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Review

Dry Port: A Review on Concept, Classification, Functionalities and Technological Processes

Erica Varese [1,*], Danilo Stefano Marigo [2] and Mariarosaria Lombardi [3]

[1] Department of Management, University of Torino, Corso Unione Sovietica, 218 bis, 10134 Torino, Italy
[2] Interdepartmental University School for Strategic Sciences, University of Torino, Corso Regina Margherita 60/A, 10153 Torino, Italy; danilomarigo@gmail.com
[3] Department of Economics, University of Foggia, Via R. Caggese 1, 71121 Foggia, Italy; mariarosaria.lombardi@unifg.it
* Correspondence: erica.varese@unito.it

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Abstract: The purpose of this article is to offer a literature review on the development and classification of inland terminals, later defined as "dry ports". The aim of the paper is to analyze the extant literature on dry ports focusing on their concept, classification, function and technological processes. The review offers an updated structured approach to what is currently defined as a dry port. To this end, a structured keyword search in major electronic databases has been conducted to find related material. As there are many different names indicating dry ports in European, South East Asian and North American countries, the following keywords were used: "dry port", "inland terminal", "freight village" and "*interporto/i*". The search was conducted in respect of the article title and text, abstract and keywords. The results show that there is no unanimous consensus concerning cataloguing of terrestrial nodal facilities serving port gateways. "Dry ports" have emerged as fundamental elements of the integration between the sea "system" and the land network. The increased interest in the genesis and development of dry ports has been accompanied by an abundant contribution of the scientific community, originating a thriving literature, which, however, does not find a common denominator.

Keywords: dry port; inland terminal; freight village; *interporto*; intermodal transport; literature review

1. Introduction

Historically, ports have always been a privileged gateway for commercial sea-trade. However, only once containers had been established significantly, did ports find themselves increasingly facing the issue of their relationship with their respective hinterlands. Over time, concepts such as "integrated logistics" and "supply chain", together with a growing understanding of environmental problems connected to the distribution chain, have strengthened this new approach.

Introducing a neologism, the concept of "dry port" has paved its way, rising as a key element for the integration of sea "system" and dry land networks. It is not only a mere physical extension of the storage capacity of quays, but most importantly a tool by which it amplifies the dimension of the port, namely its "catchment area". The increasing amount of interest in the appearance and development of dry ports, most commonly referred to as "inland terminals", has been nurtured, starting from the 1980's and up to present time, by a growing contribution by the scientific community, leading to abundant literature on this topic.

This article aims at offering a literature review on the development and classification of inland terminals, later defined as "dry ports".

The main contribution of this paper may be summarized as follows: by applying a systematic approach, this study offers an overview of research carried out on inland terminals, focusing on the development, classification and technological processes. These are key elements, which indicate current research trends on dry ports. In the authors' opinion it is crucial to verify whether, nowadays, it is possible to find a shared definition of dry port and which are its main classifications. Furthermore, in order to complete the analysis, it is essential to verify the technological elements of terminal activities carried out aiming at better quality of cargo handling.

It needs to be considered that, in recent years and even more so nowadays, activities and technical characteristics are changing very fast, for instance those related to customs.

The sequel of this paper is organized as follows: Section 2 presents the background of this topic; Section 3 describes the research approach to the systematic literature review and data collection used for the analysis; in Section 4, the results are shown and discussed, while final conclusions are drawn in the last Section.

2. Background of the Concept of Dry Port

An inland terminal serving a port was initially called a "dry port" [1].

The first studies concerning inland terminals date back to the early 1980s. In his work, Munford [2] addresses the issue of increasing congestion in port gates. The expression "dry port" is initially used in order to describe a facility primarily directed at solving this problem, by re-distributing flows of goods arriving by sea. The United Nations Conference on Trade and Development—UNCTAD—[3] suggests the following definition: "An inland terminal to which shipping companies issue their own bill of lading for import cargoes assuming full responsibility of cost and conditions and from which shipping companies issue their own bill of lading for export cargoes".

However, there seems to be no exact or at least univocal definition for an inland terminal [4–16]. The latter is, in fact, part of a far wider category, comprising logistics facilities of various kinds and sizes, which are not necessarily a constituent or part of a port cluster: dry port, inland terminal, inland port, inland hub, inland logistics center and freight village. Historically, the first freight villages were established in France in the early 1960s [17]. A freight village has been defined as an area organized for carrying out all activities related to transport, logistics and distribution of goods, both at a domestic and international level, which are performed by various operators [18–23]. Specifically, a freight village belongs to the category called "*interporto*" in Italy.

A common denominator for the above-mentioned facilities is that they provide a more or less ample and specialized variety of logistics services. In this regard, an "*interporto*" is maybe the organically most complex facility among them, just as is presumed by the more exhaustive definition of it provided by Italian law n. 240/90 [24]. In the following years, scientific literature used various methodologies in order to define inland structures. During the nineties of last century, for example, Beresford and Dubey [25] used the expression "dry port" for defining tax warehouses. These authors described the aspects concerning incorporation, and even the services a "dry port" should provide, particularly customs services, but they did not further specify kinds of connections and relationships with ports.

Slack [26] contributes by stressing the relevance of intermodal transport for the development of inland structures, which are entrusted with an inland transshipment task. He points out satellite terminals as the solution for port congestion and lists four logistics functions they may not ignore: modal transfer between two transport modalities; consolidating goods for transport preparation; stocking goods waiting for shipment; delivery to the recipient.

Jaržemskis and Vasiliauskas [27] describe a dry port as "a port situated in the hinterland servicing an industrial/commercial region connected with one or several ports by rail and/or road transport and offering specialized services between the dry port and the transmarine destinations. Normally the dry port is container and multimodal oriented and has all logistics facilities, which is needed for shipping and forwarding agents in a port".

The main reason for the above terminological differences is the way the facilities look in different geographic areas. The concept also varies as a result of scale, complexity and field of specialization [28] and because of the position and role played within a transport network.

Inland facility classification thus comes to depend on several parameters [7,29–31]. The most relevant among them is the one referring to the more or less developed co-modal prerogatives (mono modal road terminal, terminal for combined road-rail transport, terminal for combined road-inland waterway transport, terminal for both mentioned kinds of combined transport); second by importance is the parameter of logistics functions, i.e., the variety of more or less specialized services to goods which add up to transport (customs procedures, warehousing and manufacturing operations, up to retail or wholesale activities). Roso [32] introduces further parameters for differentiation: closeness to the port hub (close, at medium distance, distant) and nature of the ownership (ports owned by railway operators, peripheral public administrations or public-private companies).

Nonetheless, the most common terms used for describing such facilities are: "inland terminal", "dry port" and "inland port". They are frequently used in order to generically define inland terminals where various handling and value implementation activities are offered [33–35].

The expression "dry port" is the one most commonly used, among those listed above, for a facility behind a port, frequently called "inland customs warehouse" [36]. The European Commission [37] identifies as a "dry port" an inland terminal directly connected to the port by a railway transport service. Harrison et al. [38] take into consideration the role played by dry ports in "serving" the region they are located in, by their intermodal terminals which are part of them, since they are a consolidation point for goods and a transshipment facility among the different available modalities.

Roso [32] and Roso and Lumsden [39] offer a definition of "dry port" which stresses its connection with the port: "an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if directly to a seaport". The same concept was followed also by Rodrigue and Notteboom [40], Qiu et al. [13], Crainic et al. [41], Nguyen and Notteboom [42] and Talley and Ng [43].

Dry ports can facilitate more feasible and efficient combinations of sea cargo flows and inland flows [44] "especially with rail and truck combinations and through providing value-added services offerings at nodes" [45].

In the last decade many researchers identified success factors for dry ports related to specific cases; Black et al. [46] summarized factors influencing the success of dry ports, for instance, railway connections [39,44], cooperation among actors of the transport system [11] and development of value-added services [45].

According to Roso et al. [44], dry ports contribute not only to improving access of a port to its hinterland, thanks to the operational link between the port and inland site [29,31,47] based on partnership rather than competition [48], but even to the improvement of a more extended area, which is sometimes, as Rodrigue and Notteboom [49] observe, geographically discontinuous. In this respect, they mention that this "system" is not necessarily represented by a dyad port-dry port: it can be polycentric, i.e., made up of several dry ports, but with direct port-to-port connections.

The concept of "dry port" according to the United Nations Economic and Social Commission for Asia and the Pacific [50] may be summarized as "a dry port provides services for the handling and temporary storage of containers, general and/or bulk cargoes entering or leaving the dry port by any mode of transport such as road, railways, inland waterways or airports. A dry port of international importance shall refer to a secure inland location for handling, temporary storage, inspection and customs clearance of freight moving in international trade".

The same expression may also be used to witness that a certain inland terminal has reached a specific level in terms of services provided, as in the cases of particular customs procedures, or of the presence of third-party logistics services providers (3PL) and of other qualifying services [31]. Thus, this expression is not suitable for facilities which, on the contrary, do not show characteristics sufficiently interesting from this point of view.

Rodrigue et al. [7] prefer "inland port" to "dry port". The former is indeed considered suitable for indicating inland facilities of various kinds and dimensions, with a wide choice of logistics services, incorporated in the most various forms and situated close to important production areas. Such facilities can be found in the United States, where they cover areas normally larger than similar European facilities, with larger dimensions and storage capacity [31].

In Europe, the above expression refers to inland terminals connected to ports by a river; they are most common in Germany, the Netherlands and Belgium. Therefore, following this theory one encounters several obstacles to the use of the expression "inland port" combined with that of "inland terminal", because in Europe many terminals located in the inland do not have access to a river and/or are not close to a productive area. Finally, they do not even have a throughput comparable to the American case [35].

Notwithstanding the above problems, all scholars mentioned up to now seem to agree on the expression "inland terminal", considering it well defined at European level as inland facilities.

A terminal positioned in a port hinterland, however, needs to fulfil following criteria in order to be considered an inland terminal [51]:

- Have a direct connection to the port/s, by road as well as by rail and/or river;
- Have a "corridor" with strong transport capacity available, or be positioned on it;
- Be equipped with suitable structures and machineries, compatible with the reference port/s;
- Play a collection and distribution role at local and regional level.

Inland terminals thus play a significant role in the transport chain, through the important function of "connecting" a port to its hinterland. This connection is undoubtedly advantageous for all operators involved in the transport chain.

Notteboom [52] and Van Klink and Van den Berg [53] stress the need for ports to develop their own hinterland and to enhance increase of goods transported in containers, thus contributing to development. The above-mentioned authors confirm the importance of "competition" among ports for the sake of their better positioning on the market/s and on the main intermodal corridors. For this kind of competition, a good relationship to the hinterland is, of course, essential.

According to Van Klink and Van den Berg [53] and Mc Calla [54], the need to extend port activities and reduce transport costs to the hinterland, using intermodal means of transport, also involves the chance of expanding one's area of influence beyond the traditional reference market.

Van Klink and Van den Berg [53] define a port hinterland as the most internal area the port serves at lower cost compared with other ports in the same region. As mentioned, according to Notteboom and Rodrigue [55] the influence area of a port hinterland may even not be contiguous to the port itself. There are, in fact, situations where a certain territory, though closer to the port, is not part of its market, because it has better connections with more distant ports. This leads to the formation of more or less extended "islands", separate from the main area of the gravitational hinterland of the port. The same authors argue that dry ports and associated corridors are part of an evolutional phenomenon defined as "port regionalization", and expand the concept of "regionalization paradigm" considering the evolving role of intermediate hubs [56].

Van den Berg and De Langen [57] think that the connectivity of a port to its hinterland should be a necessary focus for Port Authorities' strategies, as well as for terminal operators and shipping companies. In a subsequent study [30] they encourage a comparison between the concept of "inland terminal" and door-to-door and port-to-port systems; they define the advantages from the point of view of shippers, logistics operators and others involved, primarily as to the issue of repositioning empty containers, which has considerable impact on port operability. The relevance of connections to the hinterland is, therefore, a critical factor for the economic success of a port platform and for the competitiveness of the entire transport chain [58]. Development of a dry port/port system absolutely requires cooperation by shipping companies and by all stakeholders of the distribution process,

as partners in an intermodal service. The number of stakeholders increases while a sea port expands to its hinterland area [59].

Monios [60] stresses the importance of the quality level of intermodal terminal management; he defines some models and compares them following the example of European, North American and Asian terminals. The so-defined models differ according to the kind of relationships between terminal operators and outside stakeholders (port and railway operators), as well as to the kind of relationships between terminal operators and logistics services providers at the terminals. Monios also argues that cooperation among all stakeholders in the distribution process is a necessary condition for transport network management in the connection system between intermodal terminals and ports. Beresford et al. [28] affirm the need to implement the transport chain between a port and its hinterland, and this is confirmed by the fact that 60% of total transport costs are linked to those generated by container distribution from and to ports.

According to Nguyen and Notteboom [61], the expression "dry port" evolved "from an intermodal terminal used in bills of lading issued by shipping lines (United Nations Conference on Trade and Development, 1982) to a broader use as defined by Roso et al., 2009".

Noting that there are many and different ways to define an infrastructure as a "dry port", the authors agree in considering mainly four components: "concept", "classification", "function" and "technological processes". Among them, they believe that the last two are prioritized characteristics, because "concept" and "classification" may be related to local regulation, as, for instance, in the case of "*interporti*", the concept and classification of which, at least at the time when they were conceived, were not related to the concept of close relation with a port. Dry port is a concept and a classification adaptable also to later infrastructures, which change their positions in the original network, or even place themselves into a new network. On the other hand, as stated above, functions and technological processes change very quickly over time, and transformation of terrestrial shipping chains will increase the speed of this process.

In this context, the authors adopt following definitions:

- a "concept" is based on a main idea or model on a theme. For example, the different taxonomy of dry ports;
- "classification" is the action or process of classifying something by a specific characteristic such as distance from the seaport;
- for "technological processes", the definition given by Rožić et al. [35] is as follows: "Technological processes represent the activities at the terminal that are conducted with the aim of better quality of cargo handling, and which require appropriate technological elements and real-time work".

3. Materials and Methods

According to Fink [62] "a literature review is a systematic, explicit, and reproducible design for identifying, evaluating, and interpreting the existing body of recorded work produced by researchers, scholars and practitioners". A researcher collects data through the analysis of existing documents [63,64]. Considering that the objective of this paper is to analyze the dry port as to its concept development, classification and technological processes, in order to identify gaps, issues and opportunities for further study and research, a literature review seems to be a valid approach. According to Easterby-Smith et al. [65] this is a preliminary step in structuring a research field and enables to identify its conceptual content [66].

A systematic approach to review existing literature was chosen in order to analyze concept, classification, function and technological processes of dry ports.

The process of analysis of this research was organized in the following steps [64,67]:

- Defining the materials of analysis: research papers (research articles, business articles and review articles) as per our aim;

- Classification context: a classification context was selected and defined, in order to classify the materials for the literature review;
- Materials evaluation: the materials were analyzed and sorted according to the classification context. This was meant to enable identification of relevant issues and interpretation of results;
- Collecting publications and delimiting the field: this literature review was limited to peer-reviewed English and Italian articles; the internet search was carried out on 18 May 2018 (it needs to be noticed that the search also detected papers published with a future date: in this case, the papers, classified as "in press", or "corrected draft", were not considered), starting, since the topic is quite recent, from the first published article (1997) on this issue.

Each of these steps has been checked and revised and, to avoid bias, all records have been examined separately by the three authors. Whenever they disagreed in the phase of evaluating an article (Phase 3), they discussed the matter until agreement was reached. Studies meeting the following criteria for data-extraction were included: the paper needed to investigate, even only in one paragraph, the dry port concept and/or classification and/or technological processes. The search strategy resulted in 52 records (after excluding duplicates).

The search was conducted as a structured keyword search. Major electronic databases were used to identify related materials; among them, those provided by library services such as Scopus hereinafter S, and Web of Science, hereinafter WoS, and the major publishers Elsevier (Amsterdam, The Nederland), hereinafter SD, Emerald (Bingley, UK), hereinafter E.

According to several Scholars [68,69] there are many different names indicating dry ports in European, South East Asian and North American countries. Baydar et al. [21] state that they are called in Great Britain and the USA "Freight Villages"; in France "*Plateforme Logistique/Plateforme Multimodale*"; in Italy "*Interporto*"; in Germany "*Güterverkehrszentrum*"; in Denmark "Transport Center" and in Singapore and China "Logistics Center".

This is the reason that it was decided to search using different keywords. The keywords "dry port", "inland terminal", "freight village" and "*interporto/i*" were used in respect of the article title and text, abstract and keywords (Phase 1) of the above-mentioned databases—Table 1. Quotation marks were used in order to specify terms which should appear next to each other; as to be sure not to miss any article, for the Italian name "*interporto*", search was conducted using both the singular ("*interporto*") and the plural word ("*interporti*").

Table 1. Search for the keywords in the library service S and in the three major publishers SD, E, and WoS: Phase 1. (Numbers refer to the number of articles extracted).

Library Service and Publishers (18 May 2018)	Phase 1: Library Service and Publishers Search				Total
	"Dry Port"	"Inland Terminal"	"Freight Village"	"*Interporto/i*"	
S	88	78	23	2	191
SD	201	231	82	32	546
E	6	4	5	0	15
WoS	60	13	11	1	85
Total	355	326	121	35	837

The research brought 837 papers into evidence.

In order to refine the number of results, duplicate papers were eliminated, i.e., the ones provided by more than one among library service and publishers (Phase 2)—Table 2.

The articles found (698) were scanned based on titles and/or abstracts and/or their full text was read thoroughly (Phase 3). As stated above, this study focused only on research, business or review articles; therefore, papers published, for example, in conference proceedings, book chapters or editorials were not included.

Table 2. First step to refine the number of results: elimination of duplicate papers. Phase 2. (Numbers refer to the number of articles extracted).

Library Service and Publishers (18 May 2018)	Phase 2: Elimination of Duplicate Papers				Total
	"Dry Port"	"Inland Terminal"	"Freight Village"	"*Interporto/i*"	
S	27	47	11	1	86
SD	165	206	77	32	480
WoS	8	0	2	0	10
E	5	4	4	0	13
S + SD	13	18	2	0	33
S + WoS	27	6	6	1	40
S + E	0	0	1	0	1
SD + WoS	3	0	0	0	3
WoS + E	1	0	0	0	1
S + SD + WoS	20	7	3	0	30
S + WoS + E	1	0	0	0	1
Total	270	288	106	34	698

Figure 1 presents the process by which the articles were selected: after the start (oval), it shows all project development stages (a parallelogram symbolizes an input/output while a rectangular shape symbolizes a process), the decision node (diamond) and the end of the process (oval again). All these phases are connected by arrows indicating the study project flows. Articles were considered eligible when their content was appropriate to the object of this paper.

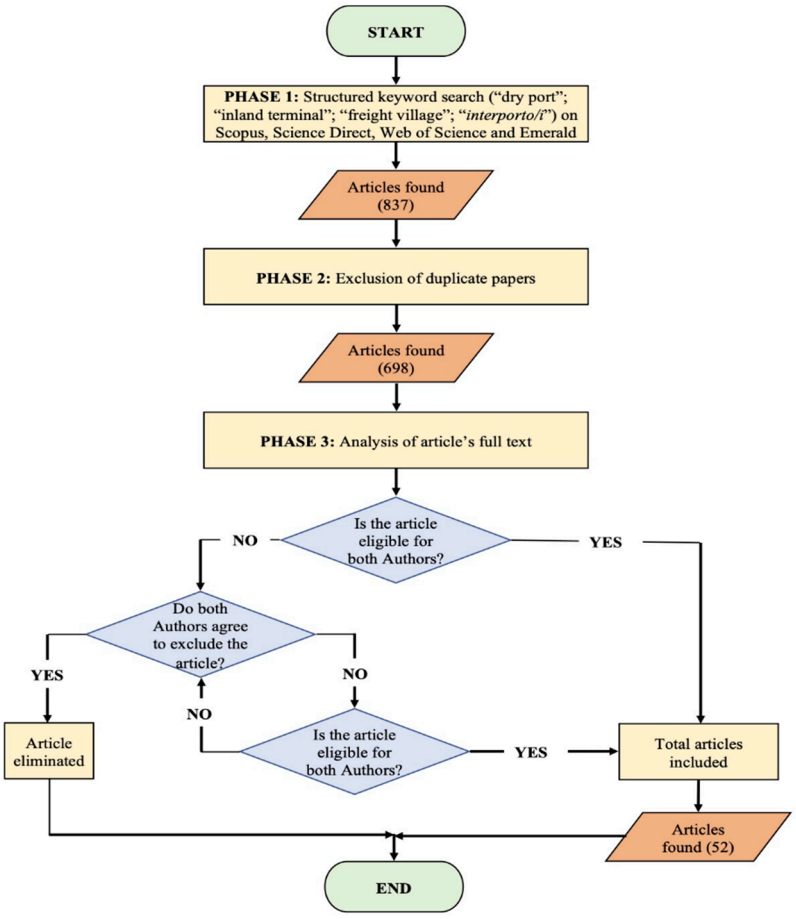

Figure 1. Flow chart: selection of included studies.

At the end, 52 relevant contributions were extracted and deemed eligible for data extrapolation (Table S1 in the Supplementary Materials Section). Most of the articles were excluded due to their focus on other aspects. Highly technical works on topics such as economics, econometrics, finance, computer science and mathematics were also excluded from the review because they were considered beyond the scope of this paper. Articles published without the author's name were excluded as well. This seems to be justified when considering the outlined aim, which concentrates basically on dry port concept, classification, function and technological processes.

4. Results and Discussion

The selected papers were classified by author or, if more than one, by authors, research aim, type of article (research article or review article), subject area (social science, and/or environmental science, and/or engineering, and/or business and management) and field of research (concept, and/or classification, and/or technological processes).

The first selected article dates back to 1997 and was written by Notteboom [52]; the most recent ones are dated 2018 [23,46]. Over the years, the interest of Scholars on this subject has increased: this is demonstrated by the augmented number of articles per year. Most of the 52 selected papers may be classified as research or business articles (46); only a few may be considered as review articles (6).

The results of this classification are summed up in Figure 2.

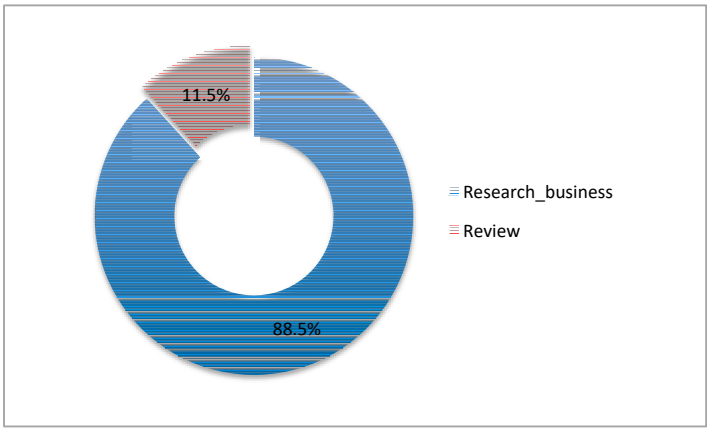

Figure 2. Main results of the literature review by type of article.

The selected papers are specifically focused on countries located almost all over the world (just to name a few, Australia, China, Vietnam, Europe, North America, Iran, Malaysia, Brazil, India and Turkey).

In total, 45 of the selected papers are included in the subject area of Social Science; 17 in Environmental Science; 13 in Engineering and 12 in Business and Management (a single paper may be included in more than one subject area) (Figure 3).

Considering that different languages lead to different terms indicating "dry port", "inland terminal", "freight village" and "*interporto/i*", and that the concept underpinning these words has been better defined over the years, most of the selected papers (43) may be included in the field of search "concept". In total, 28 deal with "classification and function" while only a small number of papers (3) analyze the "technological processes". Furthermore, as to the "field of research", a single paper may be included in more than one field. Figure 4 sums up the above-mentioned results (more details are presented in Table S1 in the Supplementary Materials Section).

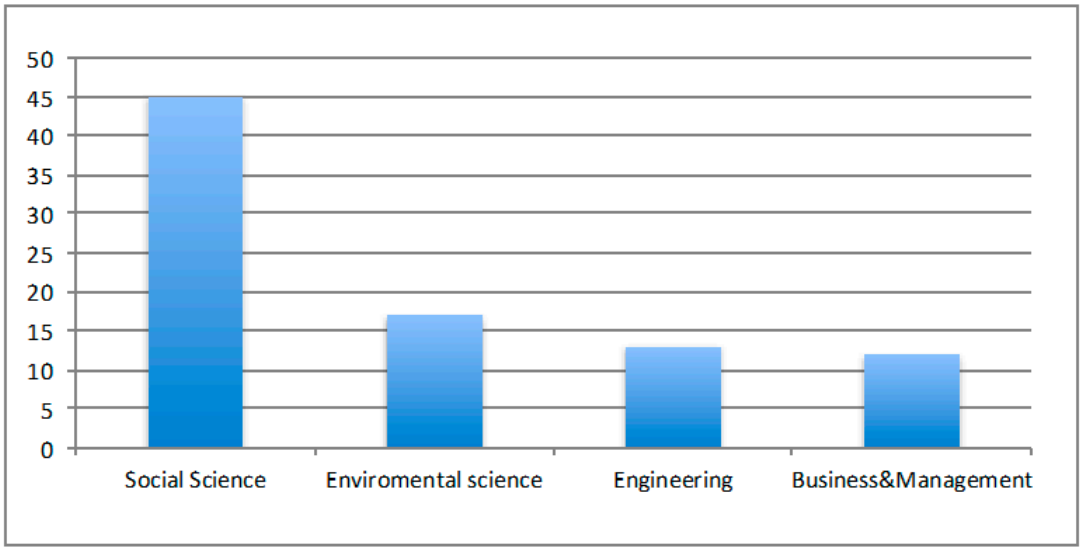

Figure 3. Main results of the literature review by subject area.

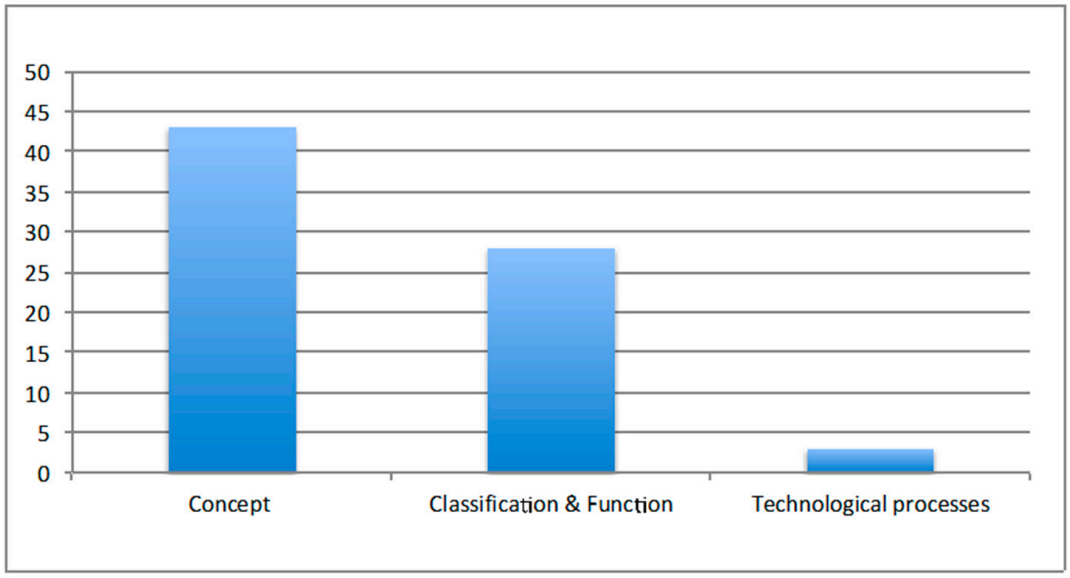

Figure 4. Main results of the literature review by field of search.

In addition, in order to better outline the key aspects of the topic and to support or challenge the findings, relevant and central references known by the authors or found in the bibliography of the selected articles were identified (33), bringing the total number of articles to 85. These references are not included in Table S1 (Supplementary Materials), but they are listed in the text of the paper.

4.1. Classification

Woxenius et al. [70] suggest a classification of inland terminals based on their different role within the transport network. They divide them into three main categories: (1) terminals with direct connection to the port, which lack in warehousing capacity and operability in moving and handling goods, and because of this, the mentioned functions have been decentralized to locations close either to the consignee or to the port; (2) terminals positioned on more important corridors, meant to speed up unloading and reloading operations of means of transport, and also comprising smaller facilities for the purpose of sending small batches of goods to set destinations; (3) hub and spoke terminals, intended as central junctions where important flows of goods pass, characterized by strong capacity

and high value-added services. In the same paper, "remote terminals" are defined as facilities on average not very relevant for behind-port activities, with small warehousing capacity.

With reference to this aspect, it seems useful to mention the classification proposed by Roso and Lumsden [39], which will be further discussed; based on the distance separating dry ports from the port, these authors divide dry ports into three categories: close, midrange and distant.

As to their remoteness from a port (close, midrange and distant), Roso [71] furthermore identified and categorized dry ports around Göteborg (Sweden).

The classification based on the distance has also inspired other authors [10,14,31,34,41–43,46,47,72].

According to this definition [32,44], a facility acquires its own connotation also depending on how ports and shipping companies control the architecture of railway service operations. This stresses its relevance from the point of view of reducing environment pollution as well, since each train can substitute, on average, 35–40 lorries, also allowing for more rational ship unloading without setting port facilities under stress.

Notteboom and Rodrigue [49,73–75] define ownership structures and basic functions of an inland port and argue that the expression "inland structure" depends, among others, on company structure, geographic location and functions available on the platform. Following their classification, inland ports can be divided into satellite terminals, trans-modal centers and transshipment centers. According to the same Authors, the incidence of land transport costs, from port to hinterland and vice-versa, may add up to 80% of the entire transport costs. This is the reason why many shipping companies consider this part of logistics a strategic area in order to reduce unit costs. According to Notteboom et al. [15], a logistics center may be classified, following functional criteria, into three main categories: (i) logistics node, the primary function of which are cargo warehousing and storage; (ii) logistics center characterized by a prominent transit function; (iii) logistics center focused on value added services.

The development of dry ports and their impact on the transport chain have been studied by many authors. In the contributions by Cullinane and Wilmsmeier [76] and Wilmsmeier et al. [36] they are associated to the theory of product life cycle. Bask et al. [45] suggest a development model for the port-dry port dyad structured in three phases ((1) Pre-phase, (2) Start-up phase, (3) Growth phase), subsequently describing each one's characteristics. The article by Bentaleb et al. [77] deepens the previous theories by Cullinane and Wilmsmeier [76], Wilmsmeier et al. [36] and Bask et al. [45]; the progression of the life of a dry port, within a dry port-port system, has been considered similarly to the life cycle of any product or service. According to this study, there are five life cycle phases of a dry port: (1) Development, (2) Introduction, (3) Growth, (4) Maturity, (5) Decline.

In China, dry ports have been classified as [28,43]: seaport-based (located on China's coast, with the major function of providing pre-customs clearance for cargo imported into China); city-based (they provide logistics services for logistics hubs that have emerged at expanding nearby cities in central China) and border-based (generally located in the landlocked border areas of western China; they are far away from seaports and provide transshipment, multimodal transportation and custom clearance services).

4.2. Function

Generally speaking, the function carried out is determined by the location of these facilities considering the most important economic-financial catchment areas, by the structure of shareholding and even by the technical characteristics of the terminal. A significant, already mentioned contribution is offered by Roso [32,44].

The contribution by Wilmsmeier et al. [36] concerns the analysis of a model for dry ports considering the spatial evolution of a transport facility. It studies the direction of dry port development and cooperation tactics of port and dry port, looking into the origin of integration processes which led to their development: "Inside-Out" when it was generated by the land side, i.e., by the dry port itself; "Outside-In" when the input for development came from the sea side, i.e., from the port. In the "Inside-Out" case, integration, in the sense of ownership, may be determined by local authorities,

by the transport company (road and railway operators and river navigation companies) or by logistics providers. "Outside-In" integration is, on the other hand, usually determined by port authorities, by port terminal operators or by shipping companies. This classification was also used by Monios and Wilmsmeier [9] and Nguyen and Notteboom [42].

Dry port functions typically include distribution, consolidation, storage, customs services and equipment maintenance [10].

Rodrigue et al. [7] identify three different functions of inland terminals: (i) satellite terminal (to serve the port terminal by accommodating additional traffic and added value functions); (ii) load center (serves regions with large volumes of containerized loads); and (iii) trans-modal center (freight flow from one port can be bundled with other rail or barge flows). Van den Berg and De Langen [57], Rodrigue and Notteboom [40], Monios and Wang [47], Van den Berg and De Langen [30] also refer to the above-mentioned functions.

An inland terminal is an intermodal terminal which, on top of carrying out the basic functions typical for intermodal transport (transshipment of containers into the various transport options and their temporary custody), also offers a range of logistics services connected to maritime requirements.

The main functions are considered to be decongesting port docks and consolidating containers needing to be transported to the port by rail or river.

In this sense, one of the primary roles of inland terminals is serving its area of influence by all means of transport, none excluded (rail, road and river), so as to further sort freight coming in from the port.

In the Italian case, with reference to the system of Ligurian ports and freight villages of the Northern Italian "*interporti*" model, the latter with dry port functions, the area of technological processes is undoubtedly an interesting aspect, which should be followed in its future development. At an operational level, some projects and pilots have been launched: their scope is to systematize the way of acquiring and using codification data of lorries and transport units at the access gates on the roadside, or of International Consignment Notes (CMR) and/or Delivery Orders on intelligent electronic portals, appositely set up at the rail terminal of Vado (Port of Savona). This in order to obtain that entrance and exit to and from an inland terminal function by the same protocols used in a port. An example is the Vamp Up (the project "Vado Multimodal Platform Intermodal Connections Optimization and Upgrading CEF Project" pursues the objective of developing Vado as a multi-modal logistics platform, thanks to the effective integration of the Vado multimodal system with the European transport network TEN-T, in order to facilitate the shipment of goods to intermodal and logistics centers behind the quays) project, aiming at offering an integrated model shared by the quay and its intermodal reference centers, and applied to all goods transfer modalities.

4.3. Technological Processes

On top of classification and development aspects, another central issue is the one concerning technological processes in port areas as well as in inland terminal areas. They are the activities qualifying services to goods; therefore, they require appropriate technological elements and a real-time work methodology [78]. Services often are the key drivers of growth and profitability [45]. At port terminals the criteria for identifying and reaching these processes are clearly defined; at inland structures, however, they are still not studied sufficiently in depth and are not completely defined [35].

A database analysis of studies and scientific papers showed the scarcity of study space dedicated to technological processes for optimization at inland terminals. Jarašūniene's paper [79], for example, examines a particular aspect, concerning optimization of the recognition of vehicles entering the inland terminal: through the development of a dynamic model, the system is able to accelerate the process of controlling entering containers and sending them to the deposit.

The study by Abacoumkin and Ballis [80] looks at chances for increasing the productivity of road-rail terminals on the basis of set design parameters and selection of alternative equipment.

To this scope, a system was developed as part of an integrated modelling tool, able to compare alternative options of such platforms; a formula for calculating the costs of the respective solutions is annexed to it. The mathematical model by Carrese and Tatarelli [81] is based on an algorithm used for optimizing handling costs of containers arriving at the inland terminal by rail. Lastly, Gronalt et al. [82] developed a simulation tool for optimizing other processes characteristic for an inland terminal.

The following, Table 3, summarizes the main elements, emerged from the previous subsections, for identifying the classification, function and technological processes of a dry port.

Table 3. Summary of the main elements for defining classification, function and technological processes.

Classification	Function	Technological Processes
Role within the transport network	Location	Optimization of the recognition of vehicles entering the inland terminal
Distance of dry ports from the port	Structure of shareholding	Optimizing handling costs of containers arriving at the inland terminal by rail
Company structure, geographic location and available functions	Technical characteristics of the terminal	Optimizing other processes characteristic for an inland terminal.
Development phases of a dry port		
Located on coast, city or landlocked border areas		

5. Conclusions

Most of the 52 selected papers may be classified as research or business articles (46); only a few may be considered as review articles (6). The selected papers are specifically focused on countries located almost all over the world.

In total, 45 of them are included in the subject area of Social Science; 17 in Environmental Science; 13 in Engineering and 12 in Business and Management.

Considering that different languages lead to different terms to indicate "dry port", "inland terminal", "freight village" and "*interporto/i*", and that the concept underpinning these words has been better defined over the years, most of the selected papers (43) may be included in the field of search "concept". In total, 28 deal with "classification & function" while only a small number of papers (3) have analyzed the "technological processes".

In addition, in order to better outline the key aspects of the topic and to support or challenge the findings, relevant and central references known by the Authors or found in the bibliography of the selected articles were identified (33), bringing the total number of articles to 85.

The majority of studies examined in this research seem to agree on the fact that within the scientific community there is no unanimous consensus concerning the cataloguing of terrestrial nodal facilities serving port gateways. In fact, these nodes take up different shapes, functions and roles, within the different contexts they are located in, and they acquire specific characteristics depending on the markets they are a reference for. On the other hand, beyond any cataloguing one cannot deny that, in the development of a more modern, complex and articulate supply chain, "dry ports" have emerged as fundamental elements of integration between sea "system" and land network; they have established themselves not only as a mere physical extension of a port quay, but also and above all as an enlargement tool of its gravitational market area. The increased interest in the genesis and development of dry ports, often generically indicated as inland terminals, has been accompanied, since the eighties of last century and up to date, by an abundant contribution of the scientific community, originating a thriving literature, which, however, does not find a common denominator.

The authors propose to focalize further study on the concepts of "co-modality" and "dry ports" and of the "*interporto*" or freight village as a new kind of hub connected with the seaport.

Supplementary Materials: The following are available online at http://www.mdpi.com/2305-6290/4/4/29/s1, Table S1: Relevant articles.

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