

A survey analysis on sustainable practices in cold supply chains

Bertolini M.*, Bottani E.**, Casella G.**, Tebaldi L.**

* *Dipartimento di Ingegneria “Enzo Ferrari”, Università degli Studi di Modena e Reggio Emilia, via P. Vivarelli 10, 41125, Modena, Italia (massimo.bertolini@unimore.it)*

** *Dipartimento di Ingegneria e Architettura, Università di Parma, Parco Area delle Scienze 181/A, 43124, Parma, Italia (leonora.bottani@unipr.it; giorgia.casella@unipr.it; letizia.tebaldi@unipr.it)*

Abstract: Due to their peculiarities, certain goods require specific storage and distribution conditions. For instance, fruits and vegetables as well as dairy products, fresh meat, frozen or pharmaceutical products must be stored and transported in controlled temperature conditions. This involves the use of refrigerated facilities and trucks that consume large quantities of energy and are responsible of huge emissions. Consequently, the so-called cold supply chains have drawn attention with regards to their sustainability perspective both during the design and management phases. In line with that, the present work aims at presenting some preliminary results from a survey analysis carried out in Italy on thirteen companies operating in this specific field, investigating their sustainability practices. Among the main findings brought out, for instance, it emerged that investments in recycled building materials (considered of low-quality) are (still?) not considered by companies, as well as the usage of alternative fuels for transports; moreover, the use of intermodal transport is rather lacking. Overall, there is great room for improvement from the sustainability perspective of cold supply chains.

Keywords: cold supply chain; sustainable practices; survey; sustainability.

1. Introduction

Sustainability: one the main keywords of the current century. And with it, all its possible declinations and several fields of application.

Among these, supply chains (SCs) play a central role; indeed, it was estimated that more than three quarters of the Green House Gas (GHG) emissions associated with many industrial sectors are due to SCs activities (Huang et al., 2009), and accordingly there is a plethora previous studies dealing with the so-called sustainable supply chain management (SSCM). To get an idea of what has been done so far, it is worth mentioning recent literature reviews by Carter et al. (2019), Panigrahi et al. (2019) or Taghikhah et al. (2019).

Specifically, within the logistics field which is one of the key activities of supply chains source of several impacts both in economic and environmental terms, the main concerns related to sustainability issues refer to processes optimization, adoption of automated systems, implementation of Just in Time (JIT) practices, inventory minimization within warehouses, while modal choice, freight consolidation, fuel efficiency (considering alternative green sources), the reuse of pallets and containers or vehicle routing optimization when dealing with transports (Kumar, 2015; Waidyathilaka et al., 2019).

More in detail, a niche which has gained particular attention is represented by what is called cold supply chain (CSC), namely a SC whose activities and processes including handling, holding and transportation ensure the control of temperature sensitive products (Hariga et al., 2017); according to Brzozowska et al. (2016), these specific products are the following: fruits and vegetables,

floriculture, meat and marine products, pharmaceutical products, dairy products and products from the ice cream sector and confectionery. These products need to be stored and transported at low temperatures, near or below the freezing point, and this implies the use of refrigerated facilities and trucks that consume large quantities of energy (Saif and Elhedhli, 2016). Indeed, about 15% of the global energy production is dedicated to fuel CSCs and cooling systems (Coulomb, 2008), which still depends on fossil fuels (Gallo et al., 2017).

The energy consumption for maintaining the set-point temperature is heavily dependent on the outdoor temperature conditions during transportation and storage, as well as it is influenced by those factors which can alter the coldness, such as the door openings, the removal/loading operations, the conduction through walls, roof and floors of the refrigerated warehouses and vehicles, the length of the journey, the heat transfer between the outside air and refrigerators (Fang et al., 2018).

What is certain, is that the greater energy consumption, the higher carbon dioxide (CO₂) emissions. This is the reason why several studies were proposed in literature specifically for CSCs in order to monitor this aspect. For instance, it is worth mentioning Li and Chen (2016), who developed a new solution of cold energy storage material (ESM) for food cold chain, according to the thermal properties of different salts.

In line with that, the present work aims at presenting the results from an empirical research carried out in the CSC context; the ultimate purpose of the study is to investigate the main common sustainable practices of that field and

the possible gaps. The methodological approach consists in a questionnaire survey phase, which involved thirteen companies operating in the CSC field. Note that for privacy reasons, the companies’ names are not mentioned. Most of the survey analysis carried out within the food cold chain are focused on the consumer awareness and behaviour (e.g. Uçar and Özfer Özçelic, 2013; Ovca and Jevšnik, 2009), or on the cold food conditions in different stores (e.g. Likar and Jevšnik, 2006); results show that European consumers tend to place the responsibility of maintaining a cold chain onto other parts of the food chain (Ovca and Jevšnik, 2009). It follows the relevance of the company perspective.

The structure of the paper is as follows: section 2 describes the research methodology; section 3 presents the scheme of the survey and the questions submitted, together with commented results, followed by conclusions (section 4).

2. Methodology

This work evolves from a previous study by Bottani et al. (2019), whose aim was to present a model developed under Microsoft Excel™ for assessing the economic and the environmental sustainability dimensions of a food CSC, and to test it on a case study. The idea is to adapt the model in question to contexts other from the food one, while remaining within the CSCs field, and make it available to different companies. Before doing that, a survey analysis has been carried out in order to understand the “degree of sustainability” of the different companies, useful for understanding whether they could appreciate and benefit from the model or not.

The survey has been developed together with the management of the company subject to the previous case study, aware of the most important and suitable eco-friendly practices, and it consists of six main sections: (1) company classification, (2) warehouse, (3) transport, (4) supply agreements, (5) sustainable practices, and (6) benefits/barriers to a sustainable policy.

The list of the main companies operating in CSC was firstly drawn up. The survey was sent by email to the contacts found on the web or via LinkedIn® to exactly ninety representatives of as many companies. Thirteen of them (14.4% response rate) replied and completed the survey; this result is in line with the minimum threshold of investigations of this kind, which is set at 10% (Malhotra & Grover, 1998).

Results were recorded under Microsoft Excel™.

3. Questionnaire and results

In this section, the questionnaire, which consists of the six main sections previously listed, is presented in detail, together with the replies provided from the thirteen respondents. The subdivision of the sections is respected in their exposition.

Note that for the sake of brevity discussion will be limited to those results believed to be most relevant and less intuitive.

Overall, what emerged is that despite research is active and purposeful in this context, operatively and in practice companies tend to be unwilling towards this topic.

3.1 Company classification

The aim of the first six questions of the survey is to classify the companies into four main groups according to their revenue and number of employees in order to set “clusters” and let the analysis be more precise; the classification includes micro, small, medium and large companies. The characteristics of the four attributes are summarized in Table 1 (European Commission, 2003).

Table 1: Companies’ classification.

	Micro	Small	Medium	Large
Employees	<10	<50	<250	≥250
Revenue (Millions of €)	≤2	≤10	≤50	>50

Moreover, origin and destination of the marketed products were investigated. The specific questions are the following:

1. Company name;
2. Respondent’s role within the company;
3. Company size (according to the subdivision provided in Table 1);
4. Origin of the marketed products (i.e. local, regional, national, European, global);
5. Destination of the marketed products (i.e. local, regional, national, European, global);
6. Marketed products (i.e. fruit and vegetables, dairy products, fresh meat, frozen products, pharma products or other).

In our case, almost all the surveys (70%) were compiled by member of the executive staff; indeed, some questions were specific and available only for those who have a whole view of the company. For sure, this guarantees the veracity of information, but at the same time it could be the reason for the lack of answer from the remaining 77 companies.

Specifically, in three cases the CEO himself replied; in two cases the general manager, while for the remaining eight companies respectively the chief executive, the logistics manager, the operations manager, the pallets responsible, the responsible of the business department, the managing partner, the owner and the responsible of the quality, safety and environment. The size of the respondent companies is reported in Table 2:

Table 2: Companies’ classification.

	Micro	Small	Medium	Large
Respondents	2	5	3	3

The set is quite well shared: half of it belongs to the micro-small world (7 companies), while the remaining half to the medium-large (6 companies). For sure, for small companies it is easier to find data; conversely for larger companies it is difficult to have vision of the situation as a

whole. Probably, small companies are also more attracted by this topic to enhance their visibility on the market and reputation. Exception made for one of the two micro companies which is a dairy, the remaining twelve are all logistics services providers.

For the sake of brevity, in the following only the main results will be mentioned as far as the origin of marketed products: nine companies declared that 1-25% of their business has local origins, five companies that 1-25% is at regional level, again five companies state that 50-75% of their marketed products is Italian, while eight companies trade European goods for 1-25%; global products are scarcely considered, and same goes for the destinations, which are rarely worldwide. Conversely, for seven companies 1-25% of their products remains at a local-regional level, while six companies cover the national territory for 1-25%. Half of the companies (seven out of thirteen) reaches other European countries.

3.2 Warehouse

The second part of the survey deals with the part of warehouses, including the majority of questions from 7 to 19, due to the relevance of the facility to the sustainability of the logistics system. Indeed, logistics activities are likely to generate undesired “byproducts” such as inefficient/excessive use of fossil burning fuels or CO₂ emissions (from an environmental point of view), and at the same time they absorb around 10% of gross domestic product of industrialised countries (from an economic perspective) (Bottani et al., 2015; World Economic Forum, 2013).

The aim is to investigate the main sustainability practices both in design and management of this facility, through the following points:

7. Valuation in terms of costs/benefits as far as 9 sustainable practices related to the design/building of a refrigerated warehouse. The 9 possible choices are below listed:

- A. Use of recycled materials for building;
- B. Installing photovoltaic panels;
- C. Installing a cogeneration/trigeneration plant;
- D. LED lighting;
- E. Installing probes for lighting control;
- F. Installing a Building Management System for the temperature control;
- G. Use of polyurethane foams for insulating panels;
- H. Installing a refrigeration system powered by CO₂ or ammonia (NH₃) instead of hydrofluorocarbons;
- I. Installing recessed loading docks and use of inflatables sealants.

Respondents could reply “I don’t know”, “Scarce”, “Sufficient”, “Good”, “Excellent”. Note that with *benefits*

reduction in consumption, costs and environmental impact are meant.

8. With reference to the abovementioned sustainable practices, indicate whether they were implemented or not;
9. Use of forklifts powered by lithium-ion batteries;
10. In case of affirmative answer to question 9, indicate whether the battery is high frequency;
11. Use of software to optimize handlings;
12. In case of negative answer to question 11, indicate whether there is intention to implement it or not;
13. Use of software for allocating goods;
14. In case of negative answer to question 13, indicate whether there is intention to implement it or not;
15. Certifications for environmental sustainability of the warehouse (e.g. LEED, BREEAM, ITACA, none or other);
16. Possess of ISO 14001;
17. In case of negative answer to question 16, indicate whether there is the intention to implement it or not;
18. Possess of ISO 50001;
19. In case of negative answer to question 18, indicate whether there is the intention to implement it or not.

As far as the question related to the ratio costs/benefits of determined sustainable practices (i.e. the 7th), results are below depicted (Table 3).

Table 3: Answers to question 7. The number indicates the total of companies which have chosen that specific reply.

Answers	I don't know	Scarce	Sufficient	Good	Excellent
A	2	8	2	1	0
B	0	2	4	5	2
C	2	1	4	5	1
D	0	0	4	3	6
E	0	1	4	6	2
F	0	0	2	6	5
G	0	1	2	9	1
H	1	1	0	7	4
I	1	1	5	4	2

What immediately stands out is that the majority of companies agrees on the scarce usage of recycled material for the building of the warehouse structure; even if the sample is too small for generalizing, this in part confirms what is declared in a report from Legambiente (2017) where results show that among the European countries Italy fits in the lowest positions in terms of recycled building materials. Conversely, almost all the respondents agree on the benefits resulting from polyurethane foams for insulating panels, allowing savings in terms of fuels involved in the combustion for refrigeration; indeed,

Ferretti et al. (2018) confirm that the most popular insulation is expanded polyurethane (PU) foam with cyclopentane as blowing agent.

Moreover, again for each of the abovementioned points, below the number of companies which have operatively applied them (Table 4, namely reply to question 8).

Table 4: Number of answers to question 8.

Answers	Not Implemented	Implemented
A	12	1
B	5	8
C	6	7
D	4	9
E	7	6
F	4	9
G	3	10
H	8	5
I	8	5

In accordance with Table 3, Table 4 confirms that no one of the companies surveyed makes use of recycled materials for building, while almost all companies have thermally insulated the facility with polyurethane. Moreover, despite the majority agrees on the fact that benefits would occur by adopting recessed loading docks and use of inflatables sealants, only 5 already own this equipment.

Regarding the forklifts powered by lithium-ion batteries, five companies declare to use them, six not, and the remaining two do not know. The six companies in question are all in the cluster of the medium-large sized, and the possible reason is the fact that this technology is still at an embryonic stage and is actually quite expensive compared to the traditional lead-battery.

Most lacking, instead, is the implementation of optimization software: only three companies declared the adoption, and among the remaining ten only two plans to implement this solution in the following three years.

In reference to the certifications, results are quite unsatisfactory: only one company (large) owns the ISO 14001, which deals with environmental issues, and only half of the remaining consider the possibility of becoming certified within three years. There are two companies certified with the ISO 50001, which deals with the energy management system (always belonging to the group of the large companies) and three of the remaining plans to adopt it within three years.

3.3 Transport

Three questions (20, 21 and 22) refer to the modes of transport adopted by the companies, and specifically they are the following:

20. Percentage of products transported by respectively road, train, sea, plane, intermodal transport. Possible answers: 0%, 1-25%, 25-50%, 50-75%, 75-99%, 100%.
21. Change over the past 5 years towards the choice the aforementioned modes of transport. Possible answers: “Increased”, “Unchanged”, “Decreased”.

22. Valuation in terms of costs/benefits as far as 8 sustainable practices related to the transport. The 8 practices are below listed:

- A. Use of software for optimizing the loading;
- B. Use of solutions (software or not) for optimizing transport and minimizing empty runs;
- C. Modifications to the vehicles design (e.g. aerodynamics, low rolling resistance tyres, etc.);
- D. Renewal of vehicle fleet (e.g. Euro 4 → Euro 5 or 6);
- E. Use of alternative fuels (e.g. methane);
- F. Shift to less impactful modes of transport (e.g. road → train);
- G. Promoting intermodal transport;
- H. Introducing training for employees.

The same considerations of question 7 hold true in this case. Overall, what emerges is that nine companies out of thirteen resort to the road transport for the whole set of products (100%), and that just one subject makes use of the intermodal option; this confirms Eurostat data from 2018 (<https://ec.europa.eu/eurostat>), which shows that in Europe the 76.4% of goods are transferred by road, the most widespread transport means. None of them contemplates the train, while as far as transport by sea two companies transfer the 1-25% of products, and one the range between 25 and 50%. Finally, only in one case the plane is involved for 1-25% of the marketed goods. These percentages were quite steady over the past five years, as almost the whole set of respondents confirmed that there were not changes in these ways (question 21); the only result it is positively worth mentioning is that six companies (almost half of the sample) declared that the transport by road was decreased. Conversely, for none of the means of transport an increased traffic was recorded.

The last question of this section refers to the evaluation of some sustainable practices linked to transports, and outcomes are shown below (Table 5).

Table 5: Answers to question 22. The number indicates the total of companies which have chosen that specific reply.

Answers	I don't know	Scarce	Sufficient	Good	Excellent
A	0	0	3	4	6
B	1	1	4	4	3
C	1	2	4	5	1
D	0	0	4	4	5
E	2	2	4	4	1
F	3	5	0	4	1
G	4	4	3	1	1
H	2	0	6	3	2

In general, there is a positive belief on the advantages which can be achieved by renewing the vehicle fleet, while as far as intermodal transport, the sample turned out to be rather pessimistic, as well as for the usage of alternative fuels. Another interesting point is the positive assessment of software to be implemented for optimizing the loading,

and accordingly avoiding inefficiencies and Less than Truck Load (LTL) shipments.

3.4 Supply agreements

As far as this brief section (only two questions), the purpose is simply to understand whether companies take care of the energy supply and stipulate contracts with renewable energy suppliers. To this end, the following questions were asked:

23. For both electricity and gas supply it is investigated whether the company has evaluated or not the possibility to improve contracts or changing suppliers, and were asked to indicate their situation in relation to the following 8 possibilities (multiple answers allowed):
 - A. No awareness about the possibility to change supplier;
 - B. This issue has not been examined;
 - C. This issue has been examined but the evaluation of benefits is too complex;
 - D. The current supplier and rate are appropriate;
 - E. Better offers were identified, but the switching procedure is too complex;
 - F. Better offers were identified, but the alternative service is of questionable reliability;
 - G. The company has already changed the pricing model (at least once) with the same supplier;
 - H. The company has already changed supplier (at least once).
24. Company was required to state whether it has contracts with suppliers who produce electricity via renewable sources or not.

With regards to agreements with supplier who produce electricity also *via* renewable sources, five of the subjects investigated benefit of this service; two of them were even not aware of this option. The remaining six negatively replied.

3.5 Sustainable practices

In this part of the survey, companies were asked to illustrate the sustainable practices they have adopted; specifically:

25. Among 6 main eco-friendly practices, the “level of take-up” was investigated. The possible answers “I don’t know”, “Not important”, “Not considered”, “Scheduled implementation”, “Adopted” were attributable to the following practices:
 - A. Separate collection and appropriate waste management;
 - B. Initiative to reduce water consumption;
 - C. Initiative to reduce atmospheric gas;
 - D. Initiative to reduce electricity consumption;

- E. Investments in green plants/innovations;
- F. Definition of targets for improving the environmental impact;

26. Eventual measurement of carbon dioxide emissions which are generated;

27. In case of affirmative answer to question 26, how they are measured;

What stands out from the answers, is that the separate collection is adopted or scheduled by almost the whole sample. Indeed, this is an action quite easy and economical to be implemented and communicated to employees. Another aspect receiving attention is the reduction of the electricity consumption (which can also have an economic side), while not so much importance is given to the water issue. To be more thorough, results are detailed in Table 6.

Table 6: Answers to question 25. The number indicates the total of companies which have chosen that specific reply.

Answers	I don't know	Not Important	Not Considered	Scheduled	Adopted
A	1	0	1	4	7
B	1	2	5	1	4
C	1	3	3	1	5
D	1	0	1	5	6
E	1	1	3	3	5
F	1	1	4	3	4

3.6 Benefits/barriers to sustainable policies

The final part of the survey refers to the benefits achievable through an appropriate sustainable policy, as well as barriers which can obstacle it. This information was acquired thanks to the two following final questions, which include a list of “pros and cons” to which respondents could reply “I don’t know”, “No importance”, “Scarce importance”, “Quite important”, “Extremely important”. Answers are detailed in the two tables that follow (i.e. Tables 7 and 8).

28. List of 5 benefits:
 - A. Cost reduction for the company;
 - B. Better reputation;
 - C. Increasing of business profit (Return on Investments – ROI);
 - D. Cost reduction for customers;
 - E. Improving in relationship with customers;
29. List of 10 barriers:
 - A. Lack of financial resources;
 - B. High investment costs;
 - C. Uncertain ROI;
 - D. Lack of human resources;
 - E. Lack of knowledge and skills;
 - F. Lack of public incentives;
 - G. Lack of clear regulations;

- H. Lack of interests from customers;
- I. Scarce collaboration from Third Party Logistics;
- J. Lack of specific services on the market.

Table 7: Answers to question 28 (benefits). The number indicates the total of companies which have chosen that specific reply.

Answers	I don't know	No Importance	Scarce Importance	Quite Important	Extremely Important
A	2	0	3	4	4
B	0	0	0	8	5
C	1	0	3	4	5
D	1	2	5	2	3
E	0	0	2	8	3

Table 8: Answers to question 29 (barriers). The number indicates the total of companies which have chosen that specific reply.

Answers	I don't know	No Importance	Scarce Importance	Quite Important	Extremely Important
A	0	1	1	10	1
B	0	0	0	13	0
C	0	0	1	7	5
D	0	2	2	5	4
E	0	1	2	4	6
F	0	0	3	3	7
G	0	1	2	5	5
H	0	1	6	5	1
I	1	0	5	5	2
J	0	1	6	4	2

Among the main benefits, as expected, a better reputation is surely positively assessed. Indeed, stakeholders are always more and more involved in sustainability issues and tend to reward those companies which are committed in this direction. As a consequence, very important is also considered the improvement in relationship with customers, while conversely the cost reduction for clients is not so taken into account. Indeed, being more sustainable does not necessarily imply a reduction in costs; actually, costs could also increase.

For barriers, instead, everybody agrees on the fact that high investment costs can preclude determinate actions, and this is correlated of course with the lack of financial resources; companies for which this is not a real problem are the ones of larger size; another uncertainty is the ROI. According to that, all the companies are quite aligned for the economic questions; indeed, also the lack of public financing is considered as being very important. The remaining points, not directly dealing with economic aspects, are less considered.

Altogether, the two key points emerging from this section is that sustainable policies are very useful for improving relationships with stakeholders (so from an external vision), but at the same time they are hindered and difficult for economic issues.

4. Conclusions

This paper aimed at presenting results from a survey carried out on thirteen companies operating in the CSC field. Unfortunately, due to the low response rate, which is probably due to the specificity of the questions, it is not possible to generalize and infer common trends, rather

than define specific gaps; this could also be seen as a sign they are not sensitive and interested to the topic. What is certain, is that from this small sample it is clear that more can be done for let the CSCs be more sustainable.

Among the main points intended to be highlighted, for sure measures must be undertaken as far as transports; indeed, the road is the most common mean, just think that approximately 650,000 refrigerated road vehicles are currently in use within the EU (Ferretti et al., 2018) and overall, the freight transportation accounts for 7 percent of global GHG emissions (Stern, 2008). According to that traffic should be reduced or at least different less impactful fuels should be considered, that is not happening right now; intermodal transport should as well be encouraged. For both these aspects, the feeling is that what is lacking is information and knowledge; in this sense, awareness campaigns should be strongly promoted, trying above all to reach those micro and small companies which can be interested, but at the same time probably wary. Another point which at present is not considered is the possibility of using recycling building materials for facilities; actually, the contributions of recycling and re-use of building material are extremely significant in reducing waste and environmental impact, as it would lead to a lower need for raw materials (Ge et al., 2017). These materials are extremely reliable and resistant, but probably again for mistrust and unfamiliarity these practices are not positively seen from the sample in question. Maybe, if they knew that the famous Italian Juventus Stadium, the Palaghiaccio from Torino, the California Academy of Science, the Dubai Expo 2020 halls and many other famous buildings have arisen from waste materials (Legambiente, 2017), they would be more cautious in categorising this practice as not advantageous. Moreover, implementing strategies for optimizing inventory are highly recommended as it happens in several e-commerce warehouses (e.g. see studies from Babagolzadeh et al., 2020, or Bozorgi, 2016) as well as algorithmic tools for planning vehicles' journeys, now implemented from the majority of third parties service providers.

It is in plan a second round of surveys' sending, wishing for an increase of answers from the addressees and a more careful analysis; but the aim is twofold. Indeed, we hope for drawing attention from companies towards the sensitive and vital topic of sustainability, also by drawing up and disseminating results. Moreover, thanks to the planned development of the model for assessing the environmental and the economic sustainable dimensions of a CSC, we consider it as a starting point for taking serious actions and commitments, as well as for gaining knowledge by subjects.

References

- Babagolzadeh, M., Shrestha, A., Abbasi, B., Zhang, Y., Woodhead, A., and Zhang, A. (2020). Sustainable cold supply chain management under demand uncertainty and carbon tax regulation. *Transportation Research Part D: Transportation and Environment*, 80, 102245.
- Bottani, E., Casella, G., Nobili, M., and Tebaldi, L. (2019). Assessment of the economic and environmental

- sustainability of a food cold supply chain. IFAC PapersOnLine, 52-13, 367-372.
- Bottani, E., Rizzi, A. and Vignali, G. (2015). Improving logistics efficiency of industrial districts: a framework and case study in the food sector. *International Journal of Logistics: Research and Application*, 18(5), 402-423.
- Bozorgi, A. (2016). Multi-product inventory model for cold items with cost and emission consideration. *International Journal of Production Economics*, 176, 123-142.
- Brzozowska, A., Imiolczyk, J., Brzeczczak, A., and Szymczyk, K. (2016). Managing cold supply chain. 5th IEEE International Conference on Advanced Logistics and Transport, June 2016, Kraków, Poland.
- Carter, C. R., Hatton, M. R., Wu, C., and Chen, X. (2019). Sustainable supply chain management: continuing evolution and future directions. *International Journal of Physical Distribution & Logistics Management*, 50(1), 122-146.
- Coulomb, D. (2008). Refrigeration and cold chain serving the global food industry and creating a better future: Two key IIR challenges for improved health and environment. *Trends in Food Science & Technology*, 19, 413-417.
- European Commission (2003). Commission recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. Official Journal L. 124 of 20.05.2003.
- Fang, Y., Jiang, Y., Sun, L., and Han, X. (2018). Design of Green Cold Chain Networks for Imported Fresh Agri-Products in Belt and Road Development. *Sustainability*, 10, 1572.
- Ferretti, I., Mazzoldi, L. and Zanoni, S. (2018). Environmental impacts of cold chain distribution operations: a novel portable refrigerated unit. *International Journal of Logistics Systems and Management*, 31(2), 267-297.
- Gallo, A., Accorsi, R., Baruffaldi, G., and Manzini, R. (2017). Designing sustainable cold chains for long-range food distribution: energy-effective corridors on the silk road belt. *Sustainability*, 9, 2044.
- Ge, X.J., Livesey, P., Wang, J., Huang, S., He, X., and Zhang, C. (2017). Deconstruction waste management through 3d reconstruction and bim: a case study. *Visualization in Engineering*, 5-13.
- Hariga, M., As'ad, R., and Shamayleh, A. (2017). Integrated economic and environmental models for a multistage cold supply chain under carbon tax regulation. *Journal of Cleaner Production*, 166, 1357-1371.
- Huang, Y. A., Weber, C. L., and Matthews, H. S. (2009). Categorization of scope 3 emissions for streamlined enterprise carbon footprinting. *Environmental Science and Technology*, 43(22), 8509–8515.
- Kumar, A. (2015). Green Logistics for sustainable development: an analytical review. *IOSRD International Journal of Business*, 1(1), 7-13.
- Legambiente (2017). L'economia circolare nel settore delle costruzioni. Retrieved 18 February 2020 from https://www.legambiente.it/sites/default/files/docs/rapporto_recycle_2017.pdf.
- Li, Y.-C.M., and Chen, Y.-H.A. (2016). Assessing the thermal performance of three cold energy storage materials with low eutectic temperature for food cold chain. *Energy*, 115, 238-256.
- Likar, K., and Jevšnik, M. (2006). Cold chain maintaining in the food trade. *Food Control*, 17, 108-113.
- Malhotra, M.K., and Grover, V. (1998). An assessment of survey research in POM: from constructs to theory. *Journal of Operations Management*, 16, 407-425.
- Ovca, A., and Jevšnik, M. (2009). Maintaining a cold chain from purchase to the home and at home: Consumers opinions. *Food Control*, 20, 167-172.
- Panigrahi, S. S., Bahinipati, B., and Jain, V. (2019). Sustainable supply chain management: A review of literature and implications for future research. *Management of Environmental Quality. An International Journal*, 30(5), 1001-1049.
- Saif, A., and Elhedhli, S. (2016). Cold supply chain design with environmental considerations: A simulation-optimization approach. *European Journal of Operational Research*, 251, 274-287.
- Stern, N. (2008). The economics of climate change: The Stern review. *American Economic Review*, 98, 1-37.
- Taghikhah, F., Voinov, A., and Shukla, N. (2019). Extending the supply chain to address sustainability. *Journal of Cleaner Production*, 229, 652-666.
- Uçar, A., and Özfer Özçelici, A. (2013). Individuals' knowledge and practices of the cold chain. *Ecology of Food and Nutrition*, 52, 116-129.
- Waidyathilaka, E., Vidanagamachchi, K., and Wickramarachchi, R. (2019). Trends in Green Vehicle Routing in Reverse Logistics. *Proceedings of the International Conference on Industrial Engineering and Operations Management - IEOM, Bangkok (Thailand)*.
- World Economic Forum (2013). “Enabling Trade: Valuing Growth Opportunities”. Retrieved 18 February 2020 from http://www3.weforum.org/docs/WEF_SCT_EnablingTrade_Report_2013.pdf