x	2
Hensher and Brewer (2002)	x			x				x		x			x				x					x				x	2
Herold et al. (2021)		x				x		x		x			x				x					x				x	2

Table 6 (continued)

General information	Type of work Litera-Research ture article review	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster
		Project Trans- report portation	SCM Intralo-Mate- gistics rial flow	Peo- ple flow	Info- flow	Pub- lic	Non- profit	Team Singe	Unspeci- fied	Con- ceptual	Tech- nological	Quali- tative	Basic Applied	Descriptive	
Herold et al. (2019)	x		x	x	x		x		x	x		x	x	x	2
Humphreys (2017)	x	x	x			x		x		x			x	x	10
Jiang (2008)		x		x		x			x			x	x	x	2
Jingmeng et al. (2013)	x		x		x		x	x		x		x	x	x	4
Johnson et al. (2016)		x		x		x			x			x	x	x	1
Jones and Woolley (2019)	x	x		x		x			x			x	x	x	2
Jones et al. (2015)	x	x		x	x	x			x			x	x	x	2
Judge et al. (2014)	x		x				x			x		x	x	x	7
Karaköprü and Kabadurmuş (2019)	x	x		x		x	x	x		x		x	x	x	7
Kassens-Noor (2010)	x	x		x		x			x			x	x	x	3
Kassens-Noor (2013a, b)	x	x		x		x			x	x		x	x	x	3
Kassens-Noor (2019)	x	x		x		x			x	x		x	x	x	1

Table 6 (continued)

General information	Type of work Literature review	Type of work Research article	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster					
			Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Single					Team	Unsponsored	Conceptual	Technological	Empirical
Kassens-Noor and Fukushima (2018)	x		x		x	x	x		x	x	x										6
Kassens-Noor and Kayal (2016)		x	x		x			x		x		x		x							3
Kassens-Noor et al. (2018)			x		x			x		x		x		x							3
Kauppi et al. (2013)	x		x		x	x		x		x		x		x							10
Kendall et al. (2010)	x		x			x		x		x		x		x							10
Kershaw (2012)			x			x		x		x		x		x							2
Khara and Lund-Thomsen (2012)	x		x		x			x		x		x		x							4
Klauser (2013)	x		x		x			x		x		x		x							9
Kovacs-Gyori et al. (2018)	x		x		x	x		x		x		x		x							1
Kristiansen et al. (2016)			x		x			x		x		x		x							3
Kubler et al. (2017)	x		x		x	x		x		x		x		x							6
Kumar et al. (2021)	x			x	x			x		x		x		x							4

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster							
		Project report	Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Singled	Unspecified		Conceptual	Technological	Empirical	Qualitative	Quantitative	Applied	Descriptive
References	Literature review																					
	X		X		X		X		X		X		X		X		X		X		X	1
Kwoezek et al. (2014)																						
	X		X		X		X		X		X		X		X		X		X		X	2
Lassacher et al. (2009)																						
	X		X		X		X		X		X		X		X		X		X		X	2
Leilei et al. (2012)																						
	X		X		X		X		X		X		X		X		X		X		X	1
Li et al. (2019)																						
	X		X		X		X		X		X		X		X		X		X		X	1
Li et al. (2013)																						
	X		X		X		X		X		X		X		X		X		X		X	3
Lindau et al. (2016)																						
	X		X		X		X		X		X		X		X		X		X		X	2
Lindsay (2013)																						
	X		X		X		X		X		X		X		X		X		X		X	2
Liu et al. (2008a, b)																						
	X		X		X		X		X		X		X		X		X		X		X	2
Liu et al. (2008b, b)																						
	X		X		X		X		X		X		X		X		X		X		X	4
Locke (2007)																						
	X		X		X		X		X		X		X		X		X		X		X	8
Loewen and Wicker (2021)																						
	X		X		X		X		X		X		X		X		X		X		X	10
Luitzen et al. (2015)																						
	X		X		X		X		X		X		X		X		X		X		X	1
Lund et al. (2011)																						
	X		X		X		X		X		X		X		X		X		X		X	4
Lund-Thomsen (2013)																						

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster					
		Project literature review	Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Singles	Unspecified		Conceptual	Empirical	Qualitative	Quantitative	Descriptive
References																				
MacIntosh et al. (2016)	x		x		x			x				x	x	x						7
Mahmudzadeh et al. (2020)	x			x			x		x			x		x						9
Malfas et al. (2004)	x		x			x	x	x				x		x						3
Malhado and Rothfuss (2013)	x		x			x						x	x	x						2
Mamic (2005)	x			x		x			x			x								5
Manzenreiter (2013)	x		x			x			x			x	x	x						4
McGuinness (2013)		x	x			x	x					x		x						6
Meier et al. (2019)	x			x		x			x			x	x							4
Memari et al. (2021)	x		x			x			x			x	x							7
Merk (2011)			x			x			x			x								4
Middleditch and Bradbury (2014)	x		x				x		x			x	x							2
Millstein and Campbell (2018)		x		x				x		x			x							10

Table 6 (continued)

General information	Type of work review	Network perspective		Flow type	Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster									
		Project report	Trans-shipment		SCM	Intralogistics	Material flow	People flow	Info. flow	Public					Non-profit	Professional	Team	Singles	Unsifted	Conceptual	Technological	Empirical	Qualitative
References																							
Minis and Tsamboulas (2008)	x		x					x			x		x										1
Minis et al. (2006a, b)	x		x					x			x		x										1
Minis et al. (2006a, b)	x			x				x			x		x										1
Minis et al. (2009)	x		x					x			x		x										2
Mirehie et al. (2021)	x		x						x				x										10
Mosadeghi et al. (2020)	x		x							x			x										2
Motla et al. (2021)	x			x					x				x										10
Mountjoy et al. (2015)		x		x					x				x										2
Mountjoy et al. (2021)	x			x						x			x										1
Mulley and Moutou (2015)			x						x				x										3
Nadvi (2011)	x			x																			4
Nadvi et al. (2011)	x		x						x				x										4

Table 6 (continued)

General information	Type of work review	Type of work		Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1		Type of research 2		Type of research 3		Topic cluster				
		Literature review	Research article	Project report	Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Single	Unspecified	Conceptual	Technical	Empirical		Qualitative	Quantitative	Descriptive	Analytical
References	Naz and Bögenhold (2020)	x				x		x		x	x		x	x		x				4				
	Odoni et al. (2009)	x				x		x	x				x	x		x				1				
	Palmieri et al. (2021)	x				x		x		x	x		x	x		x				6				
	Parent (2008)		x			x				x			x			x				1				
	Parkes et al. (2016)	x						x		x			x	x		x				2				
	Peng et al. (2013)	x				x		x	x				x			x				2				
	Liu and Gao (2013)	x				x		x	x				x			x				1				
	Pereira (2018)	x						x	x				x	x						3				
	Pereira et al. (2017)	x				x		x		x	x		x	x		x				10				
	Puangmanee and Saearlee (2020)			x						x			x	x		x					10			
	Pulugurtha et al. (2020)	x				x		x																
	Rabadi et al. (2015)	x								x														
Radicchi (2014)	x																							
Ramadan et al. (2020)	x																							

Table 6 (continued)

General information	Type of work		Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1		Type of research 2		Type of research 3		Topic cluster						
	Literature review	Research article	Project report	Trans-shipment	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Singles	Unspecified	Conceptual	Technological	Empirical		Qualitative	Quantitative	Basic	Applied	Descriptive	Analytical
Ratnatunga and Muthaly (2000)	x			x		x	x	x	x		x		x								x			x	1
Raza (2016)	x				x		x				x					x						x			6
Razavi (2014)	x			x			x		x		x				x							x			4
Ren et al. (2021)	x			x			x		x		x				x							x			6
Ribeiro and Almeida (2020)	x		x				x				x				x							x			3
Ribeiro and Cunha de Almeida (2021)	x		x				x				x				x							x			2
Ribeiro et al. (2021)	x			x			x		x						x							x			2
Richter and Ruhl (2013)		x					x		x						x							x			2
Robbins et al. (2007)	x		x				x				x				x							x			1
Roscoe and Baker (2014)	x			x			x				x				x							x			5
Rozhdestvenskaya et al. (2021)	x			x			x				x				x							x			10
Rutten et al. (2021)	x						x																		2

Table 6 (continued)

General information	Type of work Litera-Research ture article review	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster
		Project Trans- report portation	SCM Intralo-Mate- gistics rial flow flow	Info- ple flow flow	Pub- flow lic	Non- profit	Team sional	Single	Unspeak- fied	Con- cept- tual	Empiri- cal	Quali- tative	Basic	Applied	
Rutty et al. (2015)	x		x	x		x			x	x		x	x		2
Sampson et al. (2013)	x	x	x	x			x		x		x		x		8
Sarasua et al. (2016)	x	x	x	x			x		x		x		x		6
Sattayhatewa and Smith (2003)	x	x	x	x			x		x		x		x		1
Savič et al. (2018)	x	x	x	x			x		x		x		x		10
Scur and Koloski (2019)	x	x	x	x			x		x		x		x		5
Serrano et al. (2019a, b)	x	x	x	x			x		x		x		x		10
Serrano et al. (2019a, b)	x	x	x	x			x		x		x		x		10
Shi et al. (2020)	x	x	x	x			x		x		x		x		2
Shilbury (2000)	x	x	x	x			x		x		x		x		10
Simms et al. (2021)	x	x	x	x			x		x		x		x		7
Slack (2014)	x	x	x	x			x		x		x		x		10
Smith and Smith (2008)	x	x	x	x			x		x		x		x		10

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster								
		Literature review	Research article	Project report	Trans- portation	SCM	Intra-logistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team		Single	Unspecified	Conceptual	Technological	Empirical	Qualitative	Quantitative	Descriptive
Somabutr et al. (2020)		x		x		x		x		x		x		x		x						x	7
Spector (2017)	x		x					x							x							x	8
Sroka (2021)	x		x					x							x							x	3
Stewart et al. (2008)		x			x			x							x							x	10
Su et al. (2009)	x		x					x							x							x	2
Subic et al. (2012)		x				x				x					x							x	4
Summer (2011)		x		x						x					x							x	2
Summer (2012)		x		x				x							x							x	3
Sun et al. (2021)	x			x				x							x							x	2
Szymoszowskyj et al. (2016)	x			x						x					x							x	7
Thomsen and Nadvi (2010)	x			x						x					x							x	10
Toffano Pereira et al. (2019)	x		x					x							x							x	8
Triantafyllidis and Davakos (2019)	x		x					x							x							x	8
Triantafyllidis et al. (2018)		x								x					x							x	8
Villiers et al. (2019)	x		x					x							x							x	2

Table 6 (continued)

General information	Type of work	Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1	Type of research 2	Type of research 3	Topic cluster								
		Literature review	Project report	Trans-shipment	SCM	Intralogistics	Material flow	People flow	Info. flow	Pub. lic	Non-profit					Professional	Team	Singleg	Unsponsored	Conceptual	Technological	Empirical	Qualitative
Vouillamoz et al. (2009)	x		x				x		x				x				x				x		2
Wen et al. (2008)	x		x				x		x				x				x				x		2
Wicker (2018)	x		x				x										x						8
Wise et al. (2019)		x					x		x								x				x		10
Wiśniewski (2021)	x						x						x				x						7
Wojtowicz and Wallace (2010)	x		x				x		x				x				x						2
Wood (2019)	x		x				x																3
Woong Sung et al. (2017)		x					x						x				x				x		5
Wu and Li (2016)	x						x		x								x						6
Xie et al. (2017)	x						x										x						9
Xiong et al. (2013)		x					x		x								x						2
Xiong et al. (2012)		x					x		x								x				x		2
Xiong et al. (2010)		x					x		x								x						2

Table 6 (continued)

General information	Type of work		Network perspective		Flow type		Sport sector		Type of sport		Academic focus		Type of research 1		Type of research 2		Type of research 3		Topic cluster						
	Literature review	Research article	Trans-report	SCM	Intralogistics	Material flow	People flow	Info. flow	Public	Non-profit	Professional	Team	Single	Unspecified	Conceptual	Technological	Empirical	Qualitative		Quantitative	Descriptive	Analytical			
References																									
Xu and González (2017)	x	x				x	x	x					x				x			x		6			
Yamawaki et al. (2020)	x	x					x						x				x			x		3			
Yan et al. (2010)	x	x					x	x	x				x				x			x		2			
Yu and Duan (2021)	x					x				x			x				x			x		6			
Zeller (2015)	x	x					x		x				x				x			x		10			
Zhang et al. (2018)	x				x		x	x		x			x				x			x		9			
Zhang et al. (2021a, b)	x	x					x			x							x			x		6			
Zhang et al. (2021a, b)	x	x					x	x					x				x			x		6			
Zhou et al. (2021)	x												x				x			x		2			
Zoghi et al. (2009)	x	x																		x		3			
Σ	38	133	31	97	87	18	82	128	95	72	25	105	47	18	137	51	21	130	100	102	126	76	95	107	—

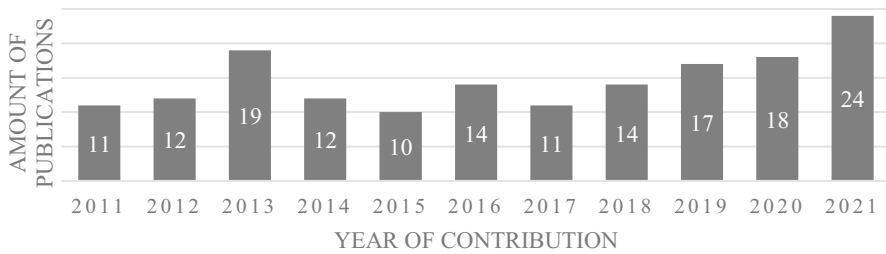


Fig. 4 Sport logistics publications since 2011

4.2 General publications analysis

4.2.1 Publication year

Beginning with (i) the descriptive statements as a preparation for (ii) the thematic analysis, the 202 selected scientific papers showed that there had been no crucial increase in publications relating to a combination of sport and logistics management topics over the previous decade (Fig. 4). The releases were almost evenly distributed over the time horizon, with a peak of 24 articles in 2021. Whether managing logistics in sport will receive intensified interest from researchers and businesses can be determined only by watching future years and expanding the research period.

4.2.2 Country of origin

Based on the affiliation of the first author, statistics were collected on the country of origin of each publication. Figure 5 gives an overview on all countries with more than five publications. Countries with four publications or less are subsumed under “others”.

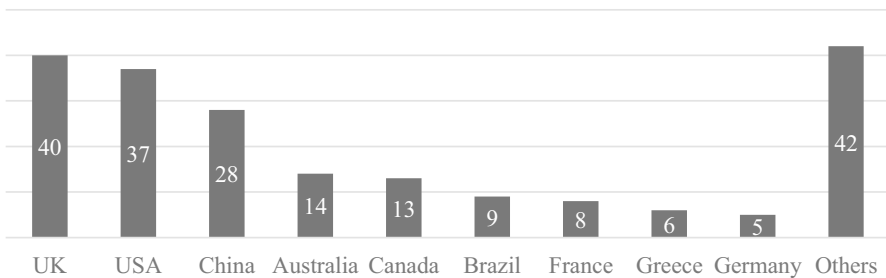


Fig. 5 Countries of origin of the publications

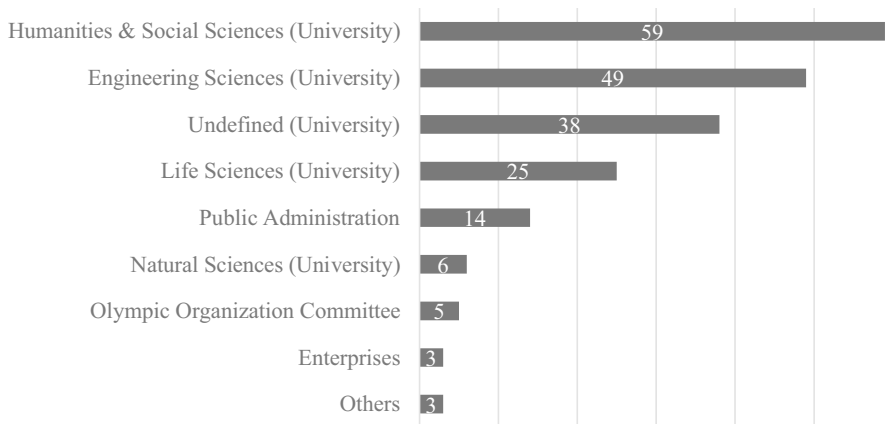


Fig. 6 Professional background of Authors

4.2.3 Authors' professional background

The professional background of the first author was analyzed based on his affiliation (Fig. 6). The vast majority of authors conducted their research at a university. Where their department/faculty affiliation was given, a distinction was made into publications from humanities and social sciences, engineering sciences, life sciences, and natural sciences. Professional backgrounds other than universities were public administrations, Olympic organization committees, or enterprises.

4.2.4 Subject areas of publications

From the publications examined, 85 could clearly be assigned to either the subject area of logistics or of sport. On the side of the journals, 40 publication were found in journals of logistics management such as International Journal of Logistics Management or International Journal of Physical Distribution & Logistics Management. From the 42 publications found in sport journals, 18 were released in sport management journals as Sport Management Review or European Sport Management Quarterly, and 24 were released in general sport journals such as Sport in Society or Journal of Sport and Tourism. On the side of the conference, three contributions are from logistics specific conventions (e.g., International IEEE Conference on Intelligent Transportation Systems), none from sport management specific conventions.

4.2.5 Leading authors and journals

The included publications were written by 547 different authors. Eva Kassens-Noor had the largest impact on the final list, with six published articles that showed a link between sport and logistics management. The journals European Sport Management Quarterly with 5 and Transportation Research Record: Journal

of the Transportation Research Board with 7 articles each contributed the most to the final list. In total, 23 different conferences and 180 journals were included.

4.2.6 Type of work

As mentioned before, the type of work refers to the central research methodology. Mostly, the contributions could be classified as research articles. In some of those research articles, the authors used a literature review (Somabutr et al. 2020) to obtain a picture of the state of the art in the corresponding research area. A few of the contributions included in the final list contained a literature review as their main methodology (Savić et al. 2018). When the authors were on site and their results were based on observation of sport logistical processes, they were categorized in the project report category (Puangmanee and Saearee 2020).

4.3 Analysis of titles and keywords

The previous look into the categorization scheme (Table 6) provided an extensive overview of research fields and research methods within sport logistics. The final list comprised 202 papers. A text-based description of all papers in detail would go beyond the scope of this study. Nevertheless, by utilizing a full title and keyword analysis, far-reaching statements about the content are possible. Following



Fig. 7 Qualitative title word cloud

keywords were thus identified. The distance between the keywords is an indicator of their proximity to each other. This means two publications with several joint keywords will be close to each other. The same applies to a group of publications with keywords that carry many cross connections. It is different for a paper that has only the minimum number of two connections via a single keyword in the overall cluster. All other keywords of this publication will be slightly offset from the others. The software identified a cluster that had the most connected keywords overall. Of the 104 keywords, not all had any connection to the defined main cluster. The software then offered to hide keywords or publications that were not connected. After this function was used, 87 connected keywords remained as the main cluster. The frequency of keyword occurrence is determined by the size of the spheres. The thickness of the lines indicates how often keywords occur together. The colors are another indicator of multiple co-occurrences of keywords, resulting in the formation of further clusters. The keyword clusters support the indication of the word cloud as the central and biggest clusters form around the Olympic Games, mega-events and the planning of its transportation. The topics of events and transportation also reoccur in a couple of smaller clusters, e.g. in the context of sustainability and public transport management. Two clusters stand out thematically: the blue cluster's focus is on production, the red cluster's focus is on supply chain management. Their points of connection are global value chains and sporting goods. They comprehend aspects such as manufacturing and labor standards as well as e-commerce, retail and outsourcing. By the size of the clusters, these sport logistics fields seem to be academically less developed than sport events and transportation.

4.4 Sport sector and type of sport

The classification of sport sectors was not always clear-cut in the papers examined. For a deterministic assignment, a fixation on the sport sector that was the central focus was used. The public sector primarily included transportation papers, which could be traced back to public transportation (Ceder and Perera 2014) and infrastructure around large sporting events. Pre-event planning (Kassens-Noor 2019) and the evaluation of the postevent impacts on the host country in terms of transportation (Hensher and Brewer 2002; Sroka 2021) and economics (Li et al. 2013) were described.

Only limited allocations to the nonprofit sector could be made. The main topics within this sector were sport tourism and spectator travel (Humphreys 2017; Wicker 2018; Wise et al. 2019); community sport, which included sport for development (MacIntosh et al. 2016); and college sport (Gallucci and Petersen 2017).

A wide range of content was selected for the professional sector. With an intersection of 68 papers on material flow, it is hardly surprising that many publications focused on production (Kumar et al. 2021), innovation in the sport equipment business (Desbordes 2001, 2002) or trade (Aguilera 2020; Roscoe and Baker 2014). In contrast to the nonprofit sector, the management of sport events in terms of monetary value was considered (Currie and Shalaby 2012; Sarasua et al. 2011; Sattayhatewa

and Smith 2003). Additionally, management around and in stadiums was located in the professional sector (Henao and Marshall 2013; Klauser 2013; Zhang et al. 2018). The emphasis on professionalization led to the assignment of research on the management of big sport clubs (Memari et al. 2021; Szymoszkowskyj et al. 2016) to the same sector.

The category type of sport was divided into team, single and undefined. The team sport category included mainly soccer (Earl et al. 2014; Vouillamoz et al. 2009) and American football (Herold et al. 2021; Judge et al. 2014), but some other team sport (Dolf and Teehan 2015) was also addressed. The focus was on team travel (Gupta et al. 2011) or more general supply chain management considerations (Serrano et al. 2019a, b). No clear pattern was discernible in individual sport. The sport here was wide-ranging, from aquatics (Gerke 2016; Gerke et al. 2015) to skiing (Spector 2017; Wise et al. 2019) to golf (Humphreys 2017). Additionally, some publications did not deal with a specific sport (Clikeman 2012), or the paper included both team and individual sport (Hensher and Brewer 2002).

4.5 Network perspective and flow type

The classification of the network perspective shows a clear preponderance of interlogistics and transportation research. Central research topics of recent transportation studies were the XXX. Summer Olympics in London 2012 (Currie et al. 2014; Dosunmu 2012; Parkes et al. 2016; Sumner 2011) and the XXIV. Summer Olympics in Beijing (Jiang 2008; Liu et al. 2008a, b; Zoghi et al. 2009) as well as major events such as the World Cup (Malhado and Rothfuss 2013; Wood 2019) and other game-day-related work (Dosunmu et al. 2017; Loewen and Wicker 2021; Tóffano Pereira et al. 2019).

Intralogistics papers are either related to sport clubs and their facilities (Cheladurai et al. 1987; Gallucci and Petersen 2017) or have a connection to production logistics (Kumar et al. 2021; Meier et al. 2019; Subic et al. 2012), preparation (Arnold et al. 2015; Odoni et al. 2009), technology services (Wu and Li 2016) and evacuation (Bateman and Majumdar 2018; Mahmudzadeh et al. 2020) of stadiums or other sport event-related locations.

One of the core issues of SCM (interlogistics) is global value chains (Appelqvist et al. 2013; Mamic 2005). These included papers about the distribution of sporting goods (Asian et al. 2020; Harvey and Saint-Germain 2001) and case studies on sport equipment brands, such as Reebok (Hecox 2013). Papers on events described management and logistics with all involved entities (Kristiansen et al. 2016).

The logistical focus was nearly balanced among publications related to people flow and those related to material flow. In contrast to the other categories, a listing in more than one of the flow types was regarded a possibility for the reason that flows of materials and people always lead to information exchange. If one of the flow types stood out in particular, a deterministic approach was taken, as in the other categories.

The material flow was often recorded from the point of view of producers (Razavi et al. 2014). As a result, many of these material flow-related papers featured the

handling of sport equipment along the supply chain (Andreff and Andreff 2009; Chen and Notteboom 2012; Woong Sung et al. 2017) but missed out on the opportunity to engage with sport equipment logistics in providing for athletes, as was partly done by Herold et al. (2021). However, there were also publications that illuminated the event-related supply of material (Brady and Davies 2014) and food (Li et al. 2019). What was evident was the fact that the supply chain management and material flow categories with 69 shared papers had a high degree of overlap.

Another overlap was noticeable between the transportation category and people flow, with 95 joint papers. As with the transportation category, the people flow papers were primarily about the 2012 London Olympics (Browne et al. 2014; Jones and Woolley 2019; Lindsay 2013), other Olympic Games (Minis et al. 2009; Mullett and Moutou 2015), football games (Elbery et al. 2019b) or different sport events (Han et al. 2018; Mosadeghi et al. 2020). Not mentioned before in the transportation category but still not to be overlooked was the number of papers concerned with the environment and so-called carbon footprint during sport events (Dolf and Teehan 2015; Sampson et al. 2013; Triantafyllidis et al. 2018).

In eight cases, even the flow of information was considered solely with reference to sport and logistics and without physical flows. Here, the findings revolved around facility location problems (Millstein and Campbell 2018; Pereira et al. 2017; Smith and Smith 2008), as observed in intralogistics, new technologies and planning processes (Kendall et al. 2010).

If the term sport logistics or related terms were deliberately coined (Herold et al. 2019, 2021; Liu and Gao 2013; Ribeiro and Almeida 2020), all three categories were attributed since these papers chose a fully holistic approach. If information flows and all physical flows were considered for the Olympic Games and the tasks of logistics management were analyzed (Denicol et al. 2021; Ribeiro et al. 2021), the papers also received three crosses.

4.6 Academic focus and type of research

In the vast majority of the research articles, the academic focus was empirical in nature. Here, different approaches were taken with interviews (Arnold et al. 2016) or the production of the authors' own research data (Rutten et al. 2021) through simulation (Fang et al. 2011a, b) or via the conduction of a project report (Jiang 2008). Some of the contributions were only conceptual, meaning they considered the work of others by conducting a literature review and following it with a built-on framework or other concept (Robbins et al. 2007). Technological papers often included an empirical aspect because technology was often used to produce the authors' own results (Ramadan et al. 2020).

In the type of research category, qualitative research often used interviews (Bateman and Majumdar 2018; Szymoszkowskyj et al. 2016) or literature reviews (Luitzen et al. 2015). Sixty-eight papers from the qualitative category were assigned to the basic type of research, which illustrates the frequency of a joint occurrence. Quantitative research often relied on statistical analysis (Mahmudzadeh et al. 2020; Razavi et al. 2014), which was applied in 44 cases. Quantitative

data ranged from survey results to simulations of traffic (Ramadan et al. 2020) or crowds (Xie et al. 2017). Some papers explicitly chose mixed methods. In mixed-methods papers, the authors ascertained the more significant method.

Many of the literature reviews fell into the basic type of research. Of the 30 literature reviews with a conceptual academic focus, 22 were basic research. The applied papers mostly had an economic focus (Lund-Thomsen 2013; Raza 2016), with 50 of the 76 papers being assigned to the third sector of sport.

Analytical papers nearly created an equilibrium by choosing a basic research approach in 50 cases and an applied research approach in 57 cases. Most descriptive papers were also basic research, with a congruency of 69 papers.

4.7 Topic clusters

In conducting (ii) the thematic analysis, topic clusters were formed (Fig. 9) that represent the central topics that occur across the board (Tranfield et al. 2003, p. 219).

Following the preceding statements about events and the final list, the authors concluded at this point that the management of logistics in sport was most prevalent in the event context. The research panel sorted 100 of the 202 final papers into event operations research. From there, a discussion led to the three central topics *event operations planning* with 30, *event operations management* with 49 and *event operations legacy* with 18 papers. The choice of a threefold partition was made because planning papers comprise primarily studies about future events or how former events were prepared, management papers include analysis of the management process during events and the general time horizon during or shortly after events and legacy papers evaluate persisting transport systems and infrastructure after events on the one hand and the perceptions of involved stakeholders or residents on the other.

The next central topic is sporting goods. Here, 14 papers were regarded as dealing with production, while 11 analyzed supply distribution. *Sporting goods production*

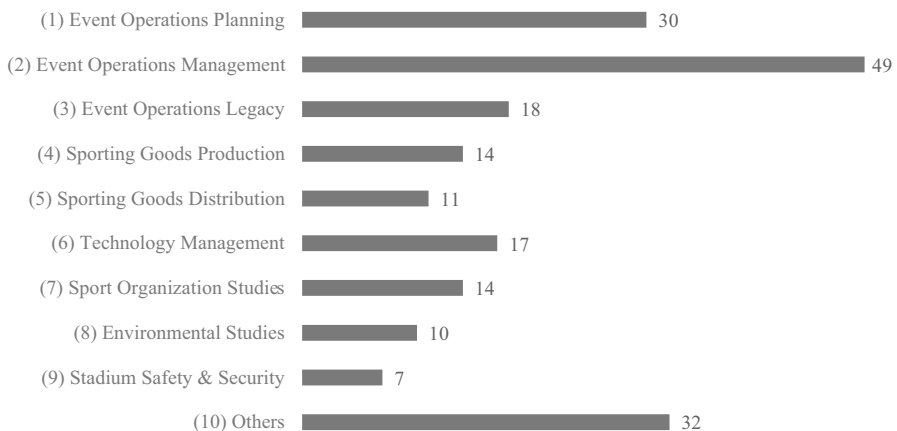


Fig. 9 Overview of the topic clusters and their frequency

papers were concerned with labor conditions, performance measurement or innovating processes. *Sporting goods distribution* mostly revolved around the supply chain from a trade perspective or its risks of disruption or focused on a specific company.

Next was *technology management*, to which 17 papers were distributed. These related primarily to new technologies such as the internet of things (IoT), artificial intelligence and big data or infrastructure planning with GIS. Security planning with specific technologies for upcoming events was also represented. The subsequent central topic was dealing with *sport organization studies*. Fourteen studies matched this topic. Those papers presented research on sport clubs, community sports, facility management or athlete management with travel and organizational stressors. *Environmental studies* as another central topic included 10 papers, mostly involving carbon dioxide emissions measured with the carbon footprint at football matches or events. With 7 papers *stadium safety and security* represents the smallest category. It deals with space management and crowd flow in stadiums, especially in evacuation and emergency scenarios.

There were 30 publications on peripheral themes that did not justify a central topic of their own (*others*). Ten of the publications dealt with the sport industry in very general terms, while seven focused on sport clusters. Further topics included a facility location problem, sport tourism, marketing, reverse logistics, sport history, accounting and sport management in general.

In the final list (Table 6), the central topics were represented by the upcoming numbers: *event operations planning* (1), *event operations management* (2), *event operations legacy* (3), *sporting goods production* (4), *sporting goods distribution* (5), *technology management* (6), *sport organization studies* (7), *environmental studies* (8), *stadium safety and security* (9), and *others* (10).

5 Discussion and research agenda

After the previous chapter comprehensively analyzed the current body of knowledge in the field of sport logistics management, this chapter discusses the implications for both practitioners and scholars, and derives future challenges. A detailed agenda for future research is derived from the analysis by classifying the upcoming research topics depending on the sport logistics triangle.

5.1 Implications and research opportunities for practitioners

In an ever growing sport industry, the need for and value of professional logistics services is continuously increasing, quantitatively as well as qualitatively. Logistics services are operations in the supply environment of systems. In sport, such systems can be enterprises, non-profit organizations, events, sporting facilities, traffic etc. These systems require physical supplies to exist.

In quantitative terms, practitioners face the need to establish new and extend existing logistics services in sport due to, e.g., increasing sport equipment sales, ever new and bigger sport events, growing sport tourism. In qualitative terms, the

Table 7 Research opportunities for practitioners

Research opportunity	Triangle fields
The design of transportation/traffic (management) systems for spectators travelling to events, using public or private transport means (e.g., subway, car)	Peo Tra Pro, Non, Pub
The prediction of demand for transportation	Mat, Peo, Inf Tra Pro, Non, Pub
The development of visitor moving patterns at sport venues (in and around sport arenas)	Peo Int Pro, Non, Pub
The horizontal and vertical supply chain integration of sport organizations (incl. arrangement of interorganizational partnerships)	Mat Sup Pro, Non
The determination of the location of logistics centers of sport organizations (e.g., sport equipment manufacturer) or of events (e.g., Olympic Games)	Mat, Inf Tra, Sup Pro, Non, Pub
The outsourcing of logistics services (third party management)	Mat, Peo, Inf Sup Pro, Non, Pub
The design and management of multi-channel sales chains for sporting goods (B2B, B2C, e-commerce)	Mat Sup Pro
The routing of people flows to, at, from sport events	Peo Int, Tra Pro, Non, Pub
The planning of resources to fulfill logistics requirements in sport organizations or at sport events (e.g., labor, transport capacity, storage conditions)	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The development of key guidelines for operations strategies at sport events	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The development of logistics services levels in sport organizations	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The integration of monitoring systems to track logistics services and evaluate service levels	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub

practitioners' aim is to continuously improve existing logistics services in sport. This usually means the increase of the logistics performance, e.g., by reducing the delivery time, increasing the delivery capacity, increasing the delivery quality, increasing the delivery flexibility.

The topic clusters event operations planning, event operations management, sporting goods production, sporting goods distribution, and stadium safety and security can be regarded as cumulating mainly issues of special interest for practitioners. Table 7 outlines developments and potentials of logistics in sport that were identified in the literature for practitioners and classifies them on the basis of the sport logistics triangle (flow type: material (Mat), people (Peo), information (Inf); network perspective: intralogistics (Int), transportation (Tra), supply chain (Sup); sport sector: professional (Pro), nonprofit (Non), public (Pub)), listing the triangle fields in the center of attention.

5.2 Implications and research opportunities for scholars

As stated in the introduction, sport logistics management is a heavily under-researched field. It offers broad research opportunities in manifold directions. In particular, project

Table 8 Research opportunities for scholars

Research opportunity	Triangle fields
The development of simulation models for transportation planning of people (e.g., spectators) and goods (e.g., catering in stadiums)	Mat, Peo, Inf Tra Pro, Non, Pub
The development of routing algorithms to optimize flow rates in sport logistics scenarios (e.g., travel schedule of a racing series)	Mat Tra Pro, Pub
The location determination and design of logistics facilities (e.g., warehousing structure for sport mega events or sport equipment retailers)	Mat, Inf Int, Tra, Sup Pro, Non, Pub
The management of equipment and its provision to athletes (athlete-centered logistics)	Mat, Inf Int, Tra Pro, Non
The usage of technology (e.g., geographic information system (GIS), video detection, Bluetooth low energy beacons) in sport logistics planning and operations	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The management of sport logistics knowledge: recording of successful implementations and transfer for future implementations (e.g., from Olympics held to future Olympics)	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The description and analysis of typical sport logistics characteristics (e.g., fields of activity, tasks, processes, components, resources, responsibilities) to derive a comprehensive scientific foundation of logistics in sport	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The development of archetypes of organizational structures depending on the sport logistics tasks to be carried out	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The development of key performance indicators (KPI) to evaluate sport logistics success	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
The resilience of supply chains in sport (incl. integration of partners, sharing of information, optimal decision-making)	Mat, Peo, Inf Sup Pro, Non, Pub
The management of public–private partnerships in sport logistics	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub
Logistics as supporting factor for sporting success	Mat, Peo, Inf Int, Tra, Sup Pro, Non, Pub

reports, the second sector of sport, single sport, and intralogistics (see Table 6) are underrepresented in publications with sport logistics focus. Based on the findings and analyses in this review, Table 8 suggests research areas that need further attention and investigation and classifies them on the basis of the sport logistics triangle (flow type: material (Mat), people (Peo), information (Inf); network perspective: intralogistics (Int), transportation (Tra), supply chain (Sup); sport sector: professional (Pro), non-profit (Non), public (Pub)), listing the triangle fields in the center of attention.

5.3 Superior/general future challenges

In addition to the specific aspects of the previous two sections, there are more general, superordinate future challenges affecting logistics in sport—practitioners and researchers alike.

Sustainability has arrived at the center of society. The sport industry increasingly recognizes the need to align its activities sustainably. Logistics can make a contribution in all three dimensions of sustainability: a good partner integration along the supply chain leads to economic sustainability, considering legacy usage when planning new transportation networks for mega events (e.g., new subway stations) leads to social sustainability, sourcing local for the production of sport equipment leads to environmental sustainability.

The growing globalization of sport is constantly raising the demands on logistics. Sporting equipment for Western markets is manufactured Far East. North American NFL teams play official matches in Europe, European soccer teams spend their pre-seasons for marketing tours through North America and Asia playing local teams. Racing series as the Formula One or the World Rally Championship travel back and forth between different continents in the course of a season. Amateur athletes in search of particular sporting challenges as well as fans following their teams around the world have turned sport tourism into a mass movement. From the logistics perspective, these globalization developments go hand in hand with a series of challenges. Most obvious is the need for significantly more transport capacity. In particular, demand is increasing along international air and shipping routes that are already heavily utilized, which requires good planning in advance to reserve the capacity needed, at a reasonable price. International transportation also is subject to customs restrictions. All material sent to other economic regions goes along with special requirements for packaging, labeling and registration. Due to the administrative processes, preparation and execution of the transport are more time-consuming and take longer. The complex processes of international supply chains have more imponderables, making their resilience particularly important.

Professional logistics, and international logistics chains in particular, goes hand in hand with an international division of labor. To successfully manage it, documentation and provision of information is key. In other words: material or people flows have to be accompanied by the right flow of information. A challenge that can only be adequately met with IT support. However, the realization of digital workflows for logistics in sport organizations still lags behind. Digitization stays one of the crucial challenges of sport logistics.

To this day, most sport logistics managers started their jobs as job as a logistician without sport education, as a sport manager without logistics education, or as a career changer. Neither is logistics management a subject in sport management curricula, nor is sport management a subject in logistics management curricula. There are not even further education programs or certificate programs to become a sport logistics manager. The establishment of education programs for sport logistics management is to be understood as a key piece of the puzzle towards further professionalization of sport logistics management. To raise awareness for the special remit of sport logistics has to become a mission for every sport logistics manager.

6 Conclusion

The motivation of the authors originated from their conviction of the undeniable pertinence of the management of logistics in sport. The underlying objective of this contribution was to elaborate a comprehensive image of the state of the art in sport logistics. To this intend, a new framework for sport logistics was developed, recent literature was reviewed, and an agenda for future research was established.

The sport logistics triangle draws from the academic disciplines of logistics management and sport management (SRQ 2): procurement, operations, distribution, and reverse logistics build its logistics management foundations, marketing, operations, and organization build its sport management foundations. The sport logistics triangle is composed of three legs: flow type, network perspective, sport sector. They allow a structured classification and contextualization of the diverse logistical activities in sport organizations. Every sport logistics activity has an intersection with each of the three legs.

To gain the most comprehensive insights, a systematic literature review was carried out and an extensive number of scientific papers was evaluated. In the interest of the inclusivity of the SLR, the authors decided to cover not only journal articles but also conference papers. A transparent four-section process of inclusion, exclusion, reference recursion and analysis resulted in the final list of 202 papers which were analyzed in content to represent the status quo of current research in sport logistics. The reader was introduced to developments in the research around the management of logistics in sport through a dichotomy of descriptive elements and thematic content. In doing so and to ensure increased transparency, the reader was provided with a comprehensible bridge between the documented information and the conclusions drawn from it. To allow the SLR to have an explanatory nature, studies were evaluated in a categorization scheme regarding their sport and logistics focuses as well as their methodological frame. Here, conclusions can be drawn about the state of the research. The numerical distributions of the type of work, type of research and the logistics and sport-related classifications (see SRQ 1 & 3) indicate the sophistication of the research and where there is still room for progress, e.g., investigations on the second sport sector, single sport, or intralogistics, especially in the form of project reports.

To complement this, the titles and keywords established by the authors were evaluated and presented in a chart. The keyword cluster indicated a hotchpotch of research. Work is being done in many areas, but not in a unified manner, which makes it much more difficult to base new research on past efforts. This publication is intended to contribute to a profound expansion of theory via the sport logistics triangle framework and to trigger a joint discourse at the interface of logistics management and sport management as the overall state of the art can be characterized as heterogenic, diffuse, and shallow (RQ 1).

Based on the evaluation of key words and titles and the content analysis, the research panel built nine topic clusters: event operations (planning, management and legacy), sporting goods (production and distribution), technology management, sport organization studies, environmental studies, and stadium safety and security

(SRQ 4) that can serve as key starting points for further research on the management of logistics in sport. In the discussion chapter, more specific research opportunities, e.g., the outsourcing of logistics services in sport organizations, the location determination and design of sport logistics facilities, or the management of equipment and its provision to athletes derived from the papers examined were given and classified on the basis of the sport logistics triangle. Practitioners and researchers were addressed separately. On a global scale, general future challenges of sport logistics management were named, i.e. sustainability, globalization, digitization, education programs (RQ 2).

The paper showed that a comprehensive conceptional umbrella for sport logistics management as the intersection of logistics management and sport management is still missing. Hence, the authors call on logistics and sport management scholars alike to engage in the manifold research opportunities of managing logistics in sport.

Appendix A

See Table 9.

Table 9 Topics excluded in web of science, scopus and IEEE xplora

Database	Excluded topics
Web of Science	All biology, all chemistry, all physics, all agriculture, all psychology, Energy fuels, Education educational research, Food science technology, Entomology, Neurosciences, Geosciences multidisciplinary, Meteorology atmospheric sciences, Agronomy, Orthopedics, Medicine general internal, Water resources, Veterinary sciences, Nutrition dietetics, Oceanography, Nanoscience nanotechnology, Oncology, Thermodynamics, Horticulture, Optics, Surgery, Fisheries, Clinical neurology, Toxicology, Health care sciences services
Scopus	Medicine, Agricultural and Biological Sciences, Biochemistry, Genetics and Molecular Biology, Health Professions, Immunology and Microbiology, Physics and Astronomy, Psychology, Earth and Planetary Sciences, Energy, Arts and Humanities, Neuroscience, Nursing, Chemistry, Pharmacology, Toxicology and Pharmaceutics, Chemical Engineering, Veterinary, Dentistry
IEEE Xplora	Internet, feature extraction, learning (artificial intelligence), security of data, cryptography, public domain software, Gaussian distribution, distributed power generation, mobile computing, power grid, statistical distributions, video signal processing, Gaussian processes, genetic algorithms, object detection, evolutionary computation, search problems, neural nets, particle swarm optimization, probability, image classification, wireless sensor networks, pattern clustering, statistical analysis, image segmentation, regression analysis, remote sensing, finite element analysis, graph theory

Appendix B

See Table 10.

Table 10 Subdatabases used in proquest

Database	Topics	Description
International bibliography of the social sciences (IBSS)	Economics, social sciences	Anthropology, economics, political science and sociology—journal articles, books, reviews
PAIS index	Social sciences	Public affairs, public and social policy, international relations—journal articles, books, government documents, statistics, gray literature, research reports, conference papers, microfiche, internet material
Periodicals archive online	Literature and language, social sciences, history, art	Arts, humanities and social sciences—scientific journal archive
Periodicals index online	Literature and language, social sciences, history, art	Arts, humanities and social sciences
Publicly available content database	Not assigned	Developed to complement other databases and collections, this database brings together or links to full texts for publicly available content from a range of different sources from around the world
Sports medicine & education index	Science and technology, social sciences, health and medicine	Physical fitness, health, sports medicine

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Data availability The author confirms that all data generated or analyzed during this study are included in this published article. Furthermore, primary and secondary sources and data supporting the findings of this study were all publicly available at the time of submission.

Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

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