Horizontal collaboration: enablers and barriers in the last-mile delivery for e-grocery

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Abstract: In the recent years, e-grocery has been growing globally, accordingly raising logistics challenges. Among them, last-mile delivery is one of the most impactful activities in the online order fulfilment from both an economic and environmental perspective dealing with small orders and dispersed destinations (at final consumers' homes).In this context, horizontal collaboration (i.e. collaboration between companies at the same level of the supply chain, for example for resource sharing) is a chance to increase efficiency and reduce the environmental impact of last-mile logistics. In line with the call made by scholars for further investigations of logistics innovations from a network perspective, the objective of this study is to identify success and failure factors to the implementation of horizontal collaboration for e-grocery, considering the perspective of different stakeholders. A multiple exploratory case study has been developed: data is collected combining secondary sources, face to face interviews and phone interviews with retailers and logistics operators, to guarantee triangulation. Interviewees highlighted potential benefits, including efficient routing and increasing vehicle saturation; however, to successfully implement a collaborative approach there is the need to overcome existing barriers, for example strong competition among retailers. Building on existing literature, this work discusses factors affecting collaboration, and classifies them as supply chain related or market related ones. This study offers insights to both academics and practitioners. On the academic side, it develops a structured classification of enablers and barriers to horizontal collaboration for e-grocery. On the managerial side, it provides a thorough analysis from the perspective of different actors suggesting directions for innovative collaborative solutions to achieve economic and environmental sustainability for the whole network.

Keywords: E-grocery, Collaboration, Last-mile delivery, Home delivery

1.Introduction

The recent growth of e-grocery has led to an increase of logistics complexities. Among all logistics activities, last-mile delivery - which is defined as the *last-stretch* of order fulfilment aimed at delivering products to final consumers (Lim, Jin and Srai, 2018) - in some cases represents half of total logistics costs (Vanelslander, Deketele and Van Hove, 2013). In addition to this, last-mile delivery is usually associated with logistics and demand side challenges. Logistics challenges include, for example, estimation of intangible transactions, small order dimension, dispersion of destinations and environmental impact (Mangiaracina *et al.*, 2019). Demand side challenges are related to high service level, diversification of priorities, and consumers' unwillingness to pay for logistics services (Osservatorio eCommerce B2C, 2021). As a consequence, last-mile delivery is considered one of the supply chain stages with the highest economic and environmental impact (Nogueira, de Assis Rangel and Shimoda, 2021).

Furthermore, e-grocery is the configuration of food & grocery e-commerce dealing with grocery products intended as an alternative to shop at the supermarket (Seghezzi, Mangiaracina and Tumino, 2022). E-grocery is generally aasociated with further logistics challenges due to product peculiarities, specific storage and transport requirements and order complexity (high number of lines per order) (Fernie, Sparks and McKinnon, 2010; Seghezzi, Mangiaracina and Tumino, 2022), thus raising the urgency of academics and practitioners to identify innovative solutions.

Although previous studies have highlighted horizontal collaboration as an opportunity to reduce economic and environmental impact for e-grocery (Argyropoulou *et al.*, 2023), there is limited research about collaboration for last-mile delivery in this field (Hingley *et al.*, 2011). The present work aims at investigating enablers and barriers to horizontal collaboration for last mile delivery for e-grocery. In order to achieve this goal, we conducted a multiple exploratory case study to identify factors affecting path towards horizontal collaboration, and how these factors can be categorized.

The following sections are structured as follows. Section 2 is dedicated to the literature review, highlights the main gaps and introduces the research question; Section 3 describes the methodology; Section 4 is dedicated to the findings of this study, and highlights the five categories of factors affecting collaboration for last-mile delivery; finally, section 5 presents the conclusions of this work with potential direction for future research.

2. Literature review

Previous studies have addressed the challenges of last-mile delivery presenting possible approaches including optimization models, routing algorithms, innovative technologies (parcel lockers, Refrigerated Ground Vehicle, electric vehicles…). In addition to this, there are studies addressing environmental sustainability, collaborative approaches and city planning (Montuori, Tumino and Seghezzi, 2023). However, there is the need for further investigation of sustainable urban logistics solutions in relationship with their supply chains or networks (Morana, Gonzalez-Feliu and Semet, 2014; McKinnon, Browne and M. Piecyk, 2015; Altuntaş Vural and Aktepe, 2022). In particular, horizontal collaboration for e-grocery deserves further investigation (Hingley *et al.*, 2011)

Collaboration is defined as a relationship between different firms (Kaufman, Wood and Theyel, 2000). Collaborative approaches can be divided based on the type of relationship (relational exchanges; transactional exchanges) and on the actors involved (vertical and horizontal collaboration). Vertical collaboration takes place between suppliers, intermediaries and retailers (Hingley *et al.*, 2011); horizontal collaboration takes place between *unrelated or competing firms at the same level of the supply chain* which decide to share resources (e.g. storage or manufacturing capacity) (Hingley *et al.*, 2011). Previous studies highlighted that collaboration may apply to different activities including packaging standards, return channels (Bengtsson and Kock, 2000; Fernie and Hart, 2001), and information sharing (Kotzab and Teller, 2003) eventually supported by digital technologies such as RFID (Angeles, 2004; Hingley, Taylor and Ellis, 2007; Pramatari, 2007). Other collaborative approaches are related to transport planning (Sprenger and Mönch, 2014), warehouse (or dark store) sharing (Boyer, Prud'homme and Chung, 2009; Mangiaracina R etal., 2018). Finally, scholars have investigated internet-based tracking systems, shared pallet networks, distribution hubs (Mason, Lalwani and Boughton, 2007), common use of standardised replenishment trays and roll cages (Hingley *et al.*, 2011).

While vertical collaboration has reached a more mature stadium among firms, the fear to lose competitive advantage hinders the success of horizontal collaboration (Hingley *et al.*, 2011). As a result, it has mainly been implemented to handle with external pressures. However, some studies highlight that collaboration can contribute to reduce economic and environmental costs (Argyropoulou *et al.*, 2023). Aktas, Bourlakis and Zissis (2021) assessed the advantages of horizontal collaboration with a quantitative approach. Their simulation model shows route optimization, distance reduction and increasing vehicle saturation rising from collaborative last-mile delivery operations in UK. By contrast, Hingley et al. (2011) adopted a qualitative approach developing a case study to investigate the role of 4PL for horizontal collaboration.

To the best of the author knowledge, there is limited research on horizontal collaboration in Italian e-grocery market where penetration rate is 2.5% (Osservatorio eCommerce B2C, 2023) thus showing a lower maturity if compared to UK e-grocery market which is expected to reach a penetration rate equal to 15,8% in 2024 (eMarketer, no date). As a consequence, current volumes do not allow

yet optimization of retailers' operational activities (i.e. storage, picking, transport) thus raising the need for further investigation of collaborative approaches to exploit economies of scale.

Considering the potential of collaborative last-mile delivery and the lack of research on this topic, this work aims at investigating enablers and barriers to horizontal collaboration in e-grocery last-mile delivery. These objectives may be summarized in the following research question (associated with some related instrumental questions/sub-questions, reported in italics).

Why do companies are/are not willing to implement horizontal collaboration for last-mile delivery for e-grocery? (What are the barriers to horizontal collaboration? What are the enablers?)

In order to answer this research question, we developed a multiple exploratory case study involving three types of stakeholders: a logistics operator, a supermarket chain and a small food retailer. The selection of these actors arises from the structure of agri-food supply chain. Figure 1, shows the hourglass shape (Borsellino et al., 2020) resulting from the different concentration of players in the stages of the supply chain. At the extremes, there are the huge number of small farmers (on the left), and the wide market served (on the right). By contrast, few manufacturers and various distributors hold central positions. This configuration suggests that due to the different concentration of markets, the power to affect others' decisions is not evenly distributed and actors with a central position have a stronger influence (Macfadyen et al., 2015).

In this context, retailers and service providers play a key role because their position enables them to have visibility on both sides of the supply chain and the power to influence both producers and customers (Macfadyen et al., 2015) to create value for the whole ecosystem. Consequently, this work has been conducted involving food retailers and logistics operators in order to identify enablers and barriers to horizontal collaboration from their perspective.
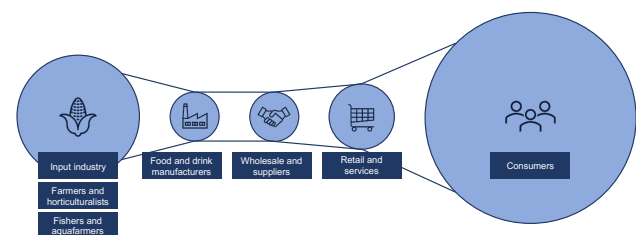

Figure 1: Figure 1: Agri-food supply chain; adapted from (Borsellino, Schimmenti and El Bilali, 2020)

3. Methodology

Considering the complexity of last-mile delivery for e-grocery, the methodology selected is a multiple explorative case study to collect rich data (Eisenhardt, 1989; Lindgreen, 2008), given the multitude of variables (Yin, 1994; Matthyssens and Vandenbempt, 2003) affecting the last-mile delivery problem.

For this purpose, we used semi-structured interviews starting from a guide and then adding further questions

following relevant lines of enquiry. As a result, we were sure to address the main topics while having the possibility to discuss more in detail some aspects.

Each interviewee has been contacted twice. Firstly, we performed the interview following the structure illustrated in paragraph 3.2. Then, brief phone calls have been organized with each interviewee for validating the outcomes. The following sub-sections are dedicated to the detailed description of the methodology adopted.

3.1 Sampling

In order to answer the research questions, the sample is composed by different players in the e-grocery supply chain. Considering the hourglass shape of the supply chain(Macfadyen *et al.*, 2015) , "Retailers and services" play a critical role due to their central position.

For these reasons and to guarantee heterogeneity of the sample, we involved a logistics operator, a supermarket chain and small food retailer. As a consequence, although the number of interviewees is limited, we consider the sample representative of grocery market where minimarkets and supermarkets represent 77% of the points of sales in Italy (ECR, 2020).

For confidentiality reasons, hereafter the interviewee will be addressed as Company A (the supermarket chain), B (the small food retailer) and C (the logistics operator), as described in table 1.

Table 1: Sample details

	A	B	C
Core business	Supermarke t chain	Food retailer	Logistics operator
Size (adapted from European Commission, 2003)	Large	Micro	Medium
Number of employees	>5,000	<10	>500
Geographi cal area	Italy-North-East	Local (Lombardy)	Italy-North
Interviewe e -years of experience	Manager - 40 years	Store manager – 20 years	Manager – 30 years

3.2 Data collection

The case study database is the result of the combination of official and internal documents, face to face and phone interviews (triangulation) maintaining a chain of events. The interviews have been performed as semi-structured interviews to collect additional information which may be relevant for the specific case. The unit of analysis is the organization since the scope of this work is the identification of enablers and barriers to collaboration for last-mile logistics from the perspective of each actor.

As a consequence, we dedicated the first part of each interview to collect data about the last-mile delivery services that they are currently offering. This mainly concerns the activities that the organization performs (i.e. handling, storage, distribution, etc), the typologies of services available for online orders (home delivery, click and collect, click and drive etc) and the characteristics of the served area. The second section of the interview focuses on the organization's distribution problem of e-grocery. Here, we investigated the main elements of the distribution problem: points of origin, product characteristics, points of destination and service level (Mangiaracina, Song and Perego, 2015). The third section addresses the current logistics solution collecting information about the vehicles, their average saturation and it ends with a question which anticipate the final section: "Are there services that you are not offering because it is not economically sustainable but that you consider offering (or your customers may desire)?" The fourth section addresses the core of the interview: collaboration. It is aimed at identifying barriers and enablers to collaboration and it is divided into three main sub-sections. Firstly, interviewees were asked to list enablers of horizontal collaboration; secondly, they were invited to provide barriers to the path towards horizontal collaboration. Thirdly, they were provided a list of five KPIs measuring customer service and they were asked to rank these KPIs according to their customers' priorities. The interviews were conducted independently from each other, and each interviewee was not aware of the others' responses. Finally, data collected with face-to-face and phone interviews have been integrated with secondary sources which contributed to appropriately interpret transcripts.

3.3 Data analysis

The first step of data analysis has been the transcription of the interviews. After that, coding has been performed with in vivo codes. We selected the inductive approach because it is aligned with the exploratory purpose of the research: we want to investigate how different stakeholders perceive collaboration for last-mile delivery. The coding process enabled the identification of codes for enablers and barriers to horizontal collaboration, then codes were grouped in categories. Cross-case analysis which is the core of the research (Yin, 1994), enabled the identification of which categories of factors are mainly considered as enablers and which of them are mainly perceived as barriers to collaboration.

We integrated empirical data with theoretical categories to propose a classification of enablers and barriers to collaboration for last-mile delivery for e-grocery.

The internal validity of this work is guaranteed by data triangulation, the collaboration of multiple researchers in setting the study and outcomes sharing with interviewee for validation.
For the external perspective, transferability arises from the use of a clear context description, transparent methodology and the use of semi-structured interviews. Detailed

information about the sample and the context is provided, explaining their core business and their current practices for e-commerce. In addition to this, in order to guarantee dependability of this study, we accurately selected the sample, involving heterogeneous firms in terms of supply chain role (logistics operator, specialized food producer and retailer, supermarket chain) and in terms of dimensions. As a result, we selected a representative sample considering the heterogeneity of the market and theoretical structure of food supply chain (Borsellino, Schimmenti and El Bilali, 2020). Nevertheless, we respected interviewees' confidentiality avoiding mentioning the name of their firms and critical data.

Finally, objectivity arises from the meticulous methodology (transcription, analysis of transcript, coding of single interviews followed by cross-case analysis and identification of categories). Two researchers defined the structure of the interview, then the same researcher performed all the interviews and accurately noted all observations, thus guaranteeing coherence of data collection. Then, both researchers contributed to data analysis.
In conclusion we employed the four criteria (internal validity, external validity, dependability, and objectivity) of trustworthiness proposed by Guba (Guba, 1981).

4. Findings

By interviewing experts in the field, we were able to identify the following five categories of factors affecting the success or failure of collaboration in this context: efficiency-related factors, effectiveness-related factors, environmental sustainability, strategy-related factors and product related factors. Finally, interviewees propose some actions to mitigate barriers. We performed the analysis of collaboration enablers and barriers in two steps: firstly, we conducted the within case analysis to identify enablers and barriers mentioned by each interviewee. Then we performed the cross-case analysis, to systematise the five categories described in the following paragraphs and to allocate each factor (both enablers and barriers) to the proper category. As a result, by counting the number of enablers and barriers belonging to each category, we were able to identify which categories are mainly considered as enablers/barriers towards collaboration.

4.1 Efficiency related factors

Efficiency is generally used (together with effectiveness and environmental impact) by academics to study last-mile delivery (Mangiaracina et al., 2019). We included in this cluster all those factors referring to costs, including, for example, space utilization, routing optimization, handling and transport costs, vehicle saturation and manpower. In particular, all the firms mentioned routing optimization and, saturation as enablers towards collaborative approaches.

4.2 Effectiveness-related factors

As efficiency, effectiveness is one of the three criteria to assess last-mile delivery (Mangiaracina et al., 2019). This category includes factors such as service level and punctuality, brand awareness, customers' priorities. Most of

these factors have been mentioned as barriers to collaboration for last-mile delivery. From a theoretical perspective, this happens for two main reasons. Firstly, last-mile delivery is the "last stretch" of order fulfilment (Lin, Li and Guo, 2021) reaching final consumer. For this reason this activity enables players to have visibility on consumers' needs. Secondly, while there is general agreement about efficiency and cost reduction, effectiveness arises from service level (Mangiaracina et al., 2019) which is strongly dependent from target customers. As a consequence, firms tend to focus on their target customers' priorities. Last-mile delivery collaboration between different companies would require the complex capability to fulfil different service level simultaneously.

4.3 Environmental sustainability

This category groups all factors which relates to environmental impact. This choice, as the previous two categories, is aligned with the three dimensions which are generally used to study last-mile delivery: efficiency effectiveness and environmental impact (Mangiaracina et al., 2019; McKinsey & Company, 2023).

From practitioners' perspective, according to a survey conducted by McKinsey(McKinsey & Company, 2023) more than 50% of the firms in the retail industry consider sustainability as a factor promoting growth. With respect to this, collaboration is an opportunity to achieve environmental sustainability: previous stydies highlighted that it enables routing optimization and improves vehicle saturation thus reducing both economic and environmental costs (e.g. emission reduction) while improving customers' service level (e.g. timeliness)(Argyropoulou et al., 2023). As a result, factors related to environmental sustainability have been mentioned buy interviewee as strong motivations (enablers) towards collaboration

4.4 Strategy-related factors

These factors refer to competitive advantage and long-term strategy. Interviewee associated to this category varibales such as geographical coverage, geographical competitive advantage, product strategies, capillarity of the network.

It's worth noticing that 50% of the barriers mentioned by Company A belongs to this category, thus suggesting that implementing collaboration in a market where internal rivalry is high requires appropriate countermeasures to protect firm's competitive advantage.

4.5 Product-related factors

Product features may represent a barrier for collaborative logistics if the retailers sell heterogeneous of products categories with specific storage and transport conditions. In this study, Company B highlighted that they mainly sell very fresh products and this causes time restriction in case of delivery to pick-up and drop-off.

The cross-case analysis identified provides a longitudinal perspective on potential criticalities. Figure 2 shows that 60% of enablers belong to the category of efficiency-related factors. The remaining 40% is evenly distributed among effectiveness related factors, environmental sustainability and strategy related factors. As previously discussed,

product-related factors may hinder the success of collaboration due to specific requirements in terms of transport and storage conditions. Nevertheless, more than half of the barriers mentioned by the interviewee belong to effectiveness-related factors and 20% are strategy-related factors.
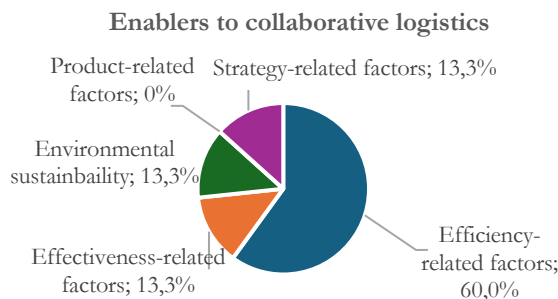
Enablers to collaborative logistics

Figure 2: Pie chart: distribution of enablers across categories. Source: Own elaboration

In Figure 3, 60% of the pie chart is covered by effectiveness-related factors, thus creating a connection between the decision to collaborate and the trade-off efficiency/effectiveness. On one side, customers' expectations (effectiveness) are increasing, and their fulfilment is a necessary condition to compete in the market (Mangiaracina *et al.*, 2019). On the other side, supply chain actors need to increase efficiency in order to achieve economic sustainability.

Strategy-related factors mainly appeared in the interviews with company A and C, which operate in a competitive environment, while company B does not perceive this as a problem, since it has distinctive products and competes in a less concentrated market.
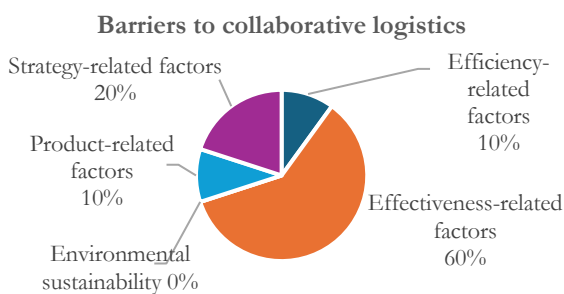
Barriers to collaborative logistics

Figure 3:Pie chart: distribution of barriers across categories. Source: Own elaboration

The interviews also allowed the identification of actions to mitigate barriers to collaborative last-mile logistics.

Firstly, to address effectiveness-related factors (which are most cited as barriers) some interviewees suggest working on customer involvement. Raising customers' awareness about logistics costs and environmental impact may result in shifting their priorities eventually choosing less impactful solutions even if this would require acceptance of longer

order cycle time or trust towards multiple brand collaborating.

With respect to this, company A and B were asked to put in order of priority the following five service level KPIs according to their customers' preferences. In order to maintain comparable results, we gave to each informant the same list of five KPIs, asking them to put them in order from the highest to the lowest priority. They answered this questions independently, and the outcome has been reported in table 2. It is noteworthy that both interviewees put the items exactly in the same order. They both consider costs as a priority for their target, followed by delivery service quality intended the customer experience during the delivery (e.g. support offered by the driver, integrity of the goods) The two KPIs related to time (i.e. punctuality and time slot availability) were positioned at the same level (3). Finally, they don't expect customers to prioritize the brand visibility on the delivery vehicle. Company B motivated this choice by stating: "Our customers buy from our shop because they trust our products". Company A raised an interesting point about city logistics "I think that in big cities like Milan, consumers are more likely to see the brand on driver's clothes when he enters the building rather than the brand on the vehicle in the street".

Table 2: Customers' priorities, KPI ranking. *Source: Interviews with Company A and B*

Customer's priorities	Company A	Company B
Timeliness (punctuality)	3	3
Time slot availability	3	3
Costs	1	1
Retailer's brand visibility on the vehicle	4	4
Delivery service quality	2	2

Another field work on is protecting retailers from undesired data sharing. Possible solutions include an integrated management system or a third party responsible for integration in order to protect sensitive data (Hingley *et al.*, 2011).

Finally, there is general agreement on the role of technology for successful collaboration in a complex environment as e-grocery supply chain. The IT system is necessary to integrate heterogeneous data from each player and to enable smaller firms to standardize data storage and efficiently update deliver data.

5. Conclusions

Last-mile delivery for e-grocery has raised logistics challenges for supply chain players. On the other side, increasing customers' expectations have raised the pressure on the whole supply chain, which results in an increased search for efficiency and long-term economic sustainability. Among multiple approaches to last-mile delivery, collaboration has emerged as a potential solution reducing

both economic and environmental costs. While there is general agreement on the positive impact of vertical collaboration on process efficiency, there is limited research on horizontal collaboration. As highlighted by recent studies, retailers usually prioritize competitive factors being open to collaborative solutions only in case of external forces beyond their control.

The aim of this work is the identification and classification of enablers and barriers to collaborative last-mile delivery for e-grocery. In order to achieve this objective, we performed a multiple explorative case study with semi-structured interviews aimed at collecting information from three different perspectives: logistics operators, supermarket chains and small food retailers.

This study highlighted five main categories of factors affecting the success of horizontal collaboration for last-mile logistics: efficiency-related factors, effectiveness-related factors, environmental sustainability, strategy-related factors and product-related factors. The cross-case analysis highlighted that most of the enablers mentioned by the interviewees belong to the category of efficiency-related factors, while effectiveness-related factors are more frequently associated with barriers hindering collaborative solutions. In order to anticipate negative impact on customers' perception, which would impact effectiveness, increasing awareness about the benefits of collaborative logistics and involving them in the process may have positive outcomes. Furthermore, some of the interviewee suggested the importance of identifying an actor playing the role of coordinator and integrator, as well as of appropriate IT systems.

From a practitioners' perspective, this study provides a structured classification of factors influencing horizontal collaboration, thus supporting decision making towards innovative logistics solutions.

Although we carefully collected data from informants and accordingly adopted a structured methodology of analysis, there are some areas of improvement and further research that future studies may address.

Firstly, though accurately selected, the sample is limited; future studies could involve additional stakeholders operating in each of the three supply chain roles of the informants. This further step could be an opportunity to investigate the weight of the variables within each category from the perspective of the interviewee

Secondly, further analysis of the identified factors and categories could lead to a framework assessing the enablers and barriers to horizontal collaboration with a structured methodology thus supporting decision making on whether to collaborate, as well as the most promising type of collaboration for the involved actors.

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Appendix A: Five categories of factors affecting horizontal collaboration.

	Company A		Company B		Company C	
	Enablers	Barriers	Enablers	Barriers	Enablers	Barriers
Efficiency-related factors	Capacity saturation; Costs reduction; Routing optimization		Cost reduction (handling); Cost reduction (transport); Capacity saturation; Vehicles saturation; Unfulfilled demand due to logistics costs	Manual update of price lists for e-consumers	Capacity saturation; Routing optimization	
Effectiveness-related factors		Impact on service level; Brand awareness; Delivery prioritization criteria (service level)	Increasing flexibility (e.g. reaching pick-up and drop off points); "Brand visibility is not a priority for our customers"	Firm's interest for brand visibility		Impact on punctuality; Retailer's brand visibility
Environmental sustainability	Environmental impact					Economic sustainability of environmental solutions (due to volumes aggregation)
Strategy-related factors	Geographical coverage	Lower competitive advantage from a geographical perspective; Strategic role of products; Information sharing.			Capillarity of the network	
Product-related factors				Fresh products storage and transport conditions.		