ON THE EFFECT OF FREIGHT VILLAGES IN TURKEY

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ABSTRACT

ON THE EFFECT OF FREIGHT VILLAGES IN TURKEY

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Freight Villages (FV) are complex facilities in which all activities related with freight transportation are realized. Main motivation behind their establishment has been related with achieving sustainability throughout the years. Various operators conduct business under one roof in FVs and coordination and collaboration are the essential part for creating harmony to achieve sustainability. However, the systematic literature review on FVs showed that the current literature does not support enough evidence to conclude that FVs significantly affect sustainability and social equity. The establishment of such facilities are realized in late 2000s in Turkey. Due to lack of value added work in the literature on FVs in Turkey, site visits to operational FVs in Turkey have been made. Because of the lack of coordination and collaboration in FVs in Turkey, currently, potential benefits offered by FVs in different parts of the world could not be realized. Still, it has been showed that if coordination and collaboration could be realized in Turkish FVs, with the change of modal split of freight transportation, favouring railroads, significant positive impacts can be achieved in terms of sustainability. These positive impacts can be achieved for economical sustainability by decreasing costs and dependence on fossil fuels, for environmental sustainability by decreasing emissions and for social equity by increasing employment.

Keywords: Freight Villages, Sustainability, Social Equity, Freight Transportation, Systematic Literature Review

ÖZ

TÜRKİYE'DEKİ LOJİSTİK KÖYLER'İN ETKİLERİ ÜZERİNE

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Lojistik Köyler (LK), yük taşımacılığıyla ilgili aktivitelerin gerçekleştirildiği kompleks tesislerdir. Yıllar boyunca kuruluşlar ardındaki ana motivasyon sürdürülebilirliğe ulaşılmasıyla alakalı olmuştur. Lojistik Köyler'de birçok farklı operatör tek bir çatı altında işlerini yaparken, eşgüdüm ve işbirliğiyle, sürdürülebilirliğe ulaşmak için uyum yaratılması esastır. Fakat LK üzerine yapılan sistematik literatür taraması, mevcut literatürün, LK'lerin sürdürülebilirliğe ve sosyal hakkaniyete hatrısayılır katkıları olduğu sonucuna varılacak kadar kanıt barındırmadığını ortaya çıkarmıştır. Türkiye'de bu tarz tesisler 2000'lerin sonunda kurulmaya başlamıştır. Literatür'de Türkiye'deki LK'ler üzerine katkı sağlayıcı çalışmaların eksikliği nedeniyle, Türkiye'deki faal LK'lere saha ziyaretleri gerçekleştirilmiştir. Türkiye'deki LK'lerde eşgüdüm ve işbirliğinin eksikliği sebebiyle, şu an için dünyanın farklı yerlerindeki LK'lerin sunduğuna benzer olası faydalar görülmemektedir. Yine de, eğer Türkiye'deki LK'lerde eşgüdüm ve işbirliği sağlanabilirse, yük taşımacılığındaki modal dağılımın demiryollarını destekleyici şekilde artmasıyla sürdürülebilirliğe olumlu katkılar sağlanabilir. Bu katkılar, ekonomik sürdürülebilirliğe, maliyetlerin düşmesi ve fosil yakıtlara bağımlılığın azalmasıyla, çevresel sürdürülebilirliğe emisyonların azaltılmasıyla ve sosyal hakkaniyete istihdamın arttırılmasıyla sağlanabilir.

Anahtar Kelimeler: Lojistik Köyler, Sürdürülebilirlik, Sosyal Hakkaniyet, Yük Taşımacılığı, Sistematik Literatür Taraması

To my family

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CHAPTER 1

INTRODUCTION

A Freight Village (FV) is an area within which all activities relating to transport, logistics, and distribution of goods both at the domestic and international level are carried out by various operators (EUROPLATFORMS, 2000). Both logistics companies and producers can conduct their business inside these clusters. Established outside the cities, these (logistics) complexes let the stakeholders perform value-added logistics activities not only by hosting them under the same roof, but also by creating a synergy between them; enabling coordination and collaboration (Baydar et al., 2017). With the presence of coordination and collaboration, FVs are purposeful systems that are prominent in terms of aiding economical sustainability, environmental sustainability, and social equity. After their first examples have been established in central Europe, FVs spread around the world through the years, as the volume of freight transportation activities increased. Nowadays, with a variety of names such as logistics parks, logistics platform, distripark and distriport, these complexes are operational over the entire world.

In Turkey, formation of such facilities started in late 2000s under control of Turkish State Railways (TCDD) and the established facilities are in operation ever since. The project consists of 20 different FVs spread over Turkey, six of which are operational. In addition to these facilities, a private FV is established, too.

This study aims to analyze the possible effects of FVs in Turkey on the different dimensions of sustainability. Before analyzing these possible effects, a systematic

literature review has been conducted from a sustainability and social equity view point, in order to understand the structure of FVs, obtain insight on their background and create new research questions. A total of 71 articles in the literature have been used for analyses and synthesis. The absence of value added work for Turkey on FVs in the literature created a need for realizing site visits to the operational FVs for analyses and interpretations. Indeed, site visits have been made to operational TCDD FVs and a private FV.

Data obtained from the site visits and the discussions made with the FV administrations will be used to come up with figures about the performance of FVs in Turkey and point out the significance of their effects to sustainability and social equity. In doing so, the FV applications in Turkey will also be compared with FV applications that took place in the literature.

The remainder of the thesis study is as follows; Chapter 2 presents the current state of freight transportation activities in today's world, defines FVs, and gives historical background on their evolution. The systematic literature review made prior to this thesis study is given in Chapter 3. Chapter 4 gives the analyses on FVs and the outcomes of the site visits to FVs in Turkey. In conclusion the current status of the FVs in Turkey in terms of aiding sustainability and social equity is presented, along with discussion and comments on the future of FVs in Turkey. Future research directions have been provided in Chapter 5.

CHAPTER 2

ON FREIGHT VILLAGES

2.1 Analysis of Freight Distribution

In today's world, where the economies are expanding with globalization over all different geographies, freight distribution is becoming more important than it has ever been throughout the history. With no doubt, the importance of freight distribution comes from its significant increase since this increase has catastrophic effects to the environment (Jaroszweski 2012). Amongst different logistics activities, freight distribution contributes most in terms of the negative effects against the environment. Such negative effects include air pollution due to emissions and increased noise and vibration.

In the last two decades, freight distribution numbers, namely volumes of good distributed, have shown different rates of increase in different economies resulting from the structure of the respective economy. Geography also played a crucial role in the modal split of the freight distribution. For an analysis of the freight distribution activities, resulting from the fact that they are major economies, three regions have been selected in this study; China, European Union (28 countries) and United States of America.

When Figure 1, Figure 2, and Figure 3 are analyzed, it is clear that there is a significant increase in freight distribution in the last two decades. In USA there is an increase of 12% (5,288 billion ton-kilometers by 1995 to 5,899 billion ton-kilometers by 2011), in European Union (EU) countries, there is an increase of 22% (2,846

billion ton-km by 1995 to 3,482 billion ton-km by 2013) and lastly, there is an increase of 368% (3,590 billion ton-kilometers by 1995 to 16,801 billion ton-km by 2013) in China. Along with the integration of the Chinese economy to the rest of the globe and the tendency for shifting production overseas, there is a tremendous increase. EU countries and USA have somewhat more mature economies compared to China.

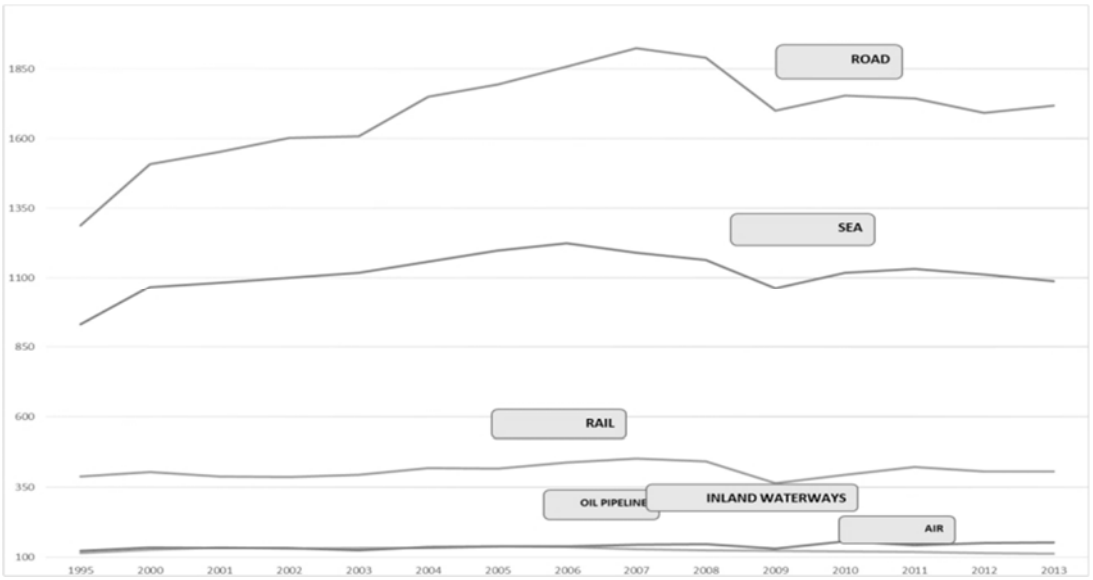

Figure 1 EU-28 performance by mode for freight transport in billion ton-km, EU Transport in Figures, Statistical Pocketbook 2015 (Baydar et al., 2017)

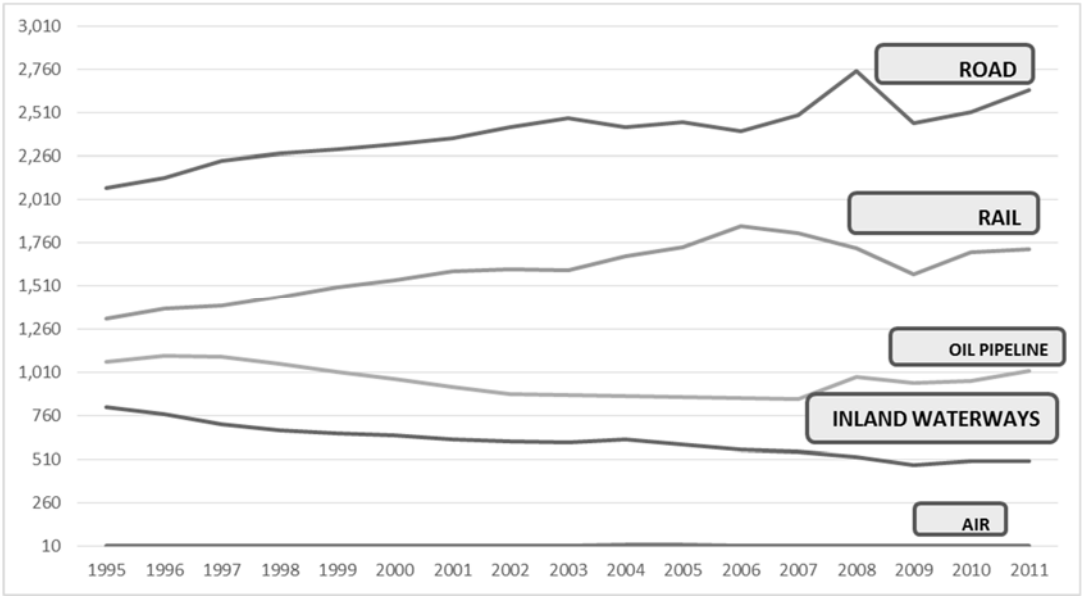

Figure 2 USA performance by mode for freight transport in billion ton-km, National Transportation Statistics, Bureau of Transportation Statistics 2015 (Baydar et al., 2017)

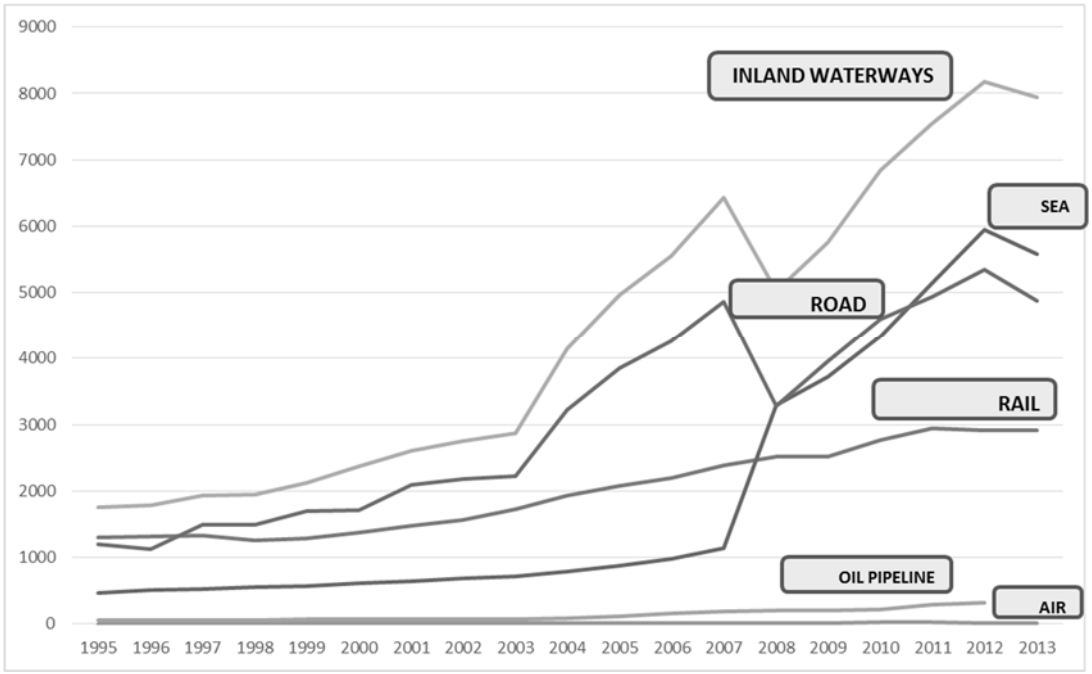

Figure 3 China performance by mode for freight transport in billion ton-km, National Bureau of Statistics of China (Baydar et al., 2017)

When the population growth, which can be regarded as a reason for the increase in business activities and freight distribution, is analyzed, there is an increase of 6.43% for EU countries, an increase of 17.07% for USA however only 12.66% increase for China for the related years (The World Bank, Data Catalog 2017); which is incomparable to the increase in freight distribution when one keeps in mind that the latter increased more than fivefold. Modal split of freight transportation also differs with respect to the properties of the different regions and availability. Facilities that can accommodate to this modality and suffice with their capacities for the increasing volumes are crucial if business and environmental sustainability are desired. Freight Villages come into the picture at this point, as facilities that can fulfill these needs.

2.2 Freight Villages

A Freight Village (FV), is a logistics cluster which hosts different acting bodies under its roof and establishes the policies to construct harmony between these different bodies to achieve *coordination* and *collaboration*. All the activities related with freight distribution take place from intercountry to intercontinental level in a FV; conducing infrastructure development (Sainz et al., 2013), increasing employment (Vrochidis, 2013) and contributing to environmental sustainability (Hanaoka et al., 2011, Lättilä et al., 2013) .

One formal explanation is made by the EUROPLATFORMS, the responsible body in EU on FVs, as “a defined area within which all activities relating to transport, logistics and the distribution of goods, both for national and international transit, are carried out by various operators. These operators can either be owners or tenants of buildings and facilities (warehouses, break-bulk centres, storage areas, offices, car parks, etc.) which have been built there. Also in order to comply with free competition rules, a FV must allow access to all companies involved in the activities set out above. A FV must also be equipped with all the public facilities to carry out the above mentioned operations. If possible, it should also include public services for the staff and equipment of the users. In order to encourage intermodal transport for the handling of goods, a FV must preferably be served by a multiplicity of transport

modes". In this definition, made by EUROPLATFORMS, there is emphasis on setting the necessary rules for coordination and collaboration and offering the necessary infrastructure (EUROPLATFORMS 2000).

FVs differ in nomenclature in different countries; some example names that are used in place of "Freight Village" are as follows: Plate Forme Logistique/ Plat Forme Multimodal in France, Interporto in Italy, Güterverkehrszentrum in Germany, Transport Centre in Denmark and Logistics Center/Logistics Centre in Singapore and China (Rimienė et al., 2007). Distribution Center, Distriport, Distripark and Dryport are the other words that are present in the literature. When this different nomenclature is analyzed, there is a certain emphasis on the words "center" and "multimodality". FVs are, certainly, facilities where freight transportation activities are *concentrated* and transformation between different modes are realized for more effective and efficient means of operations. Hence it is reasonable for these words to appear frequently. In this study, *freight village* will be used in place of all the other words given above. In the following sections, FVs historical development, their place in the supply chains and selected FV examples from the world will be given to analyze the different objectives they carried throughout out the history and their capabilities.

2.2.1 Historical Development of Freight Villages

Throughout their *evolution* FVs had different purposes to fulfil. The first FVs appeared in France, Paris region in the late 1960s with the purpose of reducing traffic in cities by consolidating freight. The main motivation behind their formation was freight transportation effectiveness. In the 1970s, FVs were also built in Italy and Germany, as rail/ road intermodal terminals. In 1980s and 1990s, FVs continued to be established in Central European countries (Netherlands and Belgium, together with France and Germany) and United Kingdom (Kapros et al. 2005). FVs this time focused more on reducing transportation costs since the global competitiveness has increased. In 1990s and early 2000s, as the importance of collaborative action is understood in business world along with an urge for horizontal and vertical

integration, FVs supported their stakeholders by means of facilitating coordination. With 2000s, FVs, along with all their former goals, try to achieve sustainability and social equity (Baydar et al., 2017). Figure 4 summarizes the historical evolution of FVs:

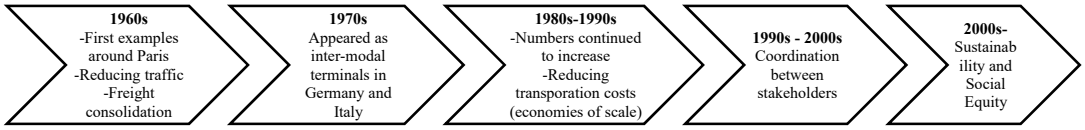

Figure 4 Evolution of Freight Villages

2.2.2 Freight Villages and Their Place in Supply Chains

FVs differ from the traditional freight transportation applications in a supply chain. They do not solely provide the infrastructure for material handling and storage but they do serve as purposeful systems that have an objective to fulfill. The main objective is to obtain a more efficient and effective means of freight transportation. The capabilities and goals of a FV may differ. FVs have different purposes depending on the different economies of the regions they have been established; generally, in the developing economies they remain to be perceived as a key to regional development whereas in the developed economies they are a key ingredient for competitiveness and sustainable business (Altuntaş et al., 2013).

In order to achieve these goals, FVs enhance integration between different transportation modes and they provide related infrastructure to answer the capacity and inter-modality needs for the economies they serve. With the services they offer, FVs aim to provide a more effective and efficient transportation flow between stakeholders in a supply chain. FVs role on a supply chain is more related with overall supply chain effectiveness because of the coordination and collaboration they construct between their users which are stakeholders of the supply chain. When a more contemporary application, i.e., City Logistics (CL) applications are considered, FVs aim to take the freight *out of the city* perimeters whereas, CL facilities focus on

how to achieve efficient and effective freight transport *inside the city*.

The main functions and services of a FV in a supply chain can be summarized in 6 areas (Boile et al. 2008):

1. **Broad Functions:** Warehousing, cargo divisioning, international cargo transfer, distribution services.
2. **Inter-modal Facilities:** Transshipment/ transloading facilities, airports, seaports, rail links to ports and/ or airports.
3. **Traditional Logistics Services**: Container handling, warehouse leasing.
4. **Contemporary Logistics Services:** Transshipment, coordination, consolidation and deconsolidation for local distribution or long distance shipping, horizontal integration between participating companies.
5. **Value-Added Logistics Services:** Free trade zone, barcoding, palletizing, performance analysis, packaging/repackaging, labelling, quality assurance operations, supply chain management consulting, commissioning, call center management, temperature controlled environments, hazardous material services.
6. **Additional Features:** Repair garages, R&D activities, hospitals, schools, post offices, weighbridges, hotels, office spaces, hygiene facilities, restaurants, conference halls).

Some example FVs located in Europe and North America, with available data in the literature, are shown in Table 1. As FVs aim to achieve inter-modality the facilities have more than one mode of transport inside or they have a different mode for transport in their vicinity. Examples shown in Table 1 give clear indications of the capability of the FVs in terms of inter-modality, all the examples have a rail connection and some of them have connection to all transportation modes (road, rail, air and water). There may be different ownerships; public, private or a mixture of these two. Some of the goals of FVs which are given in Figure 4 are also seen in the FV examples given in Table 1. Promoting intermodal transportation, regional development, supporting businesses, consolidation, providing access to different transportation modes and trying to decrease congestion by getting freight out of the

cities can be considered as such goals. The variety of additional services including hospitals, daycares, educational institutions, bars, hotels and restaurants can also be seen in Table 1. In addition to all these services, when the employment numbers and the number of tenant firms in the given FVs are considered, it is no surprise why these facilities are called “Freight Villages”; with their structures, clearly defined perimeters and inhabitants, the facilities exactly give the sense of a village.

As depicted in Figure 4, in today’s world, FVs carry the burden of answering questions related with sustainability and social equity. Hence, in order to understand, analyze and asses these systems, the sustainability and social equity concepts must also be understood so that the related perspective can be created.

Table 1 FV Examples from Europe and North America (de Cerreño et al., 2008)

	Roissy-SOGARIS, France	NTC, Denmark	GVZ Bremen, Germany	Berlin-Brandenburg Region, Germany	Interporto Bologna, Italy	AllianceTexas, USA	Raritan Center, USA	Pureland Industrial Complex, USA
Objectives	- Mitigate congestion - Promote intermodal -Support businesses	- Relocate freight facilities out of cities - Improve environment - Improve safety -Support business	- Relocate freight facilities out of cities - Mitigate congestion and promote intermodal - Consolidate industry - Resolve conflicting land use - Promote regional development	- Mitigate congestion - Promote intermodal - Promote regional development	-Consolidate industry	- Consolidate industry - Relocate freight facilities out of cities - Improve environment	-Provide access to shipping routes	- Provide access to shipping routes
Size (m^2)	538,251	1,999,218	3,622,065	6,475,200	1,999,218	6,879,900	9,510,450	12,141,000
Mode	Intermodal, rail, road, nearby airport	Intermodal, rail, road, sea	Intermodal, rail, road, water, nearby airport	Intermodal, rail, road	Intermodal, rail, road	Intermodal, rail, road, air	Intermodal, rail, road	Intermodal, rail, road
Operation and Management	SOGARIS (80% public and 20% private)	The NTC, Ltd.	GVZE Bremen	GVZE	Interporto Bologna SPA (52% public and 48% private)	Hillwood, a Perot Company	Federal Business Centers, Summit Associates, Inc., Raritan Central Railway	The Pureland Group, DP Partners, other smaller developers
Institutional Form	Public private partnership	Public private partnership	Public private partnership	Public private partnership	Public private partnership	Private	Private	Private
Public Involvement	Regional and local government	Central, regional, and local government	Central and regional government	Central and regional government	Central, regional, and local government	Local government	*(data not available)*	*(data not available)*
Tenants	100	15	114	*(data not available)*	81	170	3,000	150
Employees	2,500 (Boile et al., 2008)	*(data not available)*	5,500	4,800 (Hesse, 2004)	1,500 (Boile et al., 2008)	27,773 (Boile et al., 2008)	15,000 (Boile et al., 2008)	8,500
Services	Customs office, post office, health care, public transit, restaurant, cafeteria, security, gas station	Post office, customs service, bank, showers	Parking, customs services, gas station	Bank, restaurant, bar	Customs, post office, public transit, bank, bar, restaurant	Office, residential, hospital, education, retail, mall, entertainment, hotel, etc.	NJ Convention Center, post office, medical centre, bank, hotel, restaurant, daycare	Offices, hotels, restaurants, supermarket

2.3 Sustainability and Social Equity

The sustainability concept is first discussed formally in 1972, in a report presented to The Club of Rome[1]. In that report, the current usage of the resource and the exponential population growth is analyzed with different scenarios via a computer simulation and it is concluded that, if mankind can come up with a way of doing things that cares for the future generations, only then it may have a future. A formal comprehensive definition is made by United Nations in late 1980s as "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987).

The word sustainability actually composes from the words "sustain" and "ability" in its etymology. The word itself refers to "an ability to remain at a certain level". As with the significant increase the humankind's hazardous effects on environment, sustainability is also referred to as "the avoidance of the depletion of natural resources in order to maintain an ecological balance"[2]. Sustainability can be basically understood as a paradigm, which shapes one's decisions in using resources in order for the upcoming generations to also benefit from them. In simple words, sustainability can be described as "not depleting upcoming generations' resources for today's needs". Since the world is ringing alarm bells and the competitiveness of the markets are inflating, sustainability concept has gained attention and focus as it had never had with the start of 1990s and since then, this focus is ever increasing (Olazabal et al., 2015, Ellram et al. 2017).

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[1] Meadows, D. H., Meadows D. L., Randers, J., Behrens III, W. W. 1972. The Limits to Growth: A Report for The Club of Rome's Project on The Predicament of Mankind, Universe Books, New York. ISBN: 0-87663-165-0.

[2] Oxford Dictionary, Available online: https://en.oxforddictionaries.com/definition/sustainability, (Accessed 8 October 2017).

Sustainability has three different dimensions as the economy, environment and society which are shown in Figure 5. As show in this figure, achieving sustainability lies in the dark shaded are, which is the intersection of environment, economy and the society.

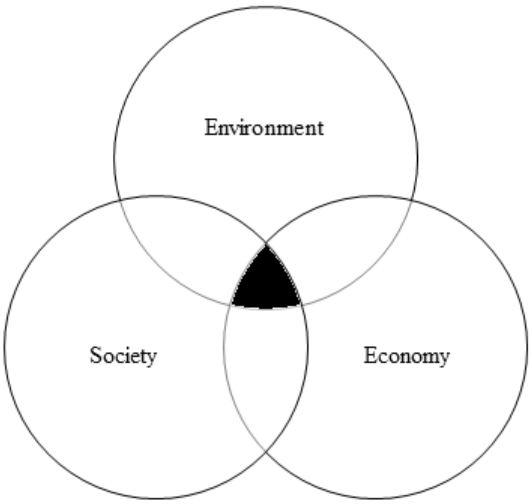

Figure 5 Three dimensions of sustainability

These different dimensions can be regarded as different aspects of efficiency as economic efficiency, environmental efficiency and social equity (Prause 2014). If any of these dimensions is absent in an operation, then, only partial integration to sustainability can be achieved. Hence, these three dimension are inseparable components. The remainder of this section will clarify these three dimensions and explain logistics activities' relations with these three components.

2.3.1 Economical Sustainability

Economical sustainability has a similar definition with the term sustainability itself, i.e. the ability of sustaining the desired level of production. When the logistics activities are considered, ever increasing competition and customer demands are the defacto words to describe the market. This, clearly results in increased complexity in operations and without new approaches and paradigms, it is not possible for the freight transportation activities to achieve a robust growth trend. The increasing logistics costs is a threat for the economical sustainability and any amount of

decrease in these costs, especially transportation costs, would yield significant returns to the market (Bromley and Foltz 2011).

In this study, economical sustainability will be generally related with the intermodality ability since the supply chain resilience is dependent on this ability to use different types of transport modes in the same flow. In addition to that, capacities and capabilities of the FVs will also be analyzed, since higher capacities will result in a bigger scale in terms of benefitting from economies of scale and different capabilities may lead to decrease in costs if certain resources are shared.

2.3.2 Environmental Sustainability

As pointed out by Daly (1990), environmental sustainability is related with sustainable yield; rate of harvest should not exceed the rate of generation and sustainable waste disposal; rate of waste production should be as large as the environment's ability to handle waste. In addition to these two, if nonrenewable resources are being used, equal amount of renewable resources must be found as substitutes.

When the intra-organisational environmental practices are considered for freight transportation and logistics activities, the use of alternative fuels, use of less polluting vehicles and speed reductions are the major initiatives when transportation and freight distribution are considered (Colicchia et al., 2013). The reason why is current dependency of vehicles on fossil fuels and the resulting emissions.

Because of the emissions, in today's world, logistics activities are accounted for nearly all of the negative effects against the environment. Along with the air pollution resulting from the emissions, vibration and noise pollution are the other main negative effects of the logistics activities. Current modes of transport also do not fully support renewable sources of energy and still indigent to fossil fuels. It is estimated that non-OECD transportation energy use will increase by an average of 2.8% per year from 2010 to 2040, compared to an average decrease of 0.3% per year for OECD countries (EIA 2014). Since a fully renewable energy source with zero

emissions and is being used in freight transportation activities is not present as of today, logistics activities violate environmental sustainability in all aspects.

2.3.3 Social Equity

Social equity is the most complex element of the above mentioned triad of sustainability (environment, economy and society). A formal definition of social equity and its relevant measures have been the subject of extensive debate and given the variety of views on social equity, defining appropriate measures is challenging and generally case-specific (Baydar et al., 2017). Mainly, three different schools have been credited in terms of understanding social equity. These are the Aristotelian idea of equity with the perspective of proportional satisfaction of needs (Bertsimas et al., 2012), classical utilitarianism, where the aim is to improve the well-being of the whole society (Marsh and Schilling, 1994), the Rawlsian school of difference-based equity, in which the aim is to improve the well-being of the worst-off beneficiaries of the services as much as possible (Yang et al., 2013).

In this study, logistics activities' relation with social equity will be limited to the extent of the equitable distribution of income created by logistics activities in a region it is located, which may be regarded as a combination of Aristotelian and Rawlsian schools.

2.4 Coordination and Collaboration

Two important concepts, coordination and collaboration, come into the scene with the development of logistics activities through the years and are vital for achieving sustainability. As stated by Sheffi (2012), for any (logistics) cluster, the possible advantages are actually a result of coordination and collaboration. Collaboration is "the action of working with someone to produce something" and coordination is "the organization of the different elements of a complex body or activity so as to enable them to work together effectively" (Oxford Dictionary 2010). In logistics activities, collaboration can be understood as gathering different acting bodies under a virtual or (as in the case of FVs) a physical roof to achieve a goal. As Wu and Haasis (2011) also point out, collaboration is a framework of operations and strategies, such as

planning, knowledge sharing, knowledge integration, acquisition, cost sharing (e.g., common infrastructure usage, joint marketing), performance reporting, rewards and punishment systems, and vision/ mission statements. Coordination, on the other hand, can be regarded as the joint planning and execution of operations for potential benefits. As stated by Jaržemskis (2007), it is necessary for interacting bodies to act in coordination and collaboration to form a synergy that has potential benefits.

Baydar et al. (2017) points out that it is worth noting coordination activities are realized in most logistics operations. However, coordination should not be solely understood as working together. It rather involves acting bodies working together as parts of a system; for a common purpose and for the benefit of all bodies. Thus, the interaction of the collaborating bodies is essential in understanding the purpose and behavior of the FV as a system.

These two new terms (Rimiené and Grundey, 2007) are essential because coordination and collaboration is the key to the effectiveness of all logistics activities. FVs' significance in logistics operations and the supply chain comes from their ability to construct and maintain an environment that leads to coordination and collaboration between their residents. What separates a FV from any logistics center (a complex where planning of logistics activities, warehousing and distribution of goods are realized) is FVs' ability to conduct their business with coordination and collaboration. The value added from a FV to the supply chain it takes place results from the fact that the FVs fulfill all their objectives given in Section 2.2 with coordination and collaboration. Hence, any FV's management should establish the necessary agreements and contracts in order to formally establish the conditions for coordination and collaboration.

2.5 Method

Having a sustainability perspective and focused on freight transportation, this thesis study will follow a method as follows; firstly the systematic literature review that has been made prior to the thesis by the author will be presented. The outcomes and findings from the systematic literature review will be basis for the analysis of FV

applications in Turkey. Secondly, the FV applications in Turkey will be analyzed, comparing the performance and the structure of the FVs in Turkey with selected FVs in Europe and USA. Since the current literature cannot bring out satisfying information on FVs, in analyzing the FV applications in Turkey, the outcomes, findings and gathered data from the site surveys to the facilities will be used. Thirdly, the possible effects of the FVs in Turkey will be analyzed and using the vehicle-km values, the freight distribution patterns and properties of the logistics sector in Turkey and the Turkish economy, discussion will be made on the significance of the effects on different dimensions of sustainability. Lastly, FVs relation with Physical Internet applications will be discussed and offered performance metrics for FVs will be shared.

CHAPTER 3

A SYSTEMATIC LITERATURE REVIEW ON FREIGHT VILLAGES AND THEIR EFFECTS TO SUSTAINABILITY AND SOCIAL EQUITY

Prior to the thesis study presented here, a systematic literature review has been made by the author in order to understand FVs' nature, organizational and structural properties, nomenclature and development process throughout the history. Researchers' paradigm was on sustainability and social equity. Hence the impact of FVs to sustainability and social equity was analyzed. The systematic literature review conducted also helped to understand how FVs were understood and handled by the academia. This systematic literature review titled "Freight villages: A systematic literature review from the sustainability and Social equity perspective" has been published in 2017 (Baydar et al., 2017). The endeavor was in search of more profound understanding of how the concept of FV is perceived in various parts of the world and over time, as well as how it relates to the overall logistics system, and sustainability and social equity. This systematic literature review, its search steps, evaluation and the interpretation of the findings will be given in this chapter.

3.1 Introduction

A Freight Village (FV) is an area within which all activities relating to transport, logistics, and distribution of goods both at the domestic and international level are

carried out by various operators (EUROPLATFORMS, 2000). Established outside the cities, these (logistics) complexes let the stakeholders perform value-added logistics activities not only by hosting them under the same roof, but also by creating

a synergy between them; enabling coordination and collaboration. Current literature clearly states that addressing sustainability and equity issues are the starting points for establishing FVs (Wu and Haasis, 2013, Boile et al., 2008; Higgins and Ferguson, 2011).

According to Kapros et al. (2005), when FVs first appeared in the European continent (the first FV being located in the Paris region) in the 1960s in order to reduce traffic in cities, by freight consolidation, their main driver was urban freight transportation effectiveness. In 1970s, FVs started appearing in Italy and Germany, this time following the concept of extended inland rail/road intermodal terminals. In the 1980s and 1990s, the number of FVs continued to increase in the Central European countries (France, Germany, Italy, Netherlands, and Belgium) and the United Kingdom (Kapros et al., 2005). Between 1980s and 1990s, a promising aspect of FVs was the reduction in transportation costs due to the economies of scale, which started to gain more importance as competitiveness in the global business environment increased.

By late 1990s and early 2000s, these systems supported their stakeholders by means of facilitating coordination. It is also of no surprise that during those years, businesses started to appreciate the importance of collaborative action, as well as relevant concepts such as horizontal and vertical integration. Currently, in the first decades of the new millennium, acting sustainably is crucial for any decision maker, more than it ever was before. Social equity, which is an inseparable part of sustainability, is likewise vital. The world is ringing alarm bells and FVs are now in a different step of their evolution where they need to address issues related to sustainability and social equity.

FVs have different purposes throughout the world, based on the varying organizations of the economies and demographic structures they serve. In the developing countries, FVs are regarded as an advantage for regional development, whereas in more developed parts of the world, they are a key ingredient for competitiveness, and/or the means for a more sustainable business (Altuntas and Tuna, 2013). Based on an overall survey of the distribution of relevant studies in the

literature, for which a detailed discussion will be provided in Section 4, a vast majority focuses on high income economies and upper middle-income economies, which constitute more than 60% of the countries of the world. Studies focused on high-income countries consider FVs as a compulsory mechanism for competitiveness and an efficient business, whereas studies based on the upper middle-income economies point to the need for FVs as development drivers to achieve social equity (Bodaubayeva, 2015).

This chapter presents a review of the state-of-the-art literature on the profile and development of FVs with two purposes. First, it discusses the impacts of FVs and determines their corresponding place in supply chain and logistics networks. Second, it questions the sustainability and social equity issues regarding FVs with specific focus on the freight transportation literature. The remainder of this chapter is organized as follows. Section 3.2 highlights the evolution of logistics and current logistics paradigms. For a better understanding of the evolution of Freight Villages, the growth of logistics and freight transportation is explained to better understand the capability and the existence of FVs throughout the world. In addition, Section 3.2 analyses freight logistics activities with descriptive statistics to understand the ongoing activities and concepts around the globe in terms of freight transportation. Section 3.3 gives a description of an FV as a purposeful system. A summary of FV evolution, along with properties of FVs in the literature and the potential benefits a supply chain network can obtain from an FV, is also given in this section. We make use of a systematic review and analysis of the literature in order to point out research directions on the topic and provide the researchers with a comprehensive guide on the body of knowledge on FVs. Section 3.4 presents the systematic literature review and describe the application of the method as well as the outcomes of the review. In addition to these, nomenclature of FVs is also investigated. The impact of FVs on sustainability and equity is discussed in Section 3.5 along with a brief definition of the perception of sustainability in the paper. The last section gives the conclusion of the paper and points to important potential work areas.

3.2 Logistics and Freight Transportation

Just as in many other different industries, there have been major changes in transportation through time, especially in logistics activities and freight transportation. Throughout this evolution, the term logistics has evolved and the perception of logistics has changed with the term itself. Over more than the last two decades, markets of the world have come closer to each other and shrunk it into a village. Consequently, the complexity, scale, and speed of transportation activities have increased significantly. In addition to all these, as the producers' strategies focus more on outsourcing, the structure of supplier-consumer relationships have turned into a chain structure and later on into webs, which resulted in the need for a holistic view for understanding of such structures. Logistics constitutes an important part of business activities especially when operations are outsourced and/or a wide market is aimed.

While the term logistics was coined for the use of military activities for a long time, it has recently gained a more civilian structure under the concept of business logistics. During the 1960s, logistics was solely understood as the physical distribution of goods, whereas by the end of the 1980s, inventory management concerns and supply chain management started to gain importance. Starting from the mid-1990s (particularly with the increase in the use of third party logistics), concepts of consolidation and coordination have become new trends (Rimiené and Grundey, 2007). The Oxford Dictionary (2010) defines consolidation as "combination of (a number of things) into a single more effective or coherent whole". Coordination, on the other hand, is defined as "the organization of the different elements of a complex body or activity so as to enable them to work together effectively". As urbanization increased after the Second World War, cities have become denser than ever and freight transportation within the cities has grown enormously. The concept of City Logistics (CL) has evolved to solve the problems regarding freight transportation inside the cities. The major distinction between CL activities and those involving FVs is the relative location of the facilities with regard to the cities; CL takes place within cities, while FVs involve logistics activities outside cities. Liu et al. (2013)

visualize the dispersion of such villages in France for the last 50 years and tries to explain this contrast using empirical data. Along with the massive developments in the information technologies, Intelligent Transportation Systems (ITS) have been used in logistics activities, starting with the end of the 20th century. ITS aim to benefit from the integration of data and transportation activities. While ITS applications may be involved in FVs as well, it is worth noticing that ITS applications are more human oriented and mainly focus on human movement. In different parts of the world, freight transportation volumes are increasing at different rates depending on the size and the nature of the economies. With the shift of economies around the world (especially due to offshore activities), freight transportation has skyrocketed in China, compared to the early years of 1990s. The figure has increased from 3,590 billion ton-kilometers in 1995 to 16,801 billion ton-kilometers in 2013, which corresponds to a nearly 400% increase (National Bureau of Statistics of China, 2015). In the US, total freight transportation increased by a smaller amount (12%), from 5,288 billion ton-kilometers in 1995 to 5,899 billion ton-kilometers in 2011 (National Transportation Statistics, 2015). Compared to the US, European countries show a more significant increase in their freight transportation numbers, 2,846 to 3,482 billion ton kilometers

(22%) from 1995 to 2013 (EU Transport in Figures, Statistical Pocketbook 2015). An important indicator that shows the recent trends in logistics activities is the modal breakdown of freight transport, showing the different transportation modes used for these activities. Even though freight transport modes shifted from road to rail and sea with the increase in containerization, freight transportation by road is still the most dominant form of transportation around the world, except for China and some European countries with very high levels of development in freight infrastructure, such as the Netherlands and Denmark (Schwab and Martin, 2015). On the other hand, the modal breakdown shows different results for China compared to the remainder of the world; with inland waterway freight transportation having the largest percentage as opposed to the roads or railways.

For China, as many industries focus on outsourcing their activities in the mainland, the amount of goods flowing through country from and to the international markets is becoming enormous as can be seen from the figures above. Furthermore in the Chinese case, substantial governmental effort is made for development of mainland China through the waterways usage. The idea is to promote the cities and the regions surrounding the waterways by increasing the economic activities there (China Today, 2016).

With the significant increase in freight transportation and its intermodal breakdown, infrastructure and the related facilities must surely be adapted so that they can offer quality service, enabling sustainable businesses and environment while caring for the stakeholders. The idea of FVs comes into picture here, claiming to provide a solution to these requirements.

3.3 Freight Villages

EUROPLATFORMS, the responsible body in EU on FVs, gives a clear definition of a freight village as "a defined area within which all activities relating to transport, logistics and the distribution of goods, both for national and international transit, are carried out by various operators. These operators can be either owners or tenants of buildings and facilities (warehouses, break-bulk centers, storage areas, offices, car parks, etc.) which have been built there. In addition, in order to comply with free competition rules, a FV must allow access to all companies involved in the activities set out above. A FV must also be equipped with all the public facilities to carry out the above-mentioned operations. If possible, it should also include public services for the staff and equipment of the users. In order to encourage intermodal transport for the handling of goods, a FV must preferably be served by a multiplicity of transport modes" (EUROPLATFORMS, 2004).

Unfortunately, there has not been a formal consensus on the nomenclature of these systems (as FVs themselves consist of many different parts working together, in harmony for a purpose). Some of the different names for these systems used in the European, South East Asian and North American countries with high levels of

logistics capabilities and high logistics indices, are given in Table 1 (Rimiené and Grundey, 2007, Schwab and Martin, 2015).

Table 2 Names for FVs

Country	Name
Great Britain & USA	Freight Villages
France	Plate Forme Logistique / Plat Forme Multimodal
Italy	Interporto
Germany	Güterverkehrszentrum
Denmark	Transport Centre
Singapore & China	Logistics Center / Logistics Centre

In this study, the term freight village is used in place of all the terms mentioned in Table 2[3]. Although different languages lead to different terms to indicate a Freight Village, it is worthwhile to notice that the phrases are used to describe activities related with goods traffic, modality, and integrality. The frequent usage of the word "center" in the terms is a sign so that these systems are complex facilities where activities related with freight transportation are concentrated. It is worth noting that coordination activities are realized in most logistics operations. However, coordination should not be solely understood as working together. It rather involves acting bodies working together as parts of a system; for a common purpose and for the benefit of all bodies. The interaction of the collaborating bodies is essential in understanding the purpose and behaviour of this system. As Wu and Haasis (2011) also point out, collaboration is a framework of operations and strategies, such as

[3] The alternative terms currently in use such as Logistics Center (Logistics Center), Distribution Center, Distriport, Distripark and Dryport can be misleading, as any facility conducting logistics activities (such as planning, warehousing, and distribution) is a "Logistics Center". On the other hand, a FV involves coordination and collaboration among different commercial bodies.

planning, knowledge sharing, knowledge integration, acquisition, cost sharing (e.g., common infrastructure usage, joint marketing), performance reporting, rewards and punishment systems, and vision/mission statements. Jaržemskis (2007) states that interacting bodies in this way form a synergy that has potential benefits.

As purposeful systems, decision making for the management of FVs needs to follow a well-structured vision, which should be in line with the purpose they have evolved to fulfill. Along with increasing the efficiency of the activities related with freight transportation, the urge for building FVs results from the need to obtain increased effectiveness from the supply chain. The purpose for the development of FVs in today's world differs throughout the globe, with each different geography having its own needs to be addressed. For developing countries, this need is much more related to market penetration possibilities and increased competitiveness (in addition to sustaining social equity through regional development), while for a developed country (in addition to all the aforementioned factors) sustainability is one of the major principles to consider.

In the current study, achieving sustainability has been related with effectiveness. Besides, we take into account the fact that "inclusion and equity are indispensable requirements for sustainable development" (Clark, 2012). We provide a more detailed account of how sustainability and equity are perceived in the scope of FVs in Section 3.5. FVs offer logistics services by means of their technological and organizational resources. In addition to supplying the necessary information and performing value-added activities, FVs also cover all activities related with logistics and transportation both in the regional and international markets. However, certain challenges arise in carrying out these activities. Higgins and Ferguson (2011) point out to these shortcomings by underlining the coordination difficulties between different levels of government and conflicting political interests. There can be risks of oversupply as every jurisdiction strives to pursue the latest trend. On the private sector side, there is the fact that modern day supply chains are mostly vertically oriented, whereas the FV concept is inherently horizontal and, in its ideal form, at least partially depends on the cooperation among firms. In many FVs, firms have

been observed to operate completely independently of others in the development. Concerns about cooperating for competitive reasons and a dependence on government subsidies have also led to difficulties in the urban consolidation/distribution potential of FVs. Structural information available in the literature regarding some of the existing FVs can be found in Table 18 in the Appendix and the main services offered by FVs can be summarized as in Section 2.2.2.

The amount of freight transported through several FVs (located in Europe) and the percentage of total traffic in the country they handle can be seen in Table 3 (since data is not available for TEU units and Road/ Rail operations, the related percentages are not shown).

Table 3 Example FVs, capabilities, and estimated traffic flows (Boile et al., 2008)

Country	Freight Village	Road	Rail	Air	Water	Road/Rail Traffic est.**	Rail Traffic est.	Road Traffic est.
France	Roissy-SOGARIS	X	X		(X)	25,000 T*	-	2,500,000 T (0.13%)
Hungary	Budapest Intermodal Logistics Centre	X	X	(X)	(X)	87,000 TEU (2005)	-	-
Italy	Interporto Bologna	X	X			3,906,000 T* (2002)	1,777,000 T (2003) (2.1%)	2,250,000 T (2003) (0.18%)
	Interporto Novara	X	X		(X)	-	-	436,000 TEU (2005)
	Interporto Parma	X	X	(X)	(X)	5,000,000 T (2006)	1,600,000 T (2006) (1.56%)	3,500,000 T (2003) (0.28%)
	Interporto Rivalta Scrivia	X	X	(X)		1,500,000 T (2006)	500,000 T (2003)	1,000,000 T (0.08%)
	Interporto Torino	X	X			-	-	3,000,000 T (2003) (0.24%)
	Interporto Quadrante Europa	X	X		(X)	26,000,000 T (2003)	6,000,000 T (2003) (7.18%)	20,000,000 T (2003) (1.6%)
	Interporto Verona	X	X			26,000,000 T (2003)	6,000,000 T (2003) (7.18%)	20,000,000 T (2003) (1.6%)
Portugal	Terminal Multimodal Da Vale Do Tejo S.A.	X	X	(X)		1,000 T (2003)	-	-
Spain	Bilkakobo-Aparcabisa	X	X		(X)	-	-	425,000 T (2003) (0.02%) ***
	Centro de Transportes de Irun	X	(X)		(X)	-	-	2,800,000 T (2003) (0.15%)

Keeping the main services offered by FVs in mind, the sample list in Table 3 gives an idea about the potential capability of such FVs in terms of freight distribution volumes and offering intermodality. However, because of lack of data, drawing exact conclusions about the exact capabilities of FVs from these figures is not possible without site surveys to reach data, particularly in countries that lack well-developed institutions. Nevertheless, when the capabilities of the FVs are investigated, it is clear that these systems are crucial elements in overall supply chain effectiveness. As there are global concerns regarding the sustainability of activities in all industries, it appears that without the coordination and collaboration supported by FVs, sustainable synergy and data management needed for conducting business become impossible. One simple explanation for this is that although there has been a common understanding on the value of information sharing and horizontal integration activities, i.e., the companies becoming aware of phenomena such as the bullwhip effect, it is not always possible to realize the integration activities as expected. Another impact of FVs with coordination and intermodality activities is the reduction in overall haul transportation distances and the decrease in emissions (Hanaoka and Regmi, 2011; Lättilä et al., 2013).

In search of more profound understanding of how the concept of FV is perceived in various parts of the world and over time, as well as how it relates to the overall logistics system, and sustainability and social equity, we present a systematic literature review in the following section.

3.4 A Systematic Review of the Literature on FVs

This section presents a systematic literature review on academic studies regarding FVs. The review is performed to assess the scope of the academic studies on FVs by focusing on the evolution of these studies over time, the countries or regions with which they are related, and their subject areas. We also aim to assess the extent at which the sustainability and social equity issues are incorporated into these studies, and point to potential research directions in these areas. We first provide the details

of the method used to search for relevant articles. The remainder of the section focuses on the results of the review.

3.4.1 Overall method

The systematic search method in this study follows that used by Kilubi (2016) and Gligor and Holcomb (2012), who concentrate on systematic reviews of strategic supply chain management. In the following sections, we explain the search steps, evaluation of this research, and the interpretations of the findings.

3.4.2 Search query

The search mainly focuses on two main academic databases, namely Scopus and ISI's Web of Knowledge. The starting keywords of the search included the two most widely-used phrases for the subject: “Freight Villages” and “Logistics Centers”. The search looked for these phrases (with quotation marks in order to avoid irrelevant articles), and yielded 58 distinct articles from aforementioned web sources. Later, in order not to miss any previously published work on the issue, an additional search was conducted using the 20 relevant keywords arising from different definitions of FVs. These keywords are provided in Table 4.

Table 4 Keywords used in the search

Distripark**	Distriport***	Freight Terminal**	Integrated Freight Center
Intermodal Freight Center+++	Platform Freight Terminal*	Transport Terminal**	Freight Center
Freight Centre	Freight Logistics Centre++	Freight Village*	Inland Port****
Intermodal Terminal+	Logistics Center*	Logistics Centre	Logistics Park*
Logistics Platform	Merchandise Integrated Center***	Transport Center	Transport Centre*

*EUROPLATFORMS, **Rimiené et al. (2007), ***Lima et al. (2010), [+]Ballis (2005), [++]Kapros et al. (2005), [+++]Kayikci (2010) stated that the above-mentioned keywords can be used interchangeably with FVs, so they had been included in the search query.

The query (which required minor format changes in different databases) was as follows: "keyword AND language = English AND ('source title includes transportation' OR source title = logistics OR 'source title includes network' OR 'source title includes freight')". The source titles were limited on purpose for a more efficient search, since the resulting sources with this search would be more specific on the concept. In order not to miss the studies published in other sources, the source filter was omitted for a second search run. With this set of keywords, and two search runs (in separate databases), a total number of 98 distinct articles were obtained after removing the duplicates in different search databases. A second search was made, this time combining the keywords that were used in this search with the new keywords "sustainability", "green" and "equity". The new search queries were as follows: "one of the new keys AND one of the previous keywords for FVs AND Language = English". To reach a controllable amount of studies, source type was specifically set to "article" (the first run also included conference papers, declarations, working papers, and books). As a result, no additional articles came up that were distinct from the ones that were found in the first search run. To obtain an overall understanding of the trends and approaches in the literature, the quotation marks were erased and a quick search among the 154 articles that were obtained as a result of the search for the query "freight AND sustainability" was made. Again, no new articles were added to the previously found articles and five articles overlapped. The main trends found to be related with the current study were methods for decreasing emissions, noise and vibration, increasing social equity through increase in investments to a region and the resulting infrastructure development. In order not to lose the scope on FVs, the second search results are not given in this study.

3.4.3 Results of the Systematic Literature Review

Following the methods by Dickersin et al. (1994), Denyer et al. (2003) and Denyer and Tranfield (2009) in their systematic literature reviews, a further elimination is made to focus solely on studies leading to relevant questions on FVs and an observation of the gaps in the literature. Among the 98 original articles, 24 focus on a generic modelling or solution technique, rather than the concept of freight villages with concerns about sustainability and equity, thereby lacking novelty in terms of contribution to the FV literature. For example, Aksoy and Ozyoruk (2015) use a mixed integer model to decide on the location of FVs of Turkish State Railways. However this model aims to the increase in efficiency in goods flow without regard to the structure of the FV. As another example, Bottero et al. (2013) consider the monitoring of the traffic in a FV with wireless sensors by focusing only on sensor sensitivity. Another example is Yang et al. (2007), which focuses mostly on locating a FV and its corresponding mathematical model, with no emphasis on the particular role of the FV in the system.

Three papers out of the remaining 74 are classified as "auxiliary", because their focus is not on directly contributing to the aim of this study. However, such studies are helpful in understanding how researchers are looking into the field from different perspectives. Of these, Ross and Droge (2004) focus on how the efficiency of the distribution systems change with the increase in size, King et al. (2014) discuss the possibility of promoting FV usage with road pricing policies, and Ishfag and Sox (2011) describe the network structure of intermodal logistic networks. The remaining 71 articles were analysed in detail to come up with new questions, research directions, and conclusions.

3.4.3.1 Classification Based On Time

As Table 5 clearly demonstrates, a look into the yearly distribution of articles shows the emphasis on the field has increased after 2008. Of the first two articles published in 1999, Wiegmans et al. (1999) analyze possible terminal market, services, size of

potential terminals, and buyers while Tsamboulas and Dimitropoulos (1999) collect data via mail and conducts statistical analysis on the appraisal on investments in FVs.

Table 5 Distribution of articles through the years

Years	**Number of Articles**	**%**
After 2013	36	51
2008-2012	16	23
2003-2007	13	18
1998-2002	6	8
Total	71	100

Because the concept of logistics itself has increasingly involved a holistic view starting from the 1990s, and due to the evolution and continuous change of the activities in the same period, there is an increasing trend regarding the studies on FVs over the years as well. More than half of the articles have been published after year 2012, and 74% have been published after 2008. Table 5 gives the distribution of articles over the years.

3.4.3.2 Classification in Terms of Country and Economy

53 (75%) of the 71 articles include information about a specific country that the data is collected and/or the study was conducted in. Numbers of articles with respect to different countries of focus are presented in Table 6. The remaining 18 articles provide generic information about the FVs. China and Greece lead the number of articles published with a specific country of interest (each with 6 papers). After China and Greece, Germany and Sweden follow with five articles. China, Greece, Germany and Sweden, along with Turkey, Lithuania, the USA, Italy, Finland, and Hungary constitute the 80% of the articles with specific country information. In total, 22 different countries were present in those 53 papers, namely (in decreasing number of papers) China, Greece, Germany, Sweden, Turkey, Lithuania, USA, Italy, Finland,

Hungary, Brazil, Spain, Poland, India, Laos, Serbia, Iran, Croatia, Mexico, Kazakhstan, the Netherlands, and Japan. These numbers point to the fact that the concept of FV has been appreciated nearly all around the world in different economies.

Table 6 Number of articles with respect to different economies (Schwab et al., 2015)

Economy	Number of Articles	%
High-income economies ($12,736 or more)	34	64
Upper-middle-income economies ($4,126 to $12,735)	17	32
Lower-middle-income economies ($1,046 to $4,125)	2	4

As mentioned before, FVs have the potential to answer different questions in different geographies. However, the amount of investment needed and the infrastructure costs may be challenging for a country with a lower-middle-income economy. The distribution of the number of articles with respect to economies shows that the majority of the articles (96%) focus on high-income or upper middle- income economies, although one must of keep in mind that the economy classification used here does not include an equal number of countries. Again, there is lack of data in the literature for the FV applications in lower-middle-income economies and the amount of overall freight transportation activities are lower for lower-middle-income economies compared to high-income and upper-middle-income economies. These two factors clearly affect the number of articles focusing on lower-middle-income economies.

3.4.3.3 Classification Based On Scope

The first step of the classification of articles is based on scope, which is summarized in Figure 6. 11 articles (15%) have a more general scope with a conceptual approach, while the remaining 60 are based on case studies either on the country level (i.e., looking at the overall dynamics for a specific country) or at the individual level (i.e.,

assessing individual FVs in the same country), and/or FVs in different countries/continents. We further classify these articles by their contribution to the literature; either by assessing a dimension(s) or by investigation and/ or proposing design approaches.

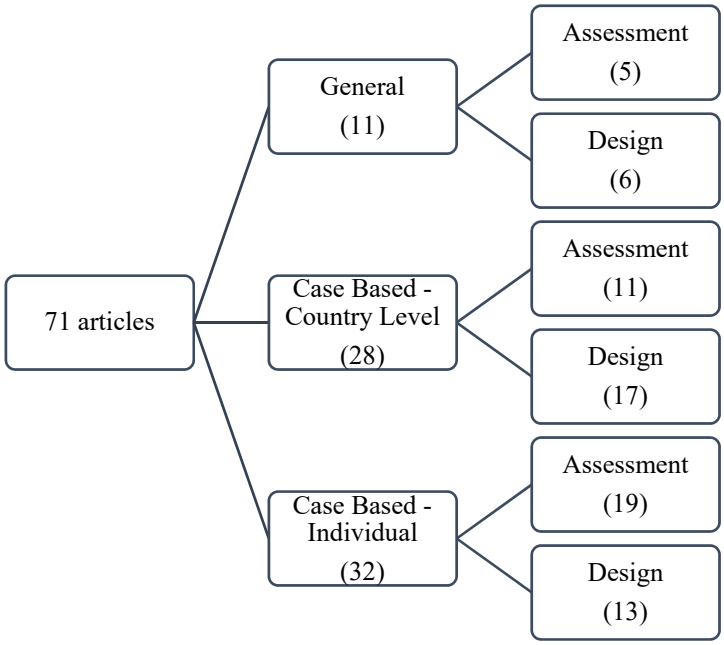

Figure 6 Articles with respect to scope

A deeper look into the 71 articles mentioned above shows that, in 49 (69%) of these articles, the focus is on a specific dimension, i.e., the characteristic of the article is reflected on that dimension only. The scope, category, and the dimension information of these 71 articles are presented in Table 19 in the Appendix. “Other” is used as a separate dimension, as there exists more than one distinct dimension for 22 of the articles, the design or the assessment methods cover more than one aspect. For these 22 articles, Table 20 in the Appendix gives details on the work carried out, presenting the different dimensions of the study.

3.4.3.4 Interpretation of Results

Clearly, the articles with the dimensions “environmental impact”, “regional

development", and "efficiency" (in terms of less negative environmental effect) add value to the literature in terms of sustainability and social equity. Altuntas and Tuna (2013) design green buying criteria for FVs. The greening effects are crucial for the environment, but a pitfall for the study is the fact that most of the time the choice of a FV will depend on the location of the facility and the lack of FVs in a region will make it impossible to impose such green buying criteria. Hanaoka and Regmi (2011) and Lättilä et al. (2013) consider the impact of coordination on the reduction in overall haul transportation distances and the decrease in emissions. Haralanbides and Gujar (2012) give a promising "eco-DEA" model to use in the assessment; although the article is considering the dry ports in India, the proposed model can be generalized easily. Monios (2015a,b) and Vrochidis (2013) point out the increase in employment numbers with the establishment of FVs. However, there are many factors affecting the national economy. Hence, the correlation between the FVs and the employment figures is not reliable. Sainz et al. (2013), on the other hand, provide a thorough assessment of the overall development of the region with the FVs (especially in terms of infrastructure).

With the articles presented in Table 20 in the Appendix, one can infer a holistic view into FVs. For example, Bodaubayeva (2015) investigates the effects of FVs in Kazakhstan in terms of impact on regional development and gives ideas about the size and potential location of such facilities. The FV-2000 report, created by the EU Commission in year 2000, is one such document giving guidelines about all the design aspects of a system.

The articles in Table 20 provide significant contributions to the literature because the authors cover multiple aspects of FVs rather than mainly focusing on a single aspect. Since these are purposeful systems, an overall view is essential to understand the place of the FVs in logistics and supply chain networks. Location, size, and governance are most popular dimensions between the articles in Table 20. Locating a FV and planning its capacity are no surprise popular dimensions for studies but the emphasis in governance, points out the distinction of a FV from a conventional

distribution center. This is because the infrastructure to form synergy and interaction of the bodies inside the FV is especially important.

By category, design papers are relatively more in number than assessment papers, and are populated under case-based country level articles. This underlines the need for performance metrics for measuring FVs' efficiency and effectiveness. In the articles presented in Table 20 in the Appendix, there is no article that focuses on assessment on intercontinental basis, i.e., presenting different characteristics of FVs located in different geographies and comparing their efficiency and effectiveness. How effective FVs really are in these aspects will be discussed in Section 3.5.

3.5 Impact of Freight Villages on Sustainability and Equity

Recent research shows that humankind's effect on the environment has come to an irreversible stage. Unlike the past few decades, when it was merely a visionary move to care for the environment, with the beginning of 21st century, these effects on the environment have become impossible to ignore. In this atmosphere, our age has given birth to the notion of sustainability, obliging us to think about the future more while taking an action. Sustainability in a broader sense is a framework that stipulates that available resources of today directly and profoundly affect those of tomorrow. The United Nations gives a comprehensive definition of sustainable development as one "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNCED, 1992). Hence, it pushes the acting bodies to think and take actions if necessary to change their life. The focus on sustainability has been particularly increasing since the start of the 1990s (Olazabal and Pascual, 2015). In fact, many countries have been implementing policies for their economies to adapt to this philosophy. Logistics activities account for most of the (nearly all negative) effects against the environment (such as extreme weather) mainly due to emissions (Jaroszweski, 2012). Hence, a sustainable approach is essential. Prause (2014) gives three different perspectives on sustainability as economic efficiency, environmental efficiency, and social efficiency. Lozano (2008) visualizes these three dimensions and discusses how their integration changes with different perspectives.

Particularly when logistics is provided as a public service, establishing social equity arises as an additional concern, along with the efficiency and effectiveness of operations. Here, the main aim is to establish a more equitable distribution of income over various geographical regions by means of logistical activities. However, a formal definition of social equity and its relevant measures have been the subject of extensive debate. Over history, three schools of equity have been dominant: (1) the Aristotelian idea of equity based on proportional satisfaction of needs (Bertsimas et al., 2012), (2) classical utilitarianism, where the aim is to improve the well-being of the whole society rather than individual people or regions (Marsh and Schilling, 1994), and (3) the Rawlsian school of difference-based equity, in which the decision makers strive to improve the well-being of the worst-off beneficiaries of the services as much as possible (Yang et al., 2013). Given the variety of views on equity, defining appropriate measures is challenging, and generally case-specific. Modern applications of social equity are based on combinations of the measures arising from the Aristotelian and Rawlsian schools. In general, the aim to satisfy such measures usually results in a trade-off between equity and efficiency of operations, and thus decision makers usually make use of compromise measures taking both aspects into account. Another important challenge in accounting for social equity is that equity-based models of logistics problems tend to be significantly computationally challenging as opposed to their efficiency-based counterparts.

As can be understood from the previous work, a FV is a purposeful system. The main motivation behind the implementation of these systems is the belief that they provide more effective ways of conducting logistics activities; adjusting to the needs of the environment surrounding them and the stakeholders they are in relation with. According to Boile et al. (2008), example purposes for FVs are environmental sustainability and economic development. Regmi and Hanaoka (2013) also point to environmental sustainability, Higgins and Ferguson (2011) mention reduction in emissions, increase in investments and employment, as well as environmental sustainability. Some fundamental findings from the literature, which are summarized in Table 8 also justify this. It is clear from these findings that FVs are designed to

contribute to the logistics and supply chain networks along in many different aspects, but most importantly in terms of sustainability. The selected articles in Table 7contribute substantially in terms of understanding the structure of FVs and the capabilities of a FV in achieving (more) sustainable logistics and supply chains. We question the literature on FVs impacts on sustainability based on two perspectives of sustainability, namely environmental impact and social equity. The economical perspective is not taken as a concern in this study, since the benefits FVs on scope and the scale of business activities are already promising, and for any commercial firm to enter such business cooperation with other firms, some measure of risk and/or cost minimization must be satisfied.

Colicchia et al. (2013) highlight the work in the literature questioning the effect of logistics activities on sustainability and how collaboration can be benefited. In terms of obtaining collaboration and coordination, FVs are definitely promising systems resulting from their structures. Nevertheless, when the articles in the mentioned literature search are analysed, few major keywords have been identified that would point to the dimension of the study is on effects of FV on sustainability. It is surprising that only six of the articles (<10%) were aimed at focusing on sustainability from the sustainability and regional development perspective, which can be seen in Table 7. From their sustainability perspectives the articles are distinguished into two groups. From the sustainability perspective, Hanaoka and Regmi (2011) point out the importance of railways in freight transportation and the possible reduction in CO_2 emissions by shifting to railways. Lättilä et al. (2013) also have similar findings; reduction in CO_2 emission by increased intermodality and dryport usage. Altuntas and Tuna (2013) declare green buying criteria, yet it is important to keep in mind that, for competitiveness and capacity limitations, generally buying criteria would be solely be the location of a FV, rather the green criteria, which promise to enable environmental sustainability. From the social equity perspective, Vrochidis (2013) and Sainz et al. (2013) relate FVs presence and the increase in employment numbers. FVs seem to fulfil being a business generator in the cases presented. However one must treat the correlation between FVs and the

increased employment numbers with caution since it is not possible to see the sole effect of FVs presence on the number of jobs created. The increase in freight capacity itself may very well increase the employment level. Lastly Monios (2015a, b) tries to come up with answers for aligning national and regional goals on the strategic planning of FVs.

Table 7 Articles focusing on articles on sustainability and social equity

Sustainability Perspective	Reference and its title	Findings
Decrease in negative environmental impact resulting from emissions	Promoting intermodal freight transport through the development of dry ports in Asia: An environmental perspective, Hanaoka et al., 2015.	Railway connections to dry ports can reduce freight emissions of CO2 and local air pollution through a modal shift that reduces the number of long-haul trucks plying on roads. Some cases demonstrate this potential. The current congestion and pollution at are isolated cases that will be eased once the capacity of the ICDs is expanded and the share of rail freight is increased. Investment in railway infrastructure/dry ports can encourage modal shifts to greener modes of transport.
	Greening logistics centers: The evolution of Industrial buying criteria towards green, Altuntaş et al., 2013.	The study tries to adopt green buying criteria to FVs service buying criteria. However it must be noted that in developing countries where the availability of such villages are low, or in instances where the FV location is the determining factor for choice, the buying criteria design may fail
	Hinterland operations of sea ports do matter: Dry port usage effects on transportation costs and CO2 emissions, Lättilä et al., 2013.	Mathematical models and simulation studies are used to show that the estimated CO_2 emissions can decrease with increased Dry port usage (the usage includes activities that a FV is capable of such as increased intermodal transportation and intermodal shift)
Aiding regional development	Intermodal transport as a regional development strategy: The case of Italian freight villages, Monios, 2015.	The national plan for FVs does not produce such coordination across the network, manifesting in conflicts between spending on old and new sites. The major finding from the research is a misalignment between the national and regional scales, as funding based on national policy does not align with port and FV planning strategies developed at the regional level.
	Logistics centres as economic drivers of their regions, Vrochidis, 2013.	Five example FVs have been selected for demonstration as case studies to show the impact of FVs on regional development. There is actually new number of jobs directly and indirectly related to transport and logistics sector. However it must be noted that, during the time period of the study (2003-2010) the freight traffic and urbanisatin numbers also increased in the case cities hence, to draw exact conclusions is hard.
	The economic impact of logistics infrastructure: the case of PLAZA – the Zaragoza Logistics Platform, Sainz et al., 2013.	The total impact of PLAZA on the Autonomous Region of Aragon is calculated by a Leontief function; adding the direct, indirect, and induced impacts, estimating the creation of 1.88% of total jobs in the area.

In addition to these findings, no formal measures have been devised to assess the impact of FVs on social equity, nor have any existing ones been used for that purpose. Here, the effect of FVs on sustainability and equity has been observed from the systematic literature review. This bears the question of whether the real impact of these systems on environmental sustainability and regional development are overrated or because of the lack of data that the true concepts regarding sustainability have not yet been considered. If so, the available information is not sufficient to justify the significance of the positive effect of these systems. Even the usage of the words “equity” and “sustainability” is a slight indication. 9 out of 71 (13%) articles contain the word “equity”; the word itself appears 17 times at total. 24 out of 71 (34%) articles contain the word “sustainability”; the word appears 226 times. However, 108 of these 226 (48%) instances appear in Wu and Haasis (2013).

Even though the studies include case-based work, to assess the true impact of FV without noise is not possible from our literature review. Hence, based solely on these results, FVs seem to fail at filling the needs they were evolved for as complex systems. Another way of looking at this issue is that, it is possible the researchers are focusing a lot on the operational side of the FVs and missing the big picture since, right from the initialization step, these systems are the products of nothing but strategic decisions. As mentioned in Section 3.3, social equity is an essential part of sustainability. It is crucial to understand that for achieving sustainability (and necessarily social equity), paradigms related with operational efficiency such as cost minimization and capacity must be abandoned. Rather, effective systems must be desired.

Table 8 Findings on FVs from selected articles.

Author / year	Title	Findings
Yang et al. (2015)	Efficiency analysis of European Freight Villages: three peers for benchmarking	FVs are not just logistical interconnection points within a logistics network but they are also business generators.
Bodaubayeva (2015)	Formation of Industrial and Logistic Parks in Kazakhstan	FVs are seen as regional growth points; supporting cost reduction and competitive advantage through acces to infrastructure and communications, the combination of all modes of transport and the unifonned logistics management of service providers.
Calis et al. (2014)	Historical Development of Worldwide Freight Villages and Freight Villages in Turkey	FVs aim at reducing logistics costs, decreasing transportation and transfer times, decreasing joint expenditures by creating synergy among persons and institutions providing logistics services, increasing the quality of service, strengthening the procurement chain of the sector to which the services are supplied and attainment of increase of added value, decreasing the environmental effect and carbon emissions, decreasing traffic accidents and congestions, make direct contribution to the optimization of the procurement change as a result of arrangement of traffic load of roads.
Wu et al. (2013)	Converting Knowledge into Sustainability Performance of Freight Villages.	FVs have less negative environmental impacts compared to classical way of conducting logistics activities. They are a cluster of quality industrial-intermodal-distribution-logistics buildings located within a secure perimeter where a range of support services are provided by every user, enabling a high degree of accessibility and transfers freight from one mode to another.
Wu et al. (2011)	Knowledge-based Stakeholder Collaboration for Sustainable Development of Freight Villages	FVs offer common services to various transport and logistics companies located within its site, as well as to other external users. A FV is a typical cluster of various firms relating to logistics activities, which rapidly extend their scope and size into worldwide global markets, as well as interact closely with their surrounding citizens and nature environment.
Winkler et al. (2011)	Management of freight villages: findings from an exploratory study in Germany	Logistical interconnection points; that function as an interface between local and long-distance goods, FVs can lead to the rationalisation of transport and logistical services, inducing cost savings along the entire logistics chain.
Lima Jr et al. (2010)	Sustainable Logistics Platform in a Regional Brazilian Airport	A FV is strategically situated site, encompassing several logistics activities, with a large transportation infrastructure that provides competitive advantages and enhances the logistics activities of the participants engaged in the companies business also generating significant number of jobs. This infrastructure is a modernalternative to solve the problems caused by the increased flow of vehicles circulating in a city because of the intensified demand of goods distribution. FVs involve alliances between organizations responsible for transport services, warehousing and distribution that can generate significant reductions in urban traffic, environmental pollution and social problems
Hamzeh et al. (2007)	Logistics Centers to Support Project-Based Production in the Construction Industry	A FV is focal point for material flow streams in a logistics chain. It thereby provides access to different shipmen modes, performs broad logistic functions, serves a wide range of users, presents information technology solutions, and offers value added services. The existence of a FV is a stimulus to generate business; acting as an impulse for business and economic development.
Ballis et al. (2007)	Freight village design using the multicriteria method PROMETHEE	A FV located in the vicinity of a large city may provide an efficient solution to urban freight transport problems including traffic congestion, regional competitiveness, and quality of life. FVs evolve alliances among the entities responsible for the transport, storage and distribution services, which can generate significant reduction in the number of trucks vehicle-kilometers
Meidute (2005)	Comparative analysis of the definitions of logistics centres	This article is the only work in the literature on the linguistic backround of the definitions and usage of these definitions.
Ballis (2005)	Freight Villages: Warehouse design and rail link aspects	A FV is a defined are organized for carrying out all activities related to transport, logistics and distribution for both national and international transit.
Kapros et al. (2005)	Multicriteria Approach to the Evaluation of Intermodal Freight Villages	FVs are specialized zones offering space and common services to transport operators for the public good.

3.6 Conclusions and Potential Research Directions

It seems that there is a research gap in the related literature due to lack of data and absence of research questions related with sustainability and equity in the context of FVs. With the output of the systematic literature review explained in Section 3.4, this fact becomes clear and leads to a number of research directions. Future work must focus on more field studies in the FV area. There is a question of data integrity and inconsistency for case-based studies. Hence, more empirical studies are needed. For a potential researcher, it is also important to keep in mind that part of the publications on transport and logistics are from non-academic resources. Therefore, both the government and the private sources should also be revised prior to such an empirical study. Another potential area for improvement is the linguistic background

of the FVs. The work by Meiduté (2005) is the only study focusing on the usage of the terms. In accordance with that, a former historical development scheme would be extremely beneficial for researchers working on the topic to understand clearly how different economies respond to such a change and how they integrate these systems with their current infrastructure, as also investigated by Rimiené and Grundey (2007). Furthermore, a GIS representation on the locations is so far available only for individual countries; an overall look and spatial analysis of intra and inter-continental freight transportation and their relation with FVs would give a lot of insight about the role of FVs in supply chains.

Although there are many review papers about logistics activities and supply chain management, our survey found no review papers on FVs. While the work by Bookbinder (2013) seems to be relevant, it collects several global logistics articles and lacks a review focusing on FVs. A comprehensive review on this subject would be very beneficial, since it would cover many aspects in literature.

Physical Internet (PI) applications might come relevant to a researcher in this field. PI applications also consider different dimensions of sustainability (i.e., economic, social, and environmental). It is worth noticing that in contrast with the centralization focus of a FV, PI applications tend to decentralize freight transportation. For social

sustainability, it is shown that PI facilities significantly decrease the effects of shift work and lead to a decrease in mileages (Fazili et al., 2017). However, creating jobs and/ or local development are not prominent features. Nevertheless, as Montreuil (2011) states, PI is visionary and open to development and enhancement, i.e. in the near future, it may evolve to fulfil different needs.

Currently, the literature also lacks clearly stated performance indicators for FVs related with sustainability and social equity. Even for measures that are more tangible (i.e., how to measure how green a FV is), there is still little academic work.

With the available work in the literature on FVs and their impact on sustainability (decreasing negative environmental impacts and increasing social welfare) in specific, it is not possible to justify the potential of FVs and their promising positive impacts on sustainability such as decreasing greenhouse gas emissions, CO_2 reduction, etc., and functioning as a business generator in the related region they operate. However, it is also crucial to keep in mind that, although the current study cannot justify the potential benefits of these systems on sustainability, with the inclusion of governmental institutions especially in terms of supporting reliable data, one can desire more clear conclusions. The authors strongly believe that it is not logical or realistic for such a system to operate or to be initialized in a, say, European country where the effect of organizations on the environment is closely monitored in detail. In addition, focusing again on the European case, due to the lack of land, such a brown field structure cannot survive solely with the benefit of economies of scale and/ or economies of scope.

CHAPTER 4

ANALYSIS OF FREIGHT VILLAGES IN TURKEY

4.1 Freight Village Applications in Turkey

In this section, the FV applications in Turkey will be discussed. Since the author had not come across value adding material on FVs in Turkey in the SLR and since the author believed that there is gap in the literature in terms of field studies, field trips had been organized and empirical data for the analysis of the FV applications were sought. First, the current structure and the organization of the freight transportation and the FVs in Turkey will be presented. Then, data from the site surveys of the selected freight villages will be presented.

As can be seen in Figure 7, Turkey is a country in which the majority of the freight transportation is still done using highways. In ton-km, 89.5% of goods transportation is done by road transport. Roads are followed by seaways 5.9% and railroads 4.6% (Turkish Statistical Institute). When the freight transportation patterns in the EU are analyzed, which the Turkey has been striving to become a member and accommodate to its standards, the percentage of goods transported by roads is 71.59% whereas the percentage of railroads is nearly quadruple of Turkey with 17.21%, seaways similar to Turkey; around 6% and there is pipeline usage with 4.86% in overall spread of goods transport.

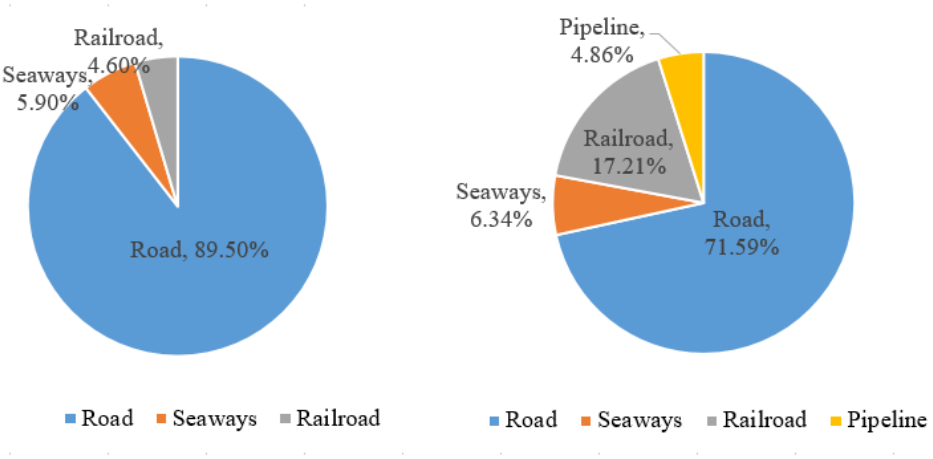

Figure 7: Percentage of transportation modes in Turkey and EU-28 (ton-km)

Much effort is being spent in Turkey by the authorities, Turkish State Railways (TCDD) and The Ministry of Transportation, Maritime Affairs and Communication namely, to increase the modal split of goods transport. The main motivation behind this endeavor is that the road transport, which is the dominant type of goods transport in Turkey, has certain disadvantages when other transportation types are considered. The two major disadvantages of road transportation when compared to rail and/ or seaway transportation modes are the cost and environmental effects. These disadvantages will be discussed in detail in the upcoming sections with the possible effects of FVs on sustainability and social equity.

TCDD and the government's solution approach to this situation is the establishment of FVs[4]. In Turkey, the FVs are initiated by TCDD. A project has been started in which the existing warehouses and loading docks are modernized and new facilities are opened. Currently there are 20 such facilities which are regarded as logistics

[4] TCDD's choice of words for its facilities is "Logistics Center". However, the term *freight village* will be used in place of *logistics center*.

centers/ villages by the TCDD. In addition to these 20 facilities, there is a private sector investment in Kazan, Ankara. This FV application will also be analyzed in the scope of this study.

The locations of the above mentioned facilities can be seen in Figure 8. It is important to state that there is not a formal legal status and/ or definition for the facilities.

Figure 8: Freight Village Applications of TCDD, Source: Courtesy of TCDD (http://www.tcdd.gov.tr/Upload/Files/ContentFiles/2010/yurticibilgi/lojistikkoy.pdf, Accessed 26 November 2016)

In Figure 8, the facilities that are in dark blue color are the ones that are being planned investment areas by the TCDD. The facilities that are red in color are the ones that are under construction. The green facilities on the other hand, are the ones that are operational. The facilities depicted in green color were former railroad warehouses and that host certain number of loading docks. These facilities have been modernized in order to meet the increased capacity demands. Two updates have been realized in Figure 8; in addition to the FVs of TCDD shown, an additional project

has been started as İzmir-Kemalpaşa FV. Furthermore, Balıkesir-Gökköy FV had been operational during the thesis study and Samsun-Gelemen was not operational and thus was not approved by the TCDD for a site visit. The total areas (in m^2) for these facilities can be seen in Table 9.

Table 9 Size, Governance and Status of FVs in Turkey

FV	Total Area (in m^2)	Governance)	Status
Konya-Kayacık	1,014,947	TCDD	Planning Phase
İstanbul-Yeşilbayır	1,000,000	TCDD	Planning Phase
Kemalpaşa-İzmir	1,000,000	TCDD	Planning Phase
Türkoğlu-Kahraman Maraş	804,884	TCDD	Planning Phase
Ankara	700,000	Private Ownership	Operational
Bitlis-Tatvan	660,000	TCDD	Planning Phase
Bilecik-Bozüyük	654,000	TCDD	Under Construction
Boğazköprü-Kayseri	620,000	TCDD	Planning Phase
Eskişehir-Hasanbey	540,000	TCDD	Operational
Sivas	500,000	TCDD	Planning Phase
Habur	500,000	TCDD	Planning Phase
Mardin	441,161	TCDD	Under Construction
Yenice-Mersin	415,681	TCDD	Under Construction
Erzurum-Palandöken	349,260	TCDD	Under Construction
Kocaeli-Köseköy	346,000	TCDD	Operational
Kars	300,000	TCDD	Planning Phase
Samsun-Gelemen	257,600	TCDD	Operational
Balıkesir-Gökköy	211,000	TCDD	Operational
İstanbul-Halkalı	220,000	TCDD	Operational
Uşak	140,000	TCDD	Operational
Denizli-Kaklık	120,000	TCDD	Operational

Including Ankara FV and TCDD FVs, 9,779,586 m^2 of land is covered by FVs of which only 25% is operational. Currently seven facilities are operational (34%) (excluding Samsun), three facilities are under construction (14%) and, more than half, the remaining twelve facilities are in planning phase (57%). Most of the FVs that are operational and planned are the previous railway depots, hubs or junction points of TCDD. Amongst the visited FVs, Denizli-Kaklık, Eskişehir-Hasanbey, Kocaeli-Köseöy and Uşak were such facilities.

Due to lack of available data about Turkey and the lack of work on Turkish FVs in the literature, site visits were made to the selected facilities. The selection was based on the feedback from the TCDD personnel, i.e.; the facilities with active freight transportation operations are selected. These facilities were Balıkesir-Gökköy, Denizli-Kaklık, Eskişehir-Hasanbey, İstanbul-Halkalı Kocaeli-Köseköy and Uşak. In addition to these facilities, a visit to the "Ankara Lojistik Üssü" located in Kazan, Ankara was made. During these visits, the questions in Table 10 were used. The form included the below questions:

1. **Location:** What were the criteria for selecting the location of the facility?
2. **Management Information System:** What is the management information being used in the system?
3. **Employment:** What are the education and experience levels of your employees? Where are your employees located at?
4. **Tenants:** Which firms can you state as your tenants in the facility?
5. **Vehicles:** What model and type are the vehicles that the facility offers to its users?
6. **Effect to Environment:** In which aspects does the facility affect the environment (sound, water, air, etc.)? Which metrics are being monitored for these areas?
7. **Certification:** What are the quality system and/ or environmental certificates the facility holds? From which authority does that certificate has been taken and what is the renewal rate?

8. **Business Volume:** What is the current business volume of the facility (monthly vehicle traffic, amount of freight handled, number of destinations in the last 6 months, weekly freight handled, and weekly vehicle traffic)?
9. **Evaluation:** How important are the following criteria for the facility: increase in employment, exhaust gases emissions, saving consumables, saving electricity and noise pollution?

Table 10 Question form used in site visits

Lokasyon	*Tesisin lokasyonu seçilirken baz alınan kriterleri yazınız*			
Bilgi İşlem Sistemi	*Tesiste şu an nasıl bir bilgi işlem sistemi kullanılıyor ve müşterilerle organizasyon nasıl sağlanıyor yazınız (Siparişler hangi ortamda toplanıyor; ör:SAP, Oracle, İç Kaynak Yazılımı)*			
İstihdam	*Tesis bünyesinde çalışan personelin kaçının ilgili alanlara girdiğini yazınız*			
Eğitim Seviyesi	Ortaokul - Lise			
	Üniversite			
Deneyim	0-5 yıl			
	5 ve üstü			
İkamet durumu	Şehir dışından geliyor			
	Tesisle aynı şehirde yaşıyor			
Kullanıcılar	*Tesiste yer alan firmaların adları, tesiste faaliyet başlama tarihleri ve sözleşmeleri nedir yazınız*			
Firma Adı	Faaliyete Başlama Tarihi	Sözleşme Türü		
Araçlar	*Fabrika faaliyetleri ve işleri için kullanılmakta olan araçlarla ilgili bilgileri giriniz*			
Araç Türü	Model			Adet

Table 10 Question form used in site visits (cont'd)

Çevre Etkisi	*Tesisin çevreye olan etkisinin ölçüldüğü alanları ve ölçüm birimini yazınız (ör.Ses Kirliliği (db))*			
Alan	Birim			
Sertifikasyon	*Tesisin sahip olduğu kalite ve/veya çevre sertifikaları hangileridir ve hangi kurum(lar) tarafından düzenlenmiştir yazınız*			
Sertifika Adı	Kurum Adı	Yenilenme Tarihi ve Sıklığı		
İş Hacmi	*Tesisin, mevcut iş hacmi ne kadardır yazınız*			
Aylık Araç Trafiği (Giriş + Çıkış)				
Kaldırılan Yük Miktarı				
Son 6 Ayda Ulaşılan Varış Noktası Sayısı (İl-İlçe)				
Haftalık Kaldırılan Yük Miktarı				
Haftalık Araç Giriş-Çıkışı				
Değerlendirme	*Aşağıdaki alanların sizin için önem derecesini işaretleyiniz*			
	Düşük Derece Önemli	**Orta Derece Önemli**	**Önemli**	**Çok Önemli**
İstihdam Artışı				
Egzoz Gazı salınımı				
Sarf Malzeme Tasarrufu				
Elektrik Tasarrufu				
Gürültü Kirliliği				

Some of the questions given in Table 10 had similar answers; the location selection of the FVs of TCDD had been made by the Logistics Department of TCDD, so all TCDD FVs answers were the same. Question 5 about the vehicles owned by the facility was not applicable to some extent, since apart from a few, the FVs in Turkey did not own material handling machines for serving the tenants. It has been discovered by the author that no performance metrics were available for the facilities, so unfortunately, this led the question 6, effect to environment, pointless. In question 8, only a small amount of the information, the yearly freight traffic has been shared by the FVs administrations. Detailed comments of this question form can be found in Appendix D. Outcomes of site visits are given in the following sections.

4.1.1 Eskişehir-Hasanbey Freight Village

Eskişehir-Hasanbey FV is located near (9 km) the organized industrial site of the city. It was the first FV a field trip was realized. The FV was established in 2014 and owned by TCDD and is a junction point for the railroads. In this FV road/ rail transport mode is available. The FV occupies 540,000 m^2 of land. Although the FV employs 570 (365 white collar and 205 white collar personnel), only 34 (6%) of those are responsible for logistics activities; the remaining personnel is responsible for technical rail road operations. Out of these 34 individuals, the education level of 26 (76%) is primary school-high school and the remaining 8 (24%) are graduates. SAP[5] and in-house developed software of TCDD are used for enterprise resource management.

[5] SAP is a leading enterprise resource management software in the industry, SAP, https://www.sap.com/corporate/en.html, Accessed 01 December 2017

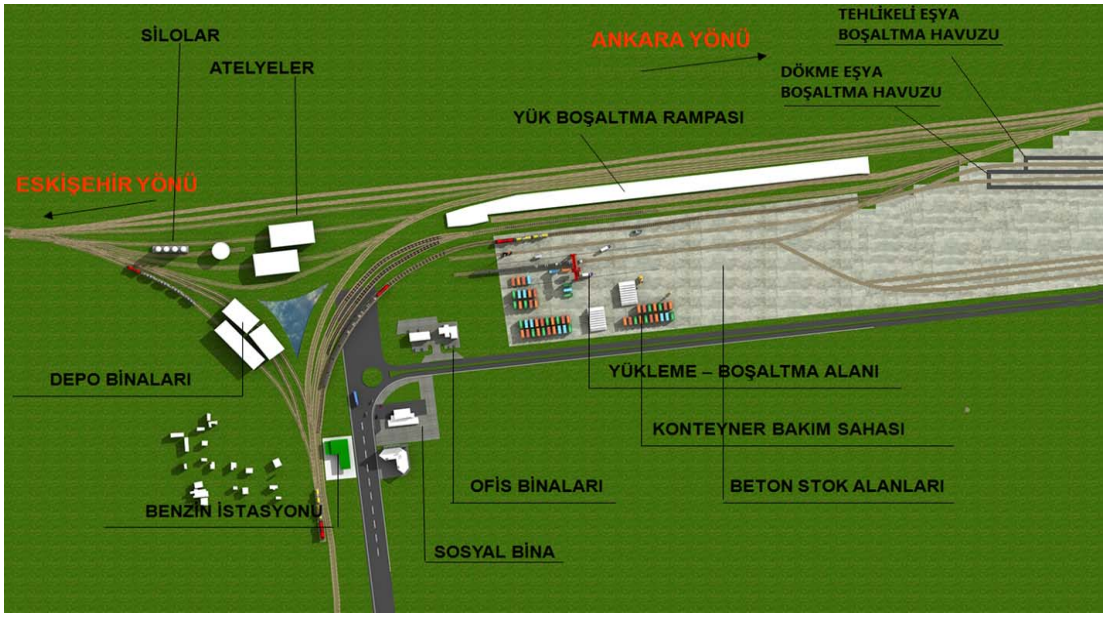

Figure 9 Layout of Eskişehir-Hasanbey FV, Source: Courtesy of TCDD

Above figure shows the layout of Eskişehir-Hasanbey FV and the layout includes a social building. However this structure is a mere building for the visiting firms to have refreshments and there are not social or technical services (hotels, healthcare, repair shops, etc.) for higher levels of freight traffic. In addition to those, no management certificates exist for the facility.

Figure 10 Overview of Eskişehir-Hasanbey FV, Source: Courtesy of TCDD

Unlike in the definition of a FV, no tenants are staying in the FV's perimeters. For using the intermodal transport, available train information is learned by the users via the call line or the internet and with the reservation system, the users are given a date

and hour for the load/ unload of their freight to/ from the train. The flow of operations can be seen in Figure 11.

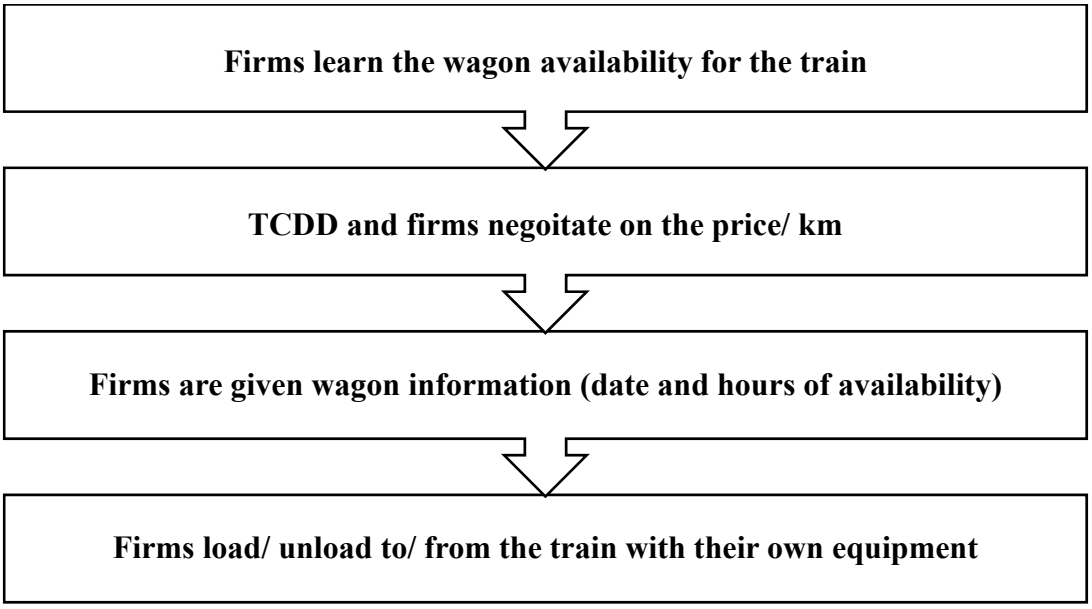

Figure 11 Flow of operations in Eskişehir-Hasanbey FV

The FV owns 2 forklifts for TCDD's operations. If, at any time, a firm comes to load/ unload, it must make arrangement for the related personnel and the equipment to be at the side. It is observed that in the vicinity of the FV, in Hasanbey, small firms that rent forklifts or material handlers on an hourly basis appeared, which can be seen as a positive impact of the FV to the employment. On a yearly basis 150,000-200,000 tons of material is handled and transported in the FV. On a monthly basis, on the average (2016), freight traffic of 580 wagons and 1,160 is observed to 30 cities in Turkey. Weekly freight transportation is around 3,500 tons.

For the FV administration, the increase in employment and saving consumables were the most important goals for the facility, followed by emissions, and saving electricity which are evaluated as important. Noise pollution was evaluated as semi-important.

4.1.2 Kocaeli-Köseköy Freight Village

Köseköy's activities date back to early 2000s when the TCDD established a warehouse near Kocaeli city center. The facility is able to run international freight distribution operations. Like Eskişehir-Hasanbey FV, only road/ rail transportation is available. By the facility administration, the lack of a connection to a port is seen as a major disadvantage for Köseköy's future. Since this missing connection would always limit the facility's activities to an extent.

Figure 12 Loading of a LPG tank in Kocaeli-Köseköy FV

With the increase in freight distribution in the region and with TCDD's project of forming FVs in Turkey, a stage enlargement plan has been designed for Köseköy. The first stage has been completed in year 2010 and 60,000m^2 of cementation has been made (10,000m^2 of this area is reserved for temporary cargo storage for customs' operations). In addition to this, 5 loading ramps have been constructed.

Especially with OMSAN[6]'s operations, there have been instances where more than a thousand train loads of goods have been sent to EU countries. Between years 2010 and 2016 a total of 2,500,000 tons of freight has been transported in the facility. Due to high speed train construction project in Turkey, freight transportation activities has stopped in year 2013 and restarted in year 2014. The facility has not been used in year 2013.

Figure 13 Loading area of Kocaeli-Köseköy FV

[6] OMSAN is a logistics company established in Turkey and conducts operations worldwide. The company offers integreated logistics solutions with all different kinds of transportation modes; rail, road, seaway and air. OMSAN's involvement includes the usage of TCDD's trains and facilities for storing goods, http://www.omsan.com/, Accessed 26 November 2017.

The second stage of the FV is still under construction. 2,000m^2 of this stage has been completed, giving Köseköy a total of 62,000m^2 of area for freight transportation. At the end of the second stage, FV's total area is expected to reach 346,000m^2, with a capacity of 1,500,000 tons/year. Current capacity is 600,000 tons/year and 1200 TEU (ton equivalent units) of cargo storage. Between years 2007 and 2016 an average of 482,000 tons/year is realized in the facility (80% of overall capacity). However, since the operations restarted in 2014, years 2014, 2015 and 2016 pulled down the average freight distribution numbers. Hence, this capacity usage should not be misinterpreted.

Figure 14 Management offices in Kocaeli-Köseköy FV

Right now, the facility has 9 white collar and 1 blue collar worker for its logistics operations. The flow of operations is same as in Eskişehir-Hasanbey FV which is given in Figure 11. However, Kocaeli-Köseköy FV hosts twenty logistics firms (which were not shared with the author due to commercial secrecy). Unfortunately,

like in Eskişehir-Hasanbey FV, no coordination and collaboration scheme is present between these firms and the FV. There are areas designated for the equipment storage or the paperwork activities of these firms which can be seen in Figure 15. The FV administration rented the parts of the facility which can be either used as a warehouse or an office for the tenant firms but the relationships ends with the rental contract. An amount of mandatory coordination is present between the tenants during loading/ unloading operations since the loading/ unloading operations is run under TCDD's supervision but apart from these activities, all other planning and storage activities are run separately.

Figure 15 Designated areas for tenants in Kocaeli-Köseköy FV

For these twenty logistics firms, 3 contractor firms which are established in the vicinity of the FV, in Köseköy, are supporting necessary equipment for handling

freight (loading/ unloading) operations. Like, Eskişehir-Hasanbey FV, these contractors increase the employment of the region. For the FV management, the increase in employment and saving consumables were the most important goals for the facility. Other areas; emissions, saving electricity and noise pollution were with low importance to the administration. Again, none of these goals were being tracked by metrics.

4.1.3 Denizli-Kaklık Freight Village

Denizli-Kaklık FV occupies a total of 120,000m^2 and is able to use 80,000m^2 (67%) of its perimeters for freight transportation. Currently only 2 people are working in the facility for logistics activities. The remaining of the facility hosts TCDD personnel who are responsible for the maintenance of the couches and locomotives. The flow of operations is the same with other TCDD FVs which is illustrated in Figure 11.

Figure 16 Administrative building and loading/ unloading area of Denizli-Kaklık FV

Denizli-Kaklık FV has a special certificate that distinguishes it from the other FVs. The facility is capable for dangerous goods transportation. By the FV administration,

this capability is seen as a significant merit for the city, since the dangerous goods transportation operations are taken out of city perimeters. However, currently, the facility only has a 39,000 ton/year of freight transportation level, with nearby end destinations such as Tekirdağ, Çorlu, Sarayköy (Denizli) and Kütahya. An average of 30 trucks are visiting the facility weekly.

Figure 17 Loading/ unloading area of Denizli-Kaklık FV

In the evaluation section of the questionnaire, all areas, increase in employment, decreasing exhaust emissions, savings in consumables, saving electricity and noise pollution have been marked as important by the FV administration.

4.1.4 Uşak Freight Village

Amongst the other FVs visited in Turkey, the FV Uşak is a very distinctive one in terms of its physical properties and location. For the current logistics activities, two loading ramps and related concreting have been made as an addition to the passenger

station of TCDD in Uşak. Although the TCDD claims this facility to be a FV[7], only 2,250m^2 (1.7%) FV project has 140,000m^2 of the total area is designated for freight distribution and very surprisingly for the author, the loading ramps and the area designated for freight distribution is located right next to the passenger station building which is located very close to the Uşak city center. Road/ rail transport are available in the facility. Figures 18, 19 and 20 clearly demonstrate the proximity of the passenger stations, the settlements and the loading ramps.

Figure 18 Uşak passenger station and warehouse

[7] TCDD, Available online: http://www.tcdd.gov.tr/Upload/Files/ContentFiles/2010/yurticibilgi/lojistikkoy.pdf (Accessed 26 November 2016).

It is clear that the facility in Uşak is by no means a FV with this structure. No social services are offered by the facility. Currently 5 white collar personnel are working in the facility, coordinating the loading/ unloading activities and the rental of the old warehouse building in facility premises. Between years 2012 and 2017 an average of 27,900 tons/year freight has been transported in the facility. As with Uşak's decreasing industrial output, the facility's freight transportation volume decreased from around 70,000 tons/year in 2012 to around 25,000 tons in 2017 (except December). A warehouse building, which is seen in Figure 21 next to the loaded wagons, is being rented to related customers and the flow of operations for freight transportation is the same in Eskişehir and Kocaeli FVs of TCDD. No equipment is owned by the facility. The firms have to arrange their own equipment for material handling.

Figure 19 An unloaded truck waiting next to the ramps in Uşak

During the interview with the FV manager, it is learnt that the municipality of Uşak wants the freight transportation operations in the station to be transported outside the city (which is exactly the starting point of establishment of FVs). Continuous effort

is spent by the governorate of Uşak and TCDD to find suitable land around Uşak for transporting the facility itself however until now these efforts are resultless.

Figure 20 End points for cargo trains and city traffic

Still, until 2019, which is the planned date for the high speed train to arrive outside of Uşak, the facility is likely to continue its activities inside the city. The goals section of the question form given in Table 10 was not applicable for Uşak since the application violated sustainability in terms of increasing the emissions, noise and vibration in the vicinity of the facility. Facility's operations continue to create congestion by increasing traffic level in the city center (the reason why the municipality wants the facility moved out of city perimeters) since the trucks must enter the city to reach the station for loading/ unloading.

Figure 21 Loading of wagons in Uşak

4.1.5 Balıkesir-Gökköy Freight Village

After eight years of efforts for establishment, Balıkesir-Gökköy FV is has started its activities in 2015. For Gökköy, TCDD states that the facility's aims include serving as a consolidation point for İzmir, Aliağa and Bandırma ports which are in Marmara and Aegean Hinterlands. Like the other FVs of TCDD, road/ rail transportation mode is present for Balıkesir-Gökköy too. The FV is located 20km away from Balıkesir city center, right next to the organized industrial site of Balıkesir. These facilities, Gökköy FV and the organized industrial site are separated by the Balıkesir-İzmir highway. Since there is a highway, there is not a rail connection.

Figure 22 Overview of Balıkesir-Gökköy FV, Source: Courtesy of TCDD

The 211,000m^2 of the FV's area hosts large number of (around 18,000) wagons mostly for repair and for loading/ unloading operations. Out of this 211,000m^2, 60,000m^2 (28%) is dedicated for freight operations. The remaining area is for locomotive and wagon repairs of TCDD. Out of 223, 7 white collar and 1 blue collar personnel are responsible for logistics operations. 5 of the logistics personnel have undergraduate degrees and 3 of them have high school education. All personnel are living in the same city, Balıkesir, where the FV is located. The entrances which are seen in the north and south in Figure 22 are used for entry and exit of trucks and the ramps shown in Figure 23 are used for loading and unloading of trucks.

Figure 23 Ramps used for loading/ unloading in Balıkesir-Gökköy FV

On the average, facility's operations add up to 427,000 tons/year but the total capacity is estimated as 1,000,000 tons/year by the TCDD. The flow of operations is the same with the one descripted in Figure 11. A total of 22 different domestic end locations are being served by the facility. The monthly vehicle traffic is around 546 trucks. There is a single logistics firm, Günaydın Group[8], which rents an open area, which can be seen in Figure 24 for storing containers. Günaydın Group realizes its freight operations as a 3rd party logistics firm. The facility does not possess any equipment or vehicles for freight transportation activities. Any firm who wants to use the facility must arrange its own equipment for its operations. A service that is offered is the weighbridge.

[8] Günaydın Group is a logistics company established in Turkey and conducts operations worldwide. The company offers integrated logistics solutions with different transportation modes; road, rail and seaway, http://www.gunaydingroup.com.tr/v3/, Accessed 16 December 2017.

Figure 24 Loading/ unloading area of Balıkesir-Gökköy FV

The increase in the employment was evaluated as semi important whereas decreasing exhaust emissions, savings in consumables, saving electricity and noise pollution have been marked as important by the FV administration.

4.1.6 İstanbul-Halkalı Freight Village

İstanbul Halkalı FV has been established in the European side of İstanbul back in 1971 and the additions to the physical infrastructure has been concluded in 1982. İstanbul-Halkalı covers a land of 220,000m^2 and road/ road and rail/ road transportation modes are available.

Until April 2016, there was a customs office inside the facility perimeters however, now the customs has been transferred to Çatalca in order to deal with the increased traffic level; which was mainly caused by the trucks using the facility. With the removal of customs from the facility, vehicle traffic to and from the facility decreased nearly by a half.

Figure 25 Administrative building of İstanbul-Halkalı FV

The flow inside the facility is the same as the other TCDD FVs, which is depicted in Figure 11. İstanbul-Halkalı holds a total of ten warehouses of which only two are operational nowadays; the total areas for these warehouses are 3,700 m^2. These active warehouses are rented to a private company, Barsan Lojistik with a build, operate and transfer model. FV's main earnings are the rents of the warehouses and the material handling equipment. For every container handled, a certain amount (€30 for full, €10 for empty containers) is paid to the FV. Currently, 6 cranes and 19 forklifts are available for use in the facility.

Like in other TCDD FVs, no performance metrics were present for the facility. In terms of certification, dangerous material transportation and handling certificate is owned by the FV. Although there does not exist performance metrics, the increase in employment and the decrease in exhaust emissions have been marked as very important by the FV. Consumables and electricity savings and the decrease in noise

pollution have been marked as important. It has been observed that there has indeed been an effort towards some of these areas, in terms of renewing the electricity infrastructure of the facility and changing the heating energy source to natural gas from fuel oil.

Like in Kocaeli-Köseköy FV, separate companies, Barsan Lojistik, Intersped, Türk Rail and Transhat[9] are operating tenants inside the facility. However, again, there is no means of coordination and/ or collaboration between them and the FV administration's relation with these tenants is limited with the rental of warehouses and the material handling equipment.

Although İstanbul-Halkalı owns the highest number of material handling vehicles among the other TCDD FVs, only 4 suitable personnel exist for using these vehicles. Since it is a government institution, FV administration is having a hard time in terms of hiring new personnel and this is seen as a major weakness; losing time because of bureaucracy. This loss of time is also seen as a low service standard by the FV administration. A total of 30 personnel are working in logistics activities (18 white collar and 12 blue collar).

[9] Third party logistics service providers established in Turkey.

Figure 26 Active warehouses in İstanbul-Halkalı FV

FV administration sees the completion of Marmaray Project and the third bridge for the city of İstanbul as opportunities for increasing the business volume of the facility since these projects are promising in terms of increasing the accessibility of the FV.

Figure 27 Loading/unloading area of İstanbul-Halkalı FV

Nevertheless, since the European side of İstanbul is expanding way to fast, the facility, which used to have its border with the city dump, is already surrounded by residential buildings as can be seen in Figure 27. The FV administration itself does not see the future of this location sustainable and supports the transfer of the FV out of the city.

4.1.7 Ankara Freight Village

The FV located in Kazan, Ankara has a private ownership. The facility is established by Ankara Lojistik Yatırımları ve Nakliyatları Ticaret A.Ş. and has been running its operations for domestic and international markets under different departments. Kazan was selected as a location due to its proximity to İstanbul-İzmit Hinterland and Ankara and the availability of land that is as large as the FV's need (700,000 m^2). The FV employs around 4000 individuals (blue and white collar) who are living in Ankara and Kazan. The educational statistics were not available for this FV. The FV resulted in an increase in employment in Kazan, though not sharing the exact

numbers, it was stated that the majority of the work force that is used in the offered services were from Kazan. The average number of (heavy) vehicles that are entering and exiting the FV in a month is 2000 where 90% are long trucks.

The construction of the domestic part of the FV, Ankara Yurtiçi Nakliye ve Lojistik Merkezi, started in 2011 and completed in 2016. For the domestic operations, any firm with a H1 certificate[10] can rent an office in the facility. Then, the firm enters the information of the freight to be transported in the facility's database. This information contains the destination, required vehicle type (if there is a requirement), tonnage and loading instructions.

Figure 28 Freight information screens for different regions of Turkey in Ankara FV

[10] The certificate that allows a firm to run domestic freight transportation operations in Turkey.

The information is continuously shown on screens inside the facility until an available (and willing) truck driver contacts the firm inside facility. Example screens for Mediterranean and Aegean Regions of Turkey can be seen in Figure 28. If, after the negotiations an agreement has been made then, the order is deleted from the screens and the truck driver picks the load. The operations are summarized in Figure 29.

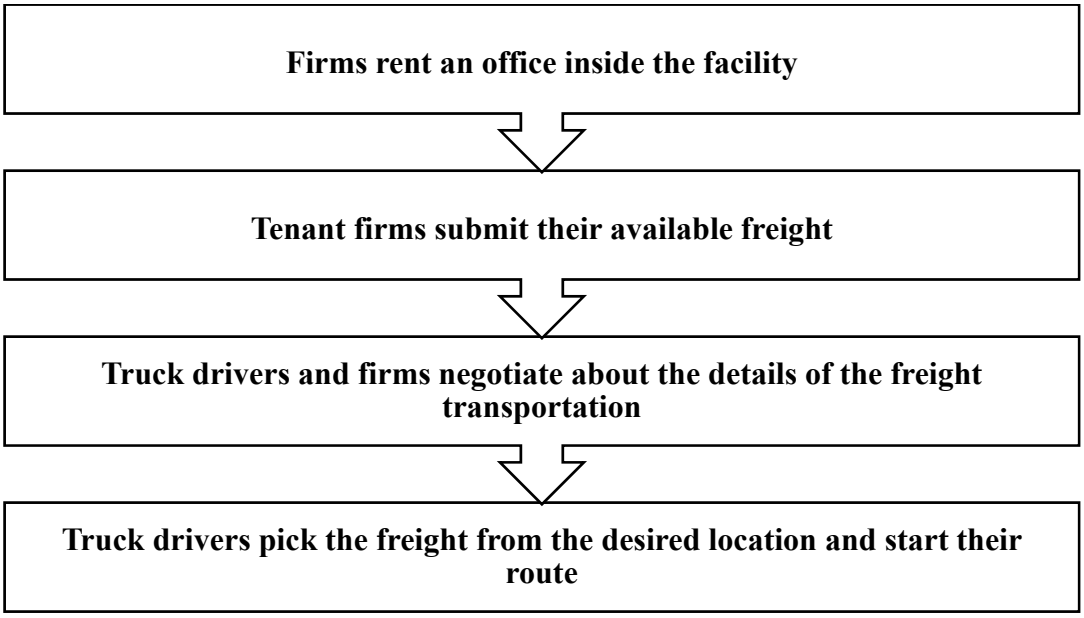

Figure 29 Flow of domestic operations in Ankara-Kazan FV

Here, the FV is used as a meeting point for the freight distribution agencies (the tenants) and the available truck drivers. The different agencies are offered offices in the FV; some of which can be seen in Figure 30.

Figure 30 Offices of agencies in Ankara FV

The domestic part of FV depends on the rents gathered from the user firms to run its operations and there is not another source of income. Currently the FV hosts 300 firms under its roof.

The following services are offered by the FV (both for domestic and international parts):

- Management offices
- Truck parks
- Restaurants and miscellaneous shops (barbershops, hardware shops, social facilities, healthcare units etc.)
- A hotel
- Gas stations
- Various repair shops (including tire companies)
- Weighbridges
- Authorities (TÜV Türk)

The FV holds ISO 9001 Quality Management Systems Certificate and an Occupational Health and Safety Certificate.

The international operations are run in a separate part of the FV. This part of the FV has been opened in late 2010 and in operation ever since. The main motivation behind the international part of the FV is to consolidate the bureaucratic operations necessary for international freight transportation in one place. In addition to the shared services which are common for the domestic and international parts of the FV, undersecretariat of customs also holds an office in the international part of the FV for completing formal paperwork necessary for international freight transportation. The operations of the international part of the FV are summarized in Figure 31.

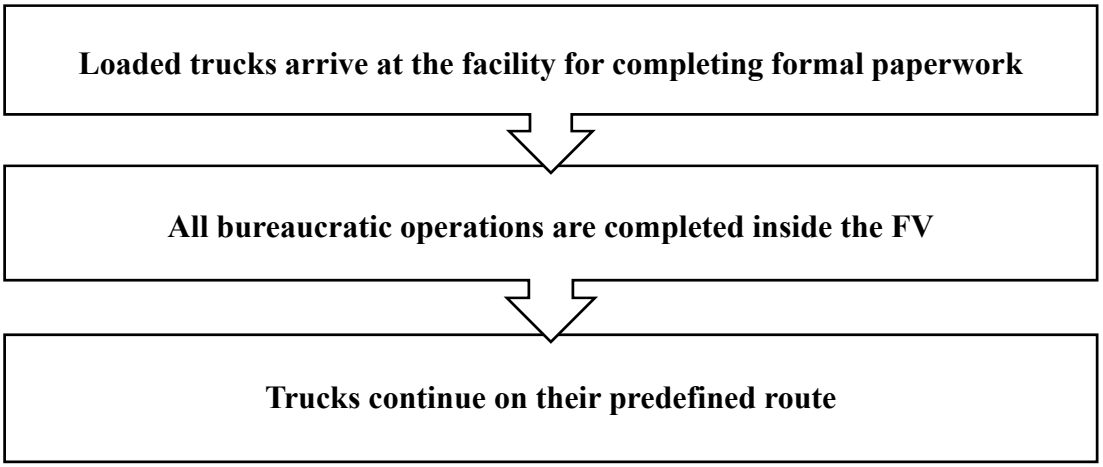

Figure 31 Flow of international operations in Ankara-Kazan FV

The international part of the FV also depends on the rents as an income source. In addition to management offices, warehouses and entrepos are also rent. Warehouses that are rent to ŞOK and CEVA, two tenant firms which are in retail and logistics sectors in Turkey can be seen in Figure 32.

Figure 32 Warehouses and loading/ unloading ramps in Ankara FV

However the FV administration does not hold any power in terms of creating coordination and collaboration between its tenants. The leases signed between the FV administration and the tenants do not include any term in the scope of coordination and collaboration. Hence, the FV administration only holds the power in terms of the usage of the warehouses. The customs services offered by the FV is seen as a value added operation for the overall supply chain in Turkey since compared to getting into intercity traffic for paperwork, this way the operations are time and money saving and more environmentally friendly since the truck traffic is taken out of the city at some extent. Some of the major tenants[11] of the international part of the FV are as follows:

[11] The banks depicted here uses the facilityfor storing eqiupment and hardware related with their operations.

- CEVA
- OMSAN
- EKOL
- Yurtiçi Nakliyat
- ŞOK
- Service Express
- McDonald's
- Merkez Bankası
- Ziraat Bankası
- G2M

For the FV administration, the increase in employment was the most important goal for the facility, followed by emissions, saving consumables and noise pollution which are evaluated as important. Saving electricity was evaluated as semi-important.

4.2 Projection of the Effects of Freight Villages in Turkey

The projection of the effects of FVs located in Turkey to sustainability and social will be given in this section. Firstly, the data from the site visits to TCDD's visited active facilities and the private facility in Ankara will be analyzed then the effects on different dimensions on sustainability will be discussed.

Using the answers from the answers to the question form used in the site visits, Table 11 is constructed. The difference between the question form and Table 11 is due two reasons. Firstly, certain questions given in Table 10 contained some parts which did not have available answers. Secondly, Table 11 is constructed in order to project the effects of FVs on sustainability more easily. Since some TCDD FVs did not host any tenants, the cells corresponding to that sections are not applicable to them (N/A). Likewise, Ankara FV refused to share yearly realized traffic numbers, which is the reason the corresponding cell is N/A.

Table 11 Overview of FV applications in Turkey

	Ankara	Balıkesir-Gökköy	Denizli-Kaklık	Eskişehir-Hasanbey	İstanbul-Halkalı	Kocaeli-Köseköy	Uşak
Size (in m²)	700,000	211,000	120,000	540,000	220,000	346000 (including the second stage)	140,000
Average Vehicle Traffic (trucks/year)	730,000	3,900	19,240	13,920	18,250	32,600	8,500
Freight Traffic Capacity (in tons/year)	7,738,000	500,000	1,000,000	1,000,000	3,650,000	1,500,000	240,00
Realized Freight Traffic (2016) (in tons/year)	N/A	41,840	204,031	176,052	354,509	346,048	90,289
Mode	Road	Rail, Road	Rail, Road	Rail, Road	Rail, Road	Rail, Road	Rail, Road
Number of Tenants	300	N/A	N/A	N/A	4	20	N/A
Number of Employees	4000	7	2	34	30	10	5
Typical Freight	Consumer Products, Construction Material, Fuel, Iron and Steel Products, Gypsum, Chemical Products, Agricultural Vehicles, Ceramic and Sanitaryware Products, Pipes, Clinker, Animal and Herbal Products, Food Products, Military Cargo, Various Minerals, Flammable and Explosive Material, Cement	Coal, Construction Material, Fuel, Iron and Steel Products, Lumber, Agricultural Machinery, Pipes, Marble, Animal and Herbal Products, Food Products, Military Cargo, Flammable and Explosive Material, Sandstone	Coal, Lumber, Sandstone, Cement and Marble, Flammable and Explosive Material,	Construction Material, Fuel, Lumber, Chemical Products, Ceramic and Sanitaryware Products, Pipes, Animal and Herbal Products, Food Products, Flammable and Explosive Material, Sandstone	Construction Material, Fuel, Iron and Steel Products, Gypsum, Chemical Products, Agricultural Vehicles, Ceramic and Sanitaryware Products, Pipes, Clinker, Animal and Herbal Products, Food Products, Military Cargo, Various Minerals, Flammable and Explosive	Construction Material, Fuel, Iron and Steel Products, Gypsum, Chemical Products, Agricultural Vehicles, Ceramic and Sanitaryware Products, Pipes, Clinker, Animal and Herbal Products, Food Products, Military Cargo, Various Minerals, Flammable and Explosive Material, Cement	Coal, Iron and Steel Products, Lumber, Agricultural Machinery, Various Minerals, Sandstone

When the FV examples given in Table 1 and Table 3 are compared with the Turkish FVs, there is a major difference in terms of size. Along with the operational, planned and under construction FVs (including the FV in Ankara), the average size for Turkish FVs are only around 540, 000m^2 where as in both the European and the US FVs, the smallest FV is Roissy-SOGARIS located in France with 538,000m^2.

In terms of sustainability and social equity, current applications in Turkey seem to have tacit assumptions in which the authorities believe the scale economy created by the FV would, somehow, lead to economic and environmental sustainability and social equity. This situation is due to absence of performance metrics and certification related with the effects to environment. Unfortunately, lack of performance metrics for different dimensions of sustainability does not let the assumptions of the authorities become more than wishful thinking. Nevertheless, in the following subsections, focus will be on the potential of the FV applications in Turkey and their possible effects on different dimensions of sustainability will be analyzed, by making estimations using the data from the site surveys. The increase in intermodality in Turkey and the capacity utilization of FVs will be the base of assumptions on possible effects of FVs. The assumptions on the possible effects of FVs will consider the cases in which the FV organizations are properly established; the base for coordination and collaboration, necessary regulations and bylaws are set and the producers and logistics service providers have access to FVs and they use these facilities.

4.2.1 Possible Effects on Environmental Sustainability

The main negative effect that can be significantly overcome by FVs is the decrease in emissions, resulting from decreased number of hauls by truck. The collaboration activities in a FV would lead to the shared use of resources and this would avoid LTL (less than truckload) trips for any company. According to the data from the responsible body on highways in Turkey; General Directorate of Highways, the total freight transported in Turkey in ton-km is 253,139,000,000 ton-km. The total vehicle-km value for the heavy and light duty vehicles; including all kinds of trucks used for freight transportation, the value is 28,266,000,000 vehicle-km (General

Directorate of Highways, 2017). When these data are compared with each other, the result is, on the average, 8.95 tons/truck is realized in freight transportation in Turkey.

In spite of this, a comprehensive study on the freight transportation activities on Turkish Highways that included technicians, mathematicians, statisticians and administrative personnel (General Directorate of Highways 2015), from a fairly large sample of heavy duty vehicles (67,205) which travelled in separate regions of Turkey for freight transportation, the average freight for a truck has been calculated as 10.6 tons/truck.

Keeping all those in mind, there is a minimum gap of 15.5% between a FTL (full truckload) and the average truck used for freight transportation in Turkey. This 15.5% should be considered as a minimum gap since some of the trucks taken in the sample of the study were also empty, which means, if they had been fully utilized, there would be a much bigger gap. Because, if those truck had also been fully utilized, they would have increased the average load calculated in the study.

As mentioned before, goods transport by road has an important negative impact to the environment in terms of emissions. The main emissions from a diesel engine are carbon monoxide, hydrocarbons, nitrogen oxides and particulate matter. The average emissions of these matters can be seen in Table 12.

Table 12 EU Emission Standards, Source: http://www.transportpolicy.net/standard/eu-heavy-duty-emissions, Accessed 1 November 2017

Tier	Date	CO	HC	NO_x	PM
Euro I	1992, <85 kW	4.5	1.1	8.0	0.612
	1992, >85 kW	4.5	0.25	8.0	0.36
Euro II	Oct 1996	4.0	1.1	7.0	0.25
	Oct 1998	4.0	1.1	7.0	0.15
Euro III	Oct 1999	1.0	0.25	2.0	0.02
	Oct 2000	2.1	0.66	5.0	0.10
Euro IV	Oct 2005	1.5	0.46	3.5	0.02
Euro V	Oct 2008	1.5	0.46	2.0	0.02
Euro VI	31 Dec 2013	1.5	0.13	0.4	0.01

When the average ages of the trucks operating in Turkey for freight transportation is analyzed, it is observed that 75% of all heavy vehicles with TR license plates and 95% of all heavy vehicles with non TR license plates are manufactured after year 2000. Even though there is a decrease in all emission types between years 1992-2000 (53% in CO, 40% in HC, 38% in NOx and 84% in PM), still there is a significant number of trucks (25% of all heavy vehicles) with high emissions.

The LTL deliveries can be decreased by a shared planning of trucks to the same end destination in case there is not a special requirement for that delivery such as cooling, safety, hazardous material, etc. At the same time, shared usage of the same train could be possible if separate firms plan together and make their corresponding train and wagon arrangements accordingly. This shared planning would be possible if and only if the coordination and collaboration is maintained between the tenants using the same FV. As depicted in the beginning of this section, current situation in the Turkish Supply Chain results is sending air at least in the 15% of the overall deliveries and these deliveries are conducted by heavy duty vehicles that of 25% are still possessing high emission values.

Last but not least, TCDD has efforts on converting the current locomotives to electrical ones, which means an increase of around %70 in horsepower which would directly affect the amount of freight that can be transported on a train. In addition, electrification of the locomotives would mean a centralized energy source for the freight transportation activities, which is the more sustainable option compared to the decentralized energy usage options (Chiara et al., 2014).

4.2.2 Possible Effects on Economical Sustainability

The major possible effect of FVs to economical sustainability lies underneath the economies of scale offered by the FVs and the capabilities of the FVs in terms of increasing intermodality. Whilst the stakeholders of the supply chain could benefit from this scale economy, there is a chance for the Turkish economy as a whole since the energy usage habits could change too.

When the cost figures for logistics activities in Turkey are analyzed, they can be grouped under five general categories as:

- Administrative Costs
- Customer Support and Order Management Costs
- Stock Keeping Costs
- Storage Costs
- Transportation Costs.

When the distribution of the costs for freight transportation in Turkey are analyzed, as can be seen in Figure 33, the majority of the costs (>80%) are due to storage, transportation and stock keeping activities.

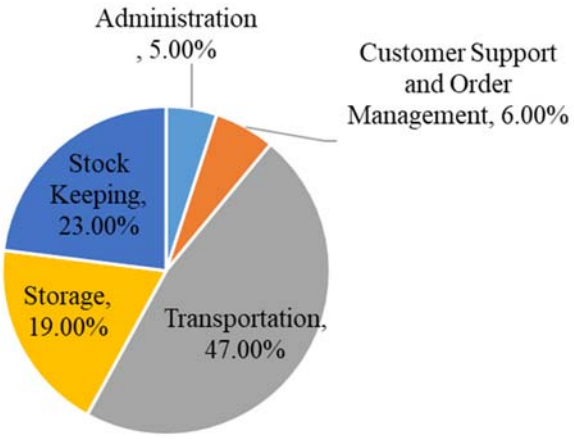

Figure 33 Distribution of costs for logistics operations in Turkey, Source: Tanyaş 2013.

For European Union countries (EU-28) and US, the distribution differs as seen in Figure 34 and Figure 35. EU-28 countries show a very similar distribution in logistics costs; again the majority (>80%) of the costs are due to storage, transportation and stock keeping activities. For US, transportation costs are much higher compared to Turkey and EU-28 and they account for 63% of the overall logistics costs. The next highest cost figure is stock keeping costs.

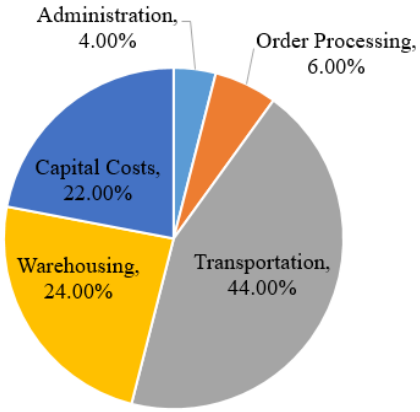

Figure 34 Distribution of costs for logistics operations in EU-28, Source: EU Commission 2015

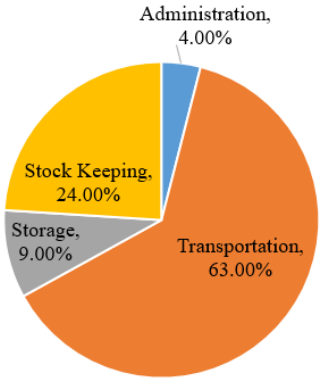

Figure 35 Distribution of costs for logistics operations in US, Source: U.S Department of Transportation 2002

In Turkey, transportation and storage costs, which, on the average, account for 66% of the overall logistics costs are the areas where the FVs' broad functions, contemporary and value-added logistics services could be of great use. For an individual firm, the current conventional freight transportation scheme that requires multiple layers of transportation brings the requirement of different infrastructure investments and the regulations to run that operation in the designated area. FVs warehousing and cargo divisioning, barcoding, palletizing, packaging/ repackaging and labelling abilities and free trade zone opportunities offered to their tenants would have significant effects in terms of money and time by decreasing the resources (time and funds) spent on storage and transportation activities. Because the usage of a FV would cut the burden of a firm of making a warehouse investment in a strategic location or being have to make partial deliveries (and thus paying the fixed cost of freight transportation in each delivery). The coordination and collaboration inside a FV would get together multiple firms that have a delivery to the same end destination together. Along with that, the shared warehouse usage both means decreased storage costs for the firms and higher utilization for the FV. Again, the estimation for LTL freight transportation is valid for the economical sustainability; as in the case of environmental sustainability, the average low utilization of 15% in truck deliveries

can be decreased by full train deliveries and/ or combined and turned into FTL deliveries.

Amongst these cost figures, administrative, customer support and order management and stock keeping costs are currently beyond the reach of sphere of influence of FVs since the current structure of FVs fails to aid companies in terms of these cost figures. The amount of kept stock is an outcome of firms' planning efforts in which the usage of a FV is only a parameter in terms of capacity. The total capital bound to the kept stock would be the same in any case. Administrative and customer support costs are not the figures where a significant decrease would be expected even if the current structure of the FVs in Turkey is to change since the amount of effort spent on these areas are related with organizational schemes and marketing strategies of the firms.

Subsequently, intermodality capability of the FVs would have potential effects on the addiction to energy. Graphed in Figure 36, Turkey has been dependent on imported energy for the past decades. The energy production has increased by 38% from 1990 to 2016 whereas energy consumption has increased by 157%. Much of this increase is also related with the increase in the industrialization and the sectoral shift in Turkey. By the end of 2016, energy consumption is nearly four times of energy production with 136,229 Thousand Ton Petroleum Equivalent Units (TTPEU). Around 20% of this energy consumption in Turkey (26,755 TTPEU) is related with the energy spent in transportation (freight and people combined).

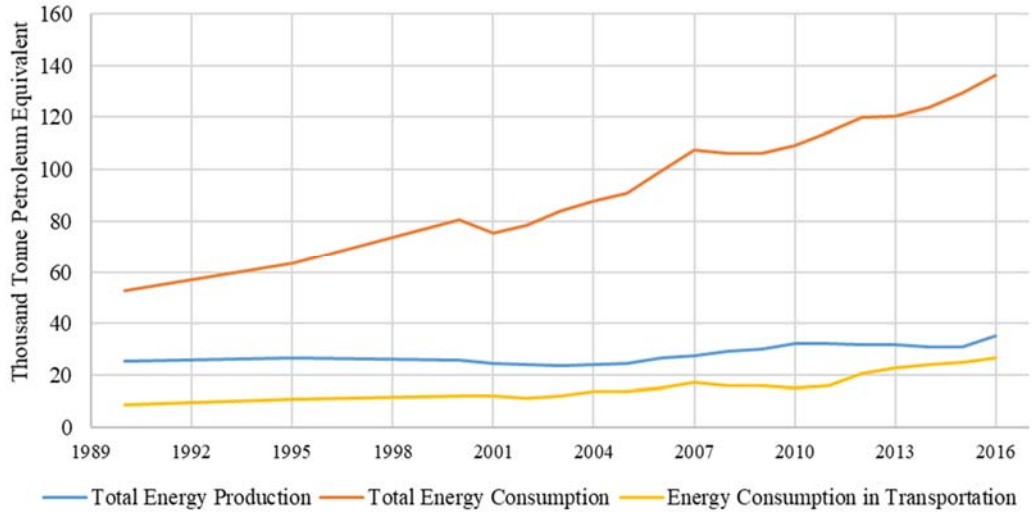

Figure 36 Total Energy Production, Consumption and Energy Consumption in Transportation in Turkey, Source: Republic of Turkey Ministry of Energy and Natural Resources 2016

To extract the possible effect of freight transportation on this production numbers, it is necessary to keep in mind the following information. Firstly, when the effect of freight transportation in this energy production is considered, currently, the majority of the freight transportation is dependent on imported diesel fuel. Secondly as given in Figure 7, around 90% of the freight is transported on highways by trucks (including light duty vehicles such as pickup trucks and heavy duty vehicles) which are run by diesel fuel. Lastly, when the vehicle-km numbers for Turkey are considered, around 24% of the overall vehicle-km are a result of truck movements. Hence, keeping all this on mind, the usage of FVs to have a more efficient energy consumption by preparing block trains and/ or more FTL deliveries, a significant decrease in energy consumption in Turkey could be realized which would eventually result in a decreased dependency in energy imports.

4.2.3 Possible Effects on Social Equity

FVs possible effects on social equity are by far the hardest and most controversial amongst the other dimensions of sustainability. This is due to the fact that the social equity concept itself is open to deep discussion and different approaches to this

concept have been developed as it was stated in Chapter 1. The main focus will be on the job creation abilities of FVs. Even in Turkey where proper grounds for coordination and collaboration is still missing and the FV utilizations are lower than capacity as shown in Table 11, the existence of FVs resulted in new job opportunities.

Table 13 FV administrations' answers for the employment question

FV	Importance of increase in employment
Ankara	Very important
Balıkesir-Gökköy	Semi important
Denizli-Kaklık	Important
Eskişehir-Hasanbey	Very Important
İstanbul-Halkalı	Very Important
Kocaeli-Köseköy	Very important
Uşak	N/A

It is important to point out that neither TCDD FVs nor the Ankara FV which is a private FV measures a metric for jobs created. However, as can be seen in Table 13, the FV administrations' answers about the question related with increase in employment in Table 10 showed how much they care about this issue. Only for Uşak, due to the structure of that particular FV, this question was not applicable. Unfortunately, for the TCDD FVs, it had been learned that there had not been a planning for the jobs created in the vicinity of the facilities. Rather, the new jobs appeared after the establishment of these facilities was an outcome. On the other hand for Ankara FV, the FV administration had a certain number of jobs in mind since the number of offered services inside the FV and the personnel required were defined prior to establishment.

If logistics activities are realized in the FV, an increase in the employment in the settlements of any size (cities, villages or towns) is inevitable since the firms need to conduct material handling activities by their own means which creates a demand for available work force. Currently, the new jobs appeared after FV establishment can be

grouped into two as the ones that are directly created inside facility by the FV governance (be that TCDD or the private sector in Ankara FV case); to accommodate with the increased business volume, and the indirect ones which have appeared to support the users of the FV with material handling activities. Overall the possible new jobs can be summarized as;

Jobs created inside the FV:

1- Administrative positions
2- Services such as; restaurants, repair shops, facilities for accommodation and healthcare offered to users of the FV.

Jobs created outside (in the vicinity) of the FV:

1- Rental of material handling vehicles (forklifts, cranes, etc.)
2- Blue collar workers for loading/ unloading operations
3- Services (if not applicable inside the FV) such as; restaurants, repair shops, facilities for accommodation offered to users of the FV.

When the different regions of Turkey are considered, the inequality is apparent. Table 14 shows the gap; as the richest region having a GDP per capita more than 3 times of the poorest region (EUROSTAT, 2017) (the regions used in this graph are NUTS (Nomenclature of Units for Territorial Statistics) regions that are used by EUROSTAT; the responsible body for statistic for EU and candidate countries).

Table 14 GDP per capita for different regions in Turkey, Source: EUROSTAT, 2017

Region	**GDP per capita 2017 (in €)**	**% with respect to EU-28 average**
İstanbul Region	25,500	82.5%
East Marmara Region	23,300	77%
West Anatolia Region	20,300	67%
West Marmara Region	19,600	65%
Aegean Region	18,300	60%
Mediterranean Region	14,850	49%
West Black Sea Region	13,000	43%
Central Anatolia Region	12,400	40%
East Black Sea Region	11,700	39%
Northeast Anatolia Region	9,100	31%
Southeast Anatolia Region	8,500	28%
Central East Anatolia Region	8,050	26.5%

When the FV applications in these regions with the GDP per capita in decreasing order are analyzed, the situation is as shown in Table 15.

Table 15 FV Applications in different regions of Turkey

Region (NUTS level-1)	**Region (NUTS level-2)**	**Region (NUTS level-3)**	**Number of FVs**
İstanbul Region	İstanbul Subregion	İstanbul Province	2 (1 operational, 1 planned)
East Marmara Region	Bursa Subregion	Eskişehir Province	1 (operational)
		Bilecik Province	1 (under construction)
	Kocaeli Subregion	Kocaeli Province	1 (operational)
West Anatolia Region	Ankara Subregion	Ankara Province	1 (operational)
	Konya Subregion	Konya Province	1 (planned)
West Marmara Region	Balıkesir Subregion	Balıkesir Province	1 (operational)
Aegean Region	İzmir Subregion	İzmir Province	1 (planned)
	Aydın Subregion	Denizli Province	1 (operational)
	Manisa Subregion	Uşak Province	1 (operational)
Mediterranean Region	Adana Subregion	Mersin Province	1 (under construction)
	Hatay Subregion	Kahramanmaraş Province	1 (planned)
West Black Sea Region	Samsun Subregion	Samsun Province	1 (operational)
Central Anatolia Region	Kayseri Subregion	Sivas Province	1 (planned)
		Kayseri Province	1 (planned)
East Black Sea Region	-	-	-
Northeast Anatolia Region	Erzurum Subregion	Erzurum Province	1 (under construction)
	Ağrı Subregion	Kars Province	1 (planned)
Southeast Anatolia Region	Mardin Subregion	Mardin Province	1 (under construction)
Central East Anatolia Region	Van Subregion	Bitlis Province	1 (planned)
		Hakkâri Province	1 (planned)

Currently out of 8 operational FVs, 7 of them are placed in the top 5 regions in terms of GDP per capita and the establishment of such facilities to the regions with higher GDP figures may be seen as a source of inequality itself however it is due to the

reason that the current facilities are placed in regions with higher industrial output and/ or locations with better coverage.

Turkey is a country where the freight transportation activities, employment and the GDP are positively correlated. As can be seen in Figure 37, between years 2000 and 2014 freight transportation numbers (in ton-km), GDP and employment numbers showed similar trends.

Figure 37 Relationship of freight, GDP and Employment in Turkey, Source: General Directorate of Highways, 2016.

Even though all three trends were subjected to the similar phenomena like financial crisis (such as 2008 and 2011), national disasters and social disruption, it is important to point out that in Turkey, the increase in freight transportation is an important indicator for the increase in employment which had been seen as a source of achieving social equity in a region with low GPD and employment numbers. Hence, FVs are prominent in terms of increasing the freight transportation volume in the regions they are to be established.

With the current modal split of Turkey, around 89% of the overall freight transportation is realized on highways, as a candidate country for EU where water

transportation is similar but the railway usage is around four times of that in Turkey (Figure 7), the employment numbers are far from close to the examples in EU as can be seen in different FV examples given in Table 1 and Table 11. Looking at the European FVs, even a small change in the percentage of the modal split with the usage of FVs can result in significant increases in employment numbers.

The planned FVs and FVs under construction are being spread along the entire country by TCDD; covering all different regions except East Black Sea Region and this new approach of TCDD is likely to increase the employment levels at least with the formation of little establishments to support the FVs with the services needed in terms of social services and the material handling activities.

4.3 Evaluation of Coordination and Collaboration in Freight Village Applications in Turkey

The analysis given in CHhapter 4 on the FV applications in Turkey points out that both TCDD's project of establishing FVs and the private investment in Ankara miss out the essential property of a FV. This essential property is the establishment of coordination and collaboration between the stakeholders of a FV. As stated in Chapter 2, establishment of these two concepts separates a FV from an ordinary logistics center and/ or a hub. In addition to that, in order to increase the utilization of FVs, a basis for coordination and collaboration should be constructed.

This lack of coordination and collaboration is also reflected in the freight transportation volumes for the Turkish FVs. Amongst the FV applications with available data in the literature, three can be selected for comparison of the freight volumes.

Table 16 Selected FVs and respective freight volumes, Source: Higgins et al. 2011

Country	FV	Size (in m2)	Realized Freight Transportation (in tons)	Available Transportation Modes
Italy	Interporto Bologna	4,269,433	4,027,000	• Road • Rail
France	Roissy-SOGARIS	538,231	2,500,000	• Road • Rail • Water in the vicinity
Spain	Centro de Transportes de Irun	400,639	2,800,000	• Road • Rail in the vicinity • Water in the vicinity

When the examples in Table 16 are considered, even for a relatively small FV, Centro de Transportes de Irun, there is massive amount of freight transportation compared to the Turkish FV applications. If the ton of freight transported/m^2 is compared with the Turkish FVs, these three FVs have a number of 1.79ton/m^2 as opposed to 0.63ton/m^2 of Turkish FVs (except Ankara, which has no available data). Highest performance was for Denizli-Kaklık FV which has typical freight consisting of coal, lumber, sandstone, cement, marble and flammable and explosive material.

Although, Roissy-SOGARIS and Centro de Transportes de Irun have access to water transport; which can be thought as a reason for high tonnage, Interporto Bologna does not have such access. In addition to that, the products that are being transported ranges from consumer electronics to raw materials; unlike the typical freight of Turkish FVs which are mainly bulk material.

The main reason behind the high freight transportation volumes is the coordination and collaboration activities are being realized in these FVs (Higgins et al., 2011). Tenants, the users of the FV who are amongst the stakeholders of the supply chain have a predefined legal basis for their interaction with the other tenants and the FV administration. Thus, the FV administration is acting as a coordinator amongst its

users. This legal basis lets users conduct shared planning and shared usage of the FVs' infrastructure in harmony and get into collaborative action.

For the case of TCDD FVs, which have freight traffic lower than their estimated capacity, as given in Table 11, the current policy of the organization, TCDD, is to persuade the users to create "block train" orders, in which a single user should at least supply 200 tons of freight. Below this amount, certain amount of penalties and increased price/ km is applied. The rationale behind this policy is to cut the amount of material handling activities for trains and decrease the possible stops for a train in order not to have many maneuvers. This, clearly, does not lead the goods transported by the railways in Turkey to be diversified as in the FVs abroad. The reason why is, the stakeholders of the Turkish Supply Chain are forced to use railway transport only if there is bulk cargo to be transported.

The lack of coordination and collaboration also takes out any chance of multiple users of a facility to come together and prepare a shared delivery. It is important to emphasize that the average freight volume for a truck in Turkey is around 10tons and it requires nearly 20 trucks of freight, at minimum, to be able to use TCDD's trains and facilities. Accumulating this much of freight is not realistic for a logistics service provider or a producer that deals with a time frame and service standards.

Even if such collaboration is realized, again because of the lack of a well-defined, systematic governance, the shared planning, storage and the terms between the users are left out of the control of the FV; the only legal connection between the FVs which host tenants under their roof and their tenants are the rental contracts for the usage of the facilities.

The users of the FVs must be subject to certain performance criteria which should be monitored by the FV administration and corrective action must be taken in case a certain performance metric cannot be satisfied. These corrective actions should include penalties in terms of monetary terms in order to create awareness for the firms. Government subsidies in terms of taxes for firms with high scores should also be considered. The weights of these metrics, along with the metrics themselves, are subject to change since FVs are purposeful systems and they should answer different problems in different regions of Turkey. Table 17 proposes such metrics for Turkish

FVs which are not limited to those given in this study. The proposed performance metrics are classified in relation with the different dimensions of sustainability and the way they should be evaluated.

Table 17 Proposed performance metrics for Turkish FVs

#	Target Evaluation	Period	Economic Sustainability	#	Target Evaluation	Period	Environmental Sustainability	#	Target Evaluation	Period	Social Equity
1	Higher the better	Monthly and Yearly	Amount of freight transported	5	Lower the better	Monthly and Yearly	Amount of consumables used	9	Higher the better	Monthly and Yearly	Number of employees
2	Higher the better	Monthly and Yearly	Amount of freight transported in shared deliveries	6	Lower the better	Monthly and Yearly	Energy usage (water and electricity)	10	Lower the better	Monthly and Yearly	Turnover ratio
3	Higher the better	Monthly and Yearly	Percentage of modal split	7	Lower the better	Monthly and Yearly	Average age of truck fleet	11	Minimum 50% or favoring women	At all times	The ratio of different genders amongst employees
4	Higher the better	Monthly and Yearly	Freight transported per m^2	8	Lower the better	Monthly and Yearly	Truck-km	12	Higher the better	Yearly	Amount of infrastructure investment in the region

4.4 Freight Villages' Future and Physical Internet

In this section, a prominent approach to logistics activities, Physical Internet and its relation with FVs will be discussed. Physical Internet (PI) started as an initiative by Benoit Montreuil in the late 2010s. Although PI is in its early days, the author believes that the PI concept should be of very high concern to any researcher since it bears some similar ideas with the FV and the future of these two applications hold a high probability of converging.

The urge for starting the PI initiative is actually parallel to that of establishing FVs; the way we handle physical objects is no longer efficient or sustainable economically, environmentally or socially (Montreuil, 2009-2012). It is believed by the author that the PI has the potential to play a crucial role in the future of FV applications by enabling the interaction between the stakeholders in a supply chain more than ever before by its innovative approach. The basic idea behind the initiative is to have a similar topology in material handling activities as in the internet's virtual world. Namely, PI has inspired from the *interconnectivity* and *encapsulation* properties of the transportation of data in the virtual internet's world.

An example here is the transfer of an e-mail from a computer to another. Interconnectivity can be summarized as these two computers which can be located even in different continents having the same protocols (IP, FTP, etc.) for file transfer. The delivery and/ or the acceptance criteria for the mail is the same. Because of this, no bureaucracy is faced and nearly no time is spent for the process of these two computers to learn their standards and/ or regulations. The reason why is that they are interconnected in a universal way. This interconnectivity also ensures any user who wants to send an email that her email will be sent and delivered to any other computer(s) that is online. In addition to interconnectivity, the encapsulation of the email, i.e. the packaging and transfer of mail, is also standard universally. The protocols related with transferring the mail does not deal with the content of the mail; rather they only deal with the size, delivery address and look for any specific attachments. When the sent button on the interface is hit, the data is segmented to the transport layer, network layer, data link layer and physical layer in an order. The physical layer is the layer where the data is sent in terms of 1s and 0s. The receiver's

physical layer receives those 1s and 0s and then transfers them to the network layer an upwards where the process this time ends with the interface of the receiver; the mail is in the receiver's inbox. In this process of encapsulation and decapsulation, any data segments or frames can be merged together and separated later on while being transported. So this results in a very efficient way of transportation where the infrastructure is fully utilized.

Current logistics activities host numerous standards, such as pallet sizes conveyors, railroad width (still wider in some old Iron Curtain countries) and bureaucratic differences especially in customs applications. Some regions of the world, for example, North America and EU, has an amount of standardization in terms of the above mentioned areas. However between these regions there are clear differences which lead to extra material handling operations in each delivery. Pallet size, which differs in U.S.A, EU and Asian Countries is an example. The EU countries would generally not accept any other pallet other than the one called EUR Pallet (120cm x 80cm). In addition to those varieties, apart from the ports where the freight transportation is made with containers, there is not a standard for packaging and the nodes on the supply chain deal with numerous kinds of boxes for freight transportation. The current encapsulation is given in Figure 38:

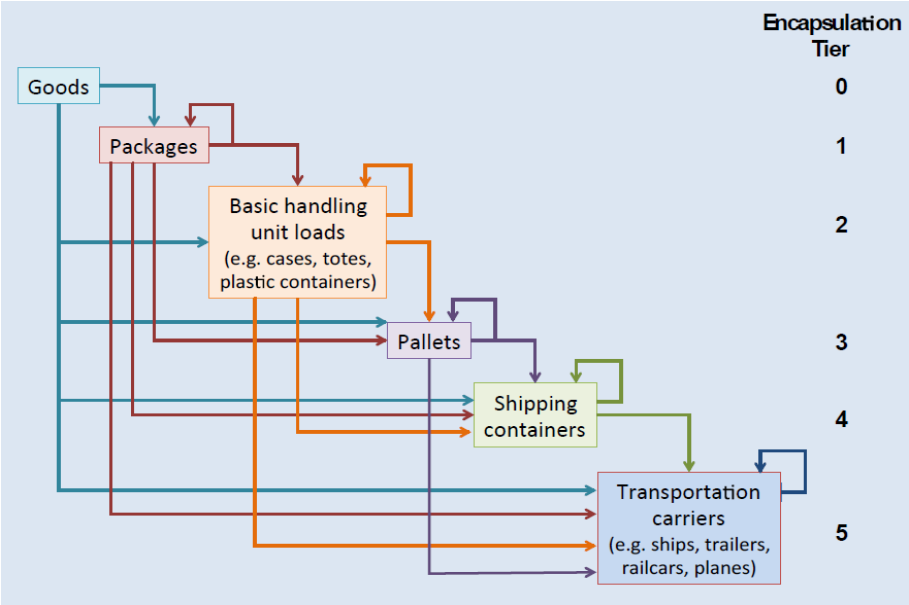

Figure 38 Current encapsulation of freight (Montreuil et al. 2015)

PI applications aim to eradicate the current applications and propose a packaging as given in Figure 39 where there will be a limited number of modular containers, which would fit in each other perfectly that results in fully utilized containers.

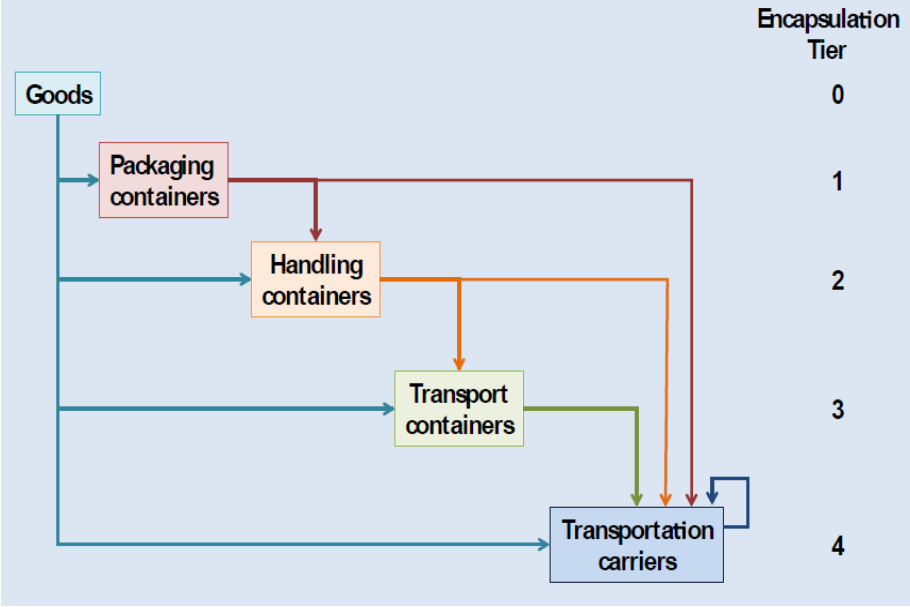

Figure 39 Freight encapsulation proposed by PI (Montreuil et al. 2015)

These *π containers* will also store precise information about themselves which will be acknowledged universally, anyone with this information will able to reach everything that is to be known about that container.

This containerization will be followed by advances in material handling applications in which the effort for transporting these containers will be minimized (wheeled containers moving over magnetic surfaces, using conveyors for transporting containers). Also when to storage of these modular containers is considered, instead of racks, containers can be stored as in the ports which would ease the handling and decrease the need for complex storage systems. In addition to that, since the containers are unimodular, the facilities which were dedicated to a single user, no longer need to be so and can serve as a hub in the supply chain. Lastly, there will be

no need for the freight to be stuck at a single position since there will surely be a transportation option for it on its direction. Since unimodular containers will be able to fit any such option, freight will always be moving towards its final destination.

This innovation is surely dependent on advanced infrastructure and information sharing between the stakeholders of the supply chains. Like the internet, the information sharing system should be open and connected as opposed to today's closed systems. When the coordination and collaboration capabilities of the FVs are considered, these concepts can surely be enhanced by the unimodular π containers and open information sharing of PI applications because the PI applications let the stakeholders in a supply chain use standard measures, procedures and infrastructure while conducting their operations. PI applications also consider different dimensions of sustainability (i.e., economic, social, and environmental).

It is worth noticing that in contrast with the centralization focus of a FV, PI applications tend to decentralize freight transportation. For social sustainability, it is shown that PI facilities significantly decrease the effects of shift work and lead to a decrease in mileages (Fazili et al., 2017). However, there may be lost jobs because of the vanished need for material handling. Along with that, because of the conventional paradigms, for example in Turkey and most of the developing countries, majority of the work force in the logistics industry is likely to have problems in gaining confidence in the knowledge sharing required by the PI application. The infrastructure needed for the PI applications may also be hard to be realized in many of the different economies. Especially the need for data transfer requires an advanced information technology infrastructure for the countries. Nevertheless, as Montreuil (2011) states, PI is visionary and open to development and enhancement, i.e. in the near future, it may evolve to fulfill different needs (Baydar et al., 2017). PI itself may create the solutions for such problems with its aid in economical sustainability (more efficient freight transportation activities) resulting in higher investments from the stakeholders of the supply chain in terms of infrastructure and education for both white and blue collar personnel.

For Turkey, PI applications are a promising area when the current situation of the

FVs is considered. Albeit the infrastructure developments and the vision needed to embrace the paradigms of PI, the applications may bring a chance for the country in terms of catching up with the developed world in logistics sector. When Turkey's current situation which is regarded as a developing country (Schwab et al., 2015) is considered, PI is prominent because PI would push the logistics sector to fully integrate with the rest of the world with higher standards than today. Furthermore, instead of covering longer distances and fewer deliveries, trucks working in freight transportation would face an increased number of deliveries which would bring increased collaboration, business volume and decreased lead times (Fazili et al., 2017). If PI applications are to take place in Turkey, the necessity of a workforce with higher skills would rise the demand from the logistics sector for this new personnel type; resulting in higher skilled individuals (at least in the logistics sector) than today and the institutions to train them. Here it is worth stating that the chances for catching this new trend is still alive and there is still time for the stakeholders of the Turkish supply chain to learn, understand and embrace this new era.

CHAPTER 5

CONCLUSION

In this study, the possible effects of FVs in Turkey on sustainability and social equity are analyzed, after a systematic literature review from a sustainability and social equity point of view is presented on FVs. The lack of value adding work and the data for Turkish FVs led to the necessity of site visits to operational FVs in Turkey. 7 Site visits have been realized to Ankara, Balıkesir-Gökköy, Denizli-Kaklık, Eskişehir-Hasanbey, İstanbul-Halkalı, Kocaeli-Köseköy and Uşak FVs.

It has been observed that the current status of the FV applications in Turkey do not comply with the definition of a FV since there is very little coordination and collaboration which is not based on a legal status and the services offered by the FVs are very limited. In terms of size and business volumes it has been seen that the FVs in Turkey are smaller and are under capacity compared to the selected FV applications in Europe and North America. When the locations of the FVs are considered, two of them, Uşak and İstanbul-Halkalı has already been surrounded by residential buildings and by no means can aid sustainability by taking freight transportation activities out of the city perimeters. Currently, neither performance metrics nor a legal status is present for the FVs which does not let proper evaluation of these facilities. Besides, since the investments and developments in passenger transportation is more popular in Turkey, it is evident that the focus on Turkish FVs in Turkey has decreased. Most importantly, the FV applications in Turkey fail to fullfill the essential property of FVs which separates them from an ordinary hub; coordination and collaboration.

For different dimensions of suitability, FVs still possess a potential for Turkey, if their usage is increased provided that coordination and collaboration is present among the users which makes them act together in shared planning, shared usage of capacity and infrastructure and share knowledge. Only then, positive effects to sustainability can be achieved.

Firstly, with the capabilities of FVs in Turkey, the major cost figures of logistics activities in Turkey; transportation and storage costs namely, can be decreased with FV usage. This interpretation is based on the modal split of freight transportation in EU-28 countries and the usage of the selected FVs in Europe. Since the TCDD FVs are intermodal terminals which all have railroad connections, the increase of modal split in Turkey towards the railroads may have possible effects to economical sustainability.

Secondly, for environmental sustainability, with the increased usage of FVs, significant decreases in emissions can be realized with the increased number of FTL deliveries and the usage of TCDD trains which will become fully electrified in the following couple of years which will also aid economical sustainability by decreasing the dependency on imported fossil fuels.

Thirdly, FVs appear to be a tool that can be used for increasing employment in the region they are to be established in Turkey. Turkish economy has a positive correlation between its GDP, freight transportation and employment numbers. Although the first FVs were established in regions which have relatively higher GDP and employment, the project aims to cover all geographical regions of Turkey when all FVs are operational.

It is vital to remark again that these possible benefits are possible if and only if the current structural property of FVs are changed; creating and enhancing the coordination and collaboration between the FV users.

Lastly, Physical Internet (PI) applications appear to be prominent in terms of aiding the FVs in achieving all different dimensions of sustainability. Overall, PI applications are promising since if a move towards PI is made, then the logistics industry standards would have to change towards a more sustainable way of doing

things. PI applications demands for a highly developed infrastructure and skilled workforce is by far the fastest way of changing itself for a more sustainable and equitable future for Turkey.

For future studies, industry should be incorporated in the context of FVs. Logistics firms' opinions about FVs, their reasons for using/ not using these facilities, their burdens, their view on the issue are untouched areas for Turkey.

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APPENDIX A

CURRENT FREIGHT VILLAGES THROUGHOUT THE WORLD WITH THEIR PROPERTIES

Table 18 Current FVs throughout the World with Their Properties

Country		General Characteristics			Transportation Modes†			
		Transport Size (Acres)	Employees & Logistic Firms		Road	Rail	Air	Water
Asia								
China	Shenzhen Pinghu Logistics[1]	4,015	-	-	X	X	X	(X)
	Huaihai Integrated Logistics Park[1]	890	-	-	X	(X)		
	Shanghai North-West ILP[1]	4,653	-	-	X	X		(X)
Korea	Busan New Port Distripark[1]	758	-	-17	X	X	X	(X)
	Gamcheon Distripark[1]	-	-	-	X	X	X	(X)
	Gwangyang Port Distripark[1]	215	-	23	X	X	X	
Taiwan	Far Glory FTZ[1]	111	25,000	-	X	X	X	
	Taisugar Logistics Park[1]	21	-	-	X		X	(X)
Europe								
Denmark	HTC Hoeje Taastrup Transport Centre[1]	371	-	3	X	X		
	NTC Nordic Transport Centre[1]	228	-	15	X	X	X	
	Skandinavisk Transport Centre[1]	321	-	-	X	X	(X)	(X)
	Taulov Transport Centre[1]	519	-	14	X	X	(X)	
France	Roissy-SOGARIS[1,2]	133	2,500	100	X	X		(X)
	Eurocentre Toulouse (Under Development)[2]	740	-	-	X	X		(X)
Germany	GVZ Bremen[1,2]	895	8,000	150	X	X	X	(X)
	GVZ Dresden[1]	61	410	4	X	X	X	(X)
	GVZ Entwicklungsgesellschaft Bremen MBH[1]	524	3,000	-	X	X	(X)	(X)
	GVZ Freienbrink[4]	321	-	-	X	X		
	GVZ GroBbeeren[4]	759	-	-	X	X		
	GVZ Hamburg[1]	138	450	6	X	X	X	(X)
	GVZ Kiel[1]	667	-	-	X	X	X	(X)
	GVZ Nuremberg[1]	833	5,500	260	X	X	X	(X)
	GVZ Osnabruck[1]	114	-	-	X	X	X	(X)
	GVZ Rostock[1]	373	-	-	X	X	(X)	(X)
	GVZ Wustermark[4]	520	-	-	X			
Hungary	Budapest Intermodal Logistics Centre[1]	247	-	-	X	X	(X)	(X)

Table 18 Current FVs throughout the World with Their Properties (cont.)

Country		General Characteristics			Transportation Modes†			
		Transport Size (Acres)	Employees & Logistic Firms		Road	Rail	Air	Water
Italy	Interporto Bologna[1]	1,055	1,500	81	X	X		
	Interporto Novara[1]	207	50	-	X	X		(X)
	Interporto Padova[1]	3,212	1,200	80	X	X		
	Interporto Parma[1]	618	1,300	60	X	X	(X)	(X)
	Interporto Rivalta Scrivia[1]	556	490	40	X	X	(X)	
	Interporto Rovigo[1]	395	30	4	X	X	X	
	Interporto Torino[1]	889	3,000	200	X	X		
	Interporto Quadrante Europa[1]	618	1,800	110	X	X		(X)
	Interporto Venezia[1]	59	250	-	X	X	X	
	Interporto Verona	605	1,800	110	X	X		
Portugal	Terminal Multimodal Do Vale Do Tejo S.A.[1]	548	22	-	X	X	(X)	
Spain	Bilkakobo-Aparcabisa[1]	49	800	40	X	X		(X)
	Centro de Transportes Aduana de Burgos[1]	40	-	17	X	X		(X)
	Centro de Transportes de Coslada[1]	247	-	15	X	X		(X)
	Centro de Transportes de Irun[1]	99	2,100	107	X	(X)		(X)
	Centro de Transportes de Madrid[1]	84	8,000	150	X	(X)		(X)
	Centro di Transporte de Vitoria[1]	268	-	20	X	X		(X)
	ZAL Port de Barcelona[1,2]	177	-	17	X	X	(X)	(X)
	Zona Franca de Barcelona[1]	130	-	7	X	(X)	(X)	(X)
	ZAL Gran Europa[1]	237	1,000	100	X	X		(X)
	Ciudad del Transporte de Pamplona[1]	150	1,000	50	X	X		(X)
United Kingdom	DIRFT Logistics Park[1]	498	-	-	X	X	(X)	
	Keypoint: Swindon's Premier Logistics Park[1]	-	-	-	X	X		
	Kingmoor Park[1]	400	-	100	X	X		
	Wakefield Europort[1]	220	-	16	X	X		
North America								
Canada	CentrePort Canada (Under Development)	20,000	-	-	X	X	(X)	X
Mexico	ADNplus Industrial Multiport (Cancelled)[5]	1,100	-	-	X	X		X
United States	AllianceTexas[1,3]	17,000	28,000	170	X	X		X
	Global TransPark[3]	15,700	-		X			X
	Greater Columbus Inland Port / Rickenbacker Intermodal Facility[1]	1,300	20,400	-	X	X		X
	Guild's Lake Industrial Sanctuary (Under Development)[1]	1,625	-	-	X	X	(X)	
	Heller Industrial Park[1]	-	-	-	X	X		
	Mesquite Intermodal Facility/Skyline Business Park[1]	400	-	-	X	X		
	Port of Huntsville[3]	1,780	-	-	X	X		X
	Pureland Industrial Complex[1]	3,000	-	150	X	X		(X)
	Raritan Center[1]	2,350	15,000	391	X	X		
	Winter Haven[1]	1,250	8,000	-	X	X		

†X refers to inside the facility and (X) refers to in the vicinity.

[1](Boile et al., 2008), [2](Weisbrod et al., 2002), [3](Walter and Poist, 2004), [4](de Cerreno et al., 2008), [5](Leitner & Harrison, 2001)

APPENDIX B

ARTICLES WITH RESPECT TO THEIR SCOPE, METHOD AND DIMENSIONS

Table 19 Articles with respect to their scope, method, and dimension

Scope	Category	Dimension	Article	References
General	Assessment	Impact	1	Hamzeh et al. (2007)
		Financial	2	Tsanmboulas et al. (2003), Meidutė et al. (2007)
		Location	2	Kayikci (2010), Marković et al. (2013)
	Design	Environ. Impact	1	Altuntas et al. (2013)
		Governance	1	Wu et al. (2011)
		Network Design	1	Cassone et al. (2010)
		Definition	2	Meidutė (2005), Rimienė et al. (2007)
		Other	1	Wiegmans et al. (1999)
Case Based - Country Level	Assessment	Efficiency	2	Somogyi et al. (2011), Haralanbides et al. (2012)
		Identifying Metrics	1	Tsamboulas et al. (1999)
		Location	3	Ruying et al. (2008), Zak et al. (2014), Roso et al. (2015), Onden et al. (2015)
		Environ. Impact	2	Hanaoka et al. (2011), Lättilä et al. (2013)
		Flexibility	1	Abrahamsson et al. (2003)
		Regional Development	1	Monios (2015)
		Other	1	Jaržemskis (2007)
	Design	Governance	2	Winkler et al. (2011), Witte et al. (2014)
		Size	1	Zheng et al. (2012)
		Action Plan	1	Giannopoulos (2008)
		Quality	1	Vural et al. (2015)
		Other	12	FV-2000 (2000), Tsukai et al. (2001), Han (2008), Rodrigue et al. (2010), Eryuruk et al. (2011), Long et al. (2011), Andrejić et al. (2013), Antai et al. (2013), Calis et al. (2014), Bodaubayeva (2015), Monios et al. (2015), Liu et al. (2015)

Table 19 Articles with respect to their scope, method, and dimension (cont.)

Case Based - Individual	Assessment	Efficiency	5	Kapros et al. (2005), Carvalho et al. (2010), DGG (2010), Yue et al. (2011), Yang et al. (2015)
		Feasibility	7	Labanuskas et al. (2007), Afandizadeh et al. (2008), Boile et al. (2008), DiJohn et al. (2009), Antún et al. (2010), Lima Jr. et al. (2010), Higgins et al. (2011)
		Regional Development	2	Sainz et al. (2013), Vrochidis (2013)
		Other	5	Tánczos et al. (2000), Hesse (2004), Bergqvist (2008), FAL Bulletin (2011), Eckhardt et al. (2012)
	Design	Location	5	Eryuruk et al. (2011), Regmi et al. (2013), Elevli (2014), Bergqvist et al. (2008), Eryuruk et al. (2012)
		Governance	1	Monios (2015)
		Risk Mgmt.	1	Breuer et al. (2012)
		Size	2	Ballis (2005), Ballis et al. (2007)
		Other	3	Hesse (2004a,b), Weisbrod et al. (2002), Wu et al. (2013)

APPENDIX C

ARTICLES WITH MULTIPLE DIMENSIONS

Table 20 Articles with multiple dimensions

Scope	Category	Dimension	Wiegmans et al. 1999	Tsamboulas et al. 1999	FV 2000	TÁNCZOS et al. 2000	Tsukai et al. 2001	Weisbrod et al. 2002	Hesse 2004	Jaržemskis 2007	Bergqvist 2008	Han 2008	Rodrigue et al. 2010	Bulletin FAL 2011	Eryuruk et al. 2011	Long et al. 2011	Eckhardt et al. 2012	Andrejic´ et al. 2013	Antai et al. 2013	Wu et al. 2013	Calis et al. 2014	Monios et al. 2015	Liu et al. 2015	Bodaubayeva 2015
General	Design	Environ. Impact			X																			
		Governance	X																					
		Network Design			X																			
		Definition	X																					
		Size	X																					
Case Based Country Level	Assessment	Efficiency		X			X			X								X						
		Identifying Metrics		X														X						
		Environ. Impact								X														
		Flexibility								X									X					X
		Regional Development																						X
	Design	Governance			X						X	X	X		X				X		X	X	X	X
		Size			X						X	X			X	X		X			X	X	X	X
		Action Plan			X						X				X							X		
		Quality			X							X			X									
		Location			X		X				X		X		X	X		X	X		X		X	X
		Network Design			X		X														X			
Case Based Individual	Assessment	Efficiency				X								X			X							
		Feasibility				X																		
		Regional Development												X										
		Environ. Impact												X										
	Design	Location				X		X	X															
		Governance				X		X	X											X				
		Risk Mgmt.																		X				
		Size						X	X															
		Network Design				X			X											X				
		Knowledge Sharing															X			X				
		Definition															X							

APPENDIX D

NOTES ON QUESTION FORM USED IN SITE VISITS

The most challenging part for obtaining answers for the questions in Table 10 was for the business volume. Albeit all the facilities were using an enterprise resource management system, it was the part of the question form the author had to make further explanations. The author believes, amongst the few possible reasons for this comes the lack of metrics and similar reporting; resulting in a confusing scheme for the administration, even though having an official permission, being afraid of presenting the performance in a written platform and the lack of belief in the significance of these measures. For the question regarding with the end destinations visited in the last 6 months, it has been observed that the administrations were unfamiliar with this sort of data.

For Eskişehir-Hasanbey and Balıkesir-Gökköy, FV administrations were kind enough to fill the forms beforehand. Nevertheless, the author discussed all the answers and figured out that, instead of the occurred numbers, capacity estimations were shared, these have been revealed in the discussions and the answers had been updated accordingly.

Although answers to some of the questions were trivial such as; location and information system, all of the questions in Table 10 have been discussed with the FV administrations. For Ankara FV, which has a private administration, the form was kindly rejected and the questions in the form have been interviewed with the FV administration. For the remaining (TCDD) FVs, the location and evaluation part of the question form was the part most of time was spent on.

Firstly, all of the FV administrations had something to say about the location selection made by the TCDD and they strongly believed that the location selection should be systematic. For Uşak and Eskişehir-Hasanbey FVs, administration believed that the location selection was inappropriate, for Uşak it must be out of the city and for Eskişehir-Hasanbey, Bilecik-Bozüyük FV was the right location and Hasanbey's location was ill planned.

Secondly, for the evaluation part, it has been observed by the attitude of all FV administrations that the administrations actually believed that the FVs do have a goal in terms of achieving sustainability and although they had not any formal measures, they had enthusiasm while sharing their thoughts and mentioning the facilities capabilities in such manners.

Size information (in terms of m^2) has been acquired from TCDD Headquarters located in Ankara. It was surprising for the author that even though an enterprise resource management system was in use for TCDD's operations, TCDD Administration refused to shared specific information about the FVs and rather, they tend to give the related permissions to conduct the site visits.

Employment, tenants and vehicles were by far the easiest forms in the question form in terms of obtaining answers.

The change in TCDD's structure in 01/01/2017 resulted in some changes in the organizational structure also and thus some of the official permissions were sought again by the author during this time.