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Abstract title: **"Last Mile Logistics Evaluation - Customer, Industrial and Institutional Perspectives"**

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Abstract

This research focuses on the development of a 'Last Mile' Logistics evaluation, capturing the perspectives of the key stakeholders involved, e.g. the final customer, parcel delivery organizations and the public sector, to enable improved service provision.

Introduction

Direct-to-consumer business delivery has risen exponentially during the last decade (BOYER *ET AL.* 2009, p. 185). This rapid development has highlighted many challenges and problems within the logistics system and the subsequent need for optimization. The multiple stakeholders involved in e-tailing, conventional retail, parcel delivery and transport systems within a particular geography is complex, with opportunities for data sharing and systems integration. At present, UK logistics providers report that 30% of small packages dispatched to customer homes fail to be delivered first time, resulting in poor customer service and avoidable logistics inefficiencies (FERNIE AND MCKINNON, 2004). This, in turn, results in larger numbers of delivery runs, which exacerbates urban congestion, pollution and accident levels. From the perspective of the consumer, lack of visibility on deliveries is a significant source of dissatisfaction. At present a significant number of consumers are deterred from utilizing the full potential of internet-based shopping solutions due to the issue of failed deliveries. For logistics providers, these non-value adding process steps have financial impact and result in knock-on scheduling delays. For the logistics industry as a whole, the lack of an integrated, collaborative network results in a high level of inefficiency. For the general public, there are significant negative environmental and societal impacts caused by increased numbers of vehicles, which are often unsuitable for urban infrastructure. Institutional stakeholders (e.g. local and regional government) also have a critical role to play in the

design of the logistics systems, e.g. regulating, pricing and supporting freight transportation infrastructure. However, no generic approach or tool currently exists which captures all the main system characteristics, to evaluate 'last mile' solutions suitable to the requirements of their urban area and, therefore, may hinder a comprehensive evaluation.

This research focuses on the development of a 'Last Mile' Logistics evaluation, capturing the perspectives of the key stakeholders (customer, industrial and institutional) involved, in order to promote improved service provision.

Literature Review

This literature review summary examines the context of last mile logistics in order to explore (a) the actual driving forces in order to clarify challenges and requirements of the last mile logistics area of research and (b) to provide a general categorization of last mile logistics user groups within this research in order to inform a potential performance measurement system. A definition of last mile logistics is presented providing the basis for the development of the evaluation approach for 'last mile' solutions.

Definition of Last Mile Logistics

Despite limited literature reported in the area of "last mile logistics", this term is often used in related areas, such as the urban freight delivery, e-commerce, grocery delivery and the delivery part of the supply chain (BOYER *ET AL.* 2009). LINDNER (2011) analyzed the context of last mile logistics within these areas and developed the following definition:

"Last mile logistics is the last part of a delivery process. It involves a series of activities and processes that are necessary for the delivery process from the last transit point to the final drop point of the delivery chain."

A similar definition used by well-known logistics provider DHL INTERNATIONAL GMBH (2011) is very similar describing the last mile as the “last step” in the parcel delivery. However, these definitions are geographically insufficient, because they do not consider the whole urban area. The last ‘transit point’, for example, may be located within the urban area, which is often predefined by the institution. Therefore, the upstream logistics element to the transit point has to be included, in order to enable a comprehensive evaluation from an institutional perspective. The same may be applied to the ‘drop point’, due to the fact that the customer may use a vehicle for the pick-up of a delivery at the ‘drop point’. In this case the driven distance between the drop point and the final destination point also causes negative impacts to the urban area, which the institution tries to avoid. Therefore, the definition has to capture the whole urban area, which is predefined by the institution, including the upstream logistics to the transit point, the pick-up distance for the customer and the destination point. Furthermore, the existing definition does not capture the aim of last mile logistics. RUSSO AND COMI (2011) report that the urban transportation system is a complex system in which freight is moved on the same transportation system on which passengers travel with the aim of providing ‘homogeneous freight movements’. TANIGUCHI ET AL (2001) consider urban logistics as a process for totally optimizing the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy. However, this definition is too focused on special targets, such as congestion, safety, energy saving etc. and does not clearly define the specific geographical areas. Hence, a new definition of ‘last mile’ logistics is proposed as part of this research;

“Last mile logistics is the last part of a B2C delivery process. It takes place within a predefined delivery area (e.g. urban area); including the upstream logistics to the last transit point until the destination point of the parcel. It involves a series of activities and processes, of critical value to all the involved stakeholders (e.g. Customer, Industry and Institution) within the delivery area”

This definition also better reflects the three layer model previously developed (LINDNER, 2011) to capture network configuration for B2C Service provision (see *figure 1*) which can be used to summarize the key elements of the B2C delivery network from the three disparate views of the primary stakeholders, namely the customer/consumer, the industrial practitioner and the institutional actor. In particular, it can capture “*series of activities and processes, of critical value*”, e.g. the network unit operations; the configuration of the operations within each layer; the service capabilities; the flow of materials and information within and between layers; the interfaces between the key stakeholders.

‘Last Mile’ Stakeholder Identification, Requirements, Objectives and Interests

This research focuses on the identification of requirements, objectives and interests for the main stakeholders within the last mile logistics system. This enables definition of the different roles, inter-relationships and governance models within the system in order to inform an effective last mile logistics evaluation.

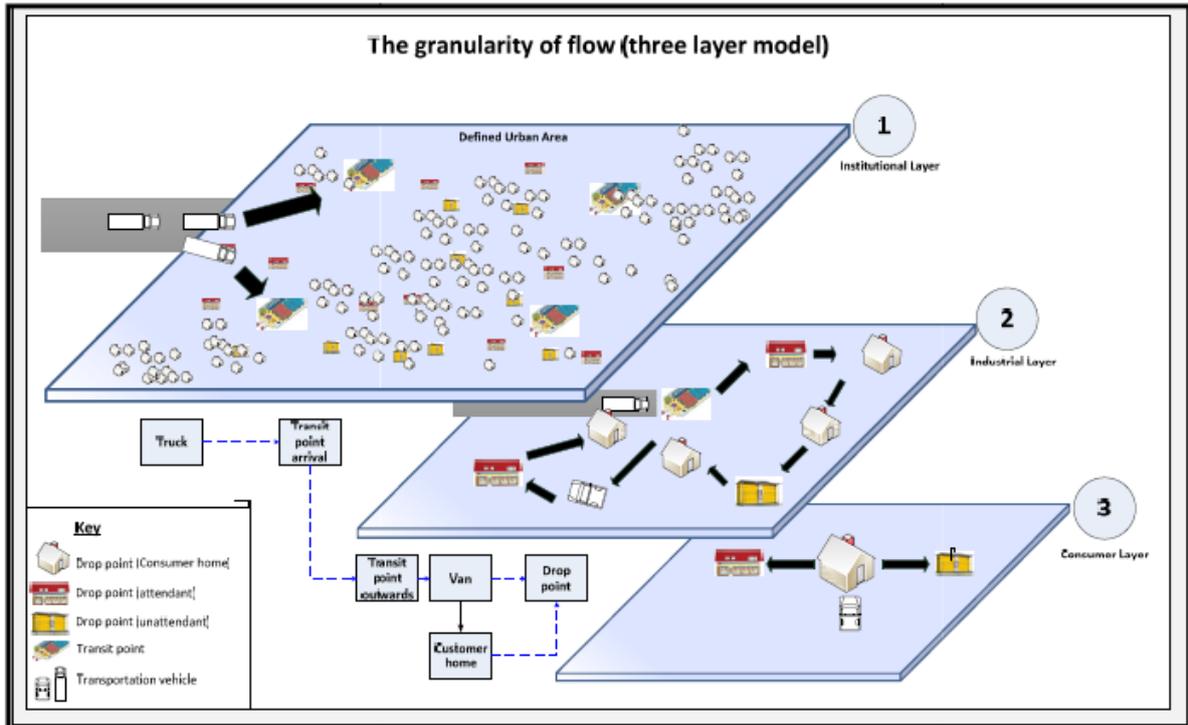


Figure 1. Network Configuration for B2C Service provision

There are several stakeholders associated with urban freight delivery. However, in order to reduce evaluation complexity and provide clarity, it is necessary to identify only the main stakeholders and their interests. TANIGUCHI ET AL (2001) identify the following four categories of key stakeholders involved in urban freight transport:

- *Shippers* (manufactures, wholesalers and retailers)
- *Freight carriers* (transporters, warehouse, and companies)
- *Consumers* (usually residents)
- *Administrators* (national, state and city level)

RUSSO AND COMI (2011) in turn reduce these four stakeholder categories to three, i.e.

- *End-consumers*; including the inhabitants (residents, business people, or employees), whose main interest is minimum hindrance caused by the goods transportation

- *Transportation operators*; whose main interest is the lowest cost delivery while meeting the customer needs (such as high quality and short lead time)
- *Public administration*; including the local government, whose aim is to provide an attractive urban area. Within the context of this research e.g. the provision of an effective and efficient transportation operation and focus on the minimization of the external effects of transportation and the maximization of the net economic benefits.

The three stakeholder categorization is also proposed for this research, because ‘shippers’ and the ‘freight couriers’ are both industrial entities which may have similar objectives, e.g. *low cost while meeting the customer needs*. Therefore, the three main stakeholders are defined as:

- *Industrial Stakeholder*
- *Customer*
- *Institution*

Two type of relationship between stakeholders in a last mile logistics system are *cooperation* and *competition*. *Cooperation* is usually achieved when two parties have the same objectives or interests and make an agreement, which provides a win-win situation. The cooperation between freight carriers are often fixed in the design stage, in the form of e.g. an open consolidation centre. Through common usage, the existing capacity can be used and shared more efficiently. Public-private partnerships are examples where private goals and public interests may be mitigated. *Competition* usually exists between different freight carriers, within the urban area. They offer different customized services to attract and retain customers. The relationship tendency within urban logistics is cooperation. This is promoted by the administration in the form of regulations, equipment restrictions and incentives (MUÑUZURI ET AL. 2005; RUSSO AND COMI 2011). The other form of relationship between

stakeholders is defined through their interests in the last mile logistics system, which can be predefined as *common interests*, *trade-offs* or *independent*. The first two types, i.e. common interests and trade-offs define the relationship between the stakeholders. For instance, a higher load factor may cause, as a consequence, a reduction in the satisfaction level of the customer (in terms of time), but a decrease of operational costs and a reduction of pollutants. Hence, there is a trade-off between the customer and the other stakeholders, while the interests of the industry and institution may be common. *Figure 2* summaries this *competition*, *cooperation*, *trade-offs* and *common elements* relationship and is used to inform an effective evaluation depending on the type of relationship between the affected parties.

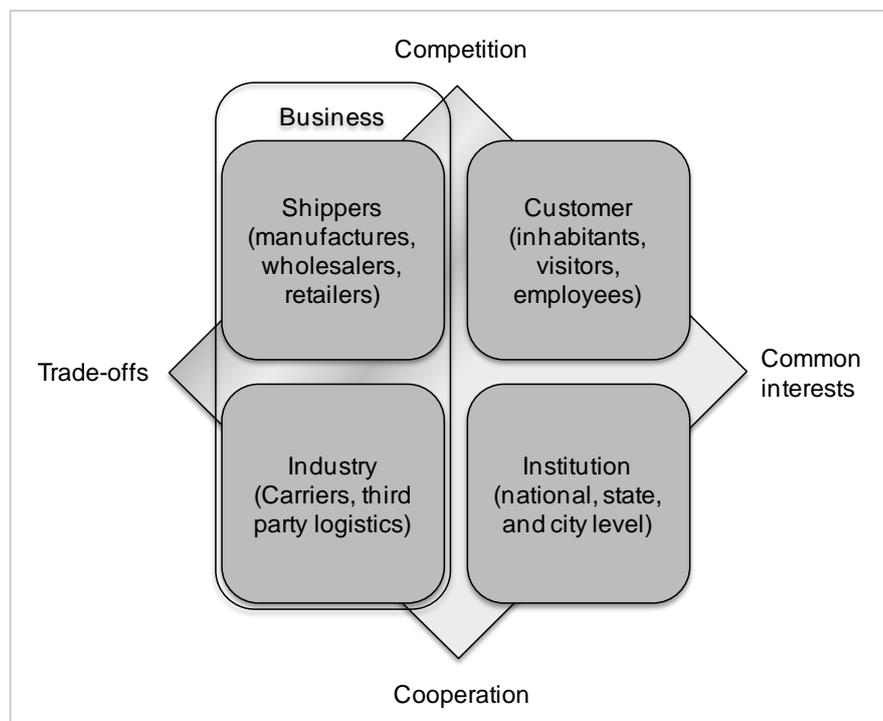


Figure 2: Stakeholders of the last mile logistics system

Industrial stakeholder

The ‘industrial stakeholder’ is the service provider within the urban area, which includes the delivery entering the predefined urban area up to the drop point and the provision of additional services, such as assembly, installation etc. Therefore, it is the last link between the

customer and the goods seller. The used assets for providing the services are owned by the involved service operators, such as couriers, express deliveries and parcel forwarders. The main task of the industrial stakeholder is to leverage its assets to satisfy the customer, while adhering to the regulations within the urban area.

FUGATE ET AL. (2010) consider logistics performance in three main dimensions: *efficiency*, *effectiveness* and *differentiation* and has verified a positive relationship. The two dimensions *efficiency* and *effectiveness* describe the performance of the logistical processes often expressed by *quality*, *cost* and *time* (ATKINSON 1999) due to ease of measurability. Differentiation includes the development and offer of services that are perceived as being unique and superior in some way (SWAMIDASS 2000). Within the literature, flexibility is largely discussed as an important enabler of customized delivery services (DUCLOS ET AL. 2003). The offered services and quality of these services are important evaluation criteria for the industrial stakeholder (in addition to being of interest to those of the customer). *Figure 3* summarizes the industrial stakeholder interests identified from the literature.

Customer

In terms of demand setting within the last mile system, the customer is one of the initiators and therefore a key stakeholder of the delivery task (the other is the shipper). Hence, customer satisfaction may be used as a measure of the range, quality and performance for the required delivery service.

Industrial interests	
Cost	High revenue
	Low current assets
	Low fix assets
	Low operational costs
Quality	Material flow
	Information flow
	Service
Time	Reduce time waste
Flexibility	Adaptable capacities
	Adaptable processes
Reliability	Reduce variations from quality targets

Figure 3. Industrial Stakeholder interests

In addition, another key feature to consider is the relationship between service characteristics and the value of the delivery goods (GEVAERS ET AL. 2010). *Low value* goods have a high affinity to service characteristics, such as “time window”, “frequency” and “usage of a delivery box”, but they do not require a “return option” or a “delivery with signature”; while *medium* and *high value* products have exactly the opposite needs. The indicators presented in *figure 4* summarize customer interests identified from the literature and are representative of the overall performance of the last mile delivery service, due to the fact that the customer is the last point within the delivery chain.

Institutional Stakeholder

The institutional stakeholder represents the interests of the community and is typically an administrative body (i.e. local, regional, national and international). Their task is to preserve and improve the social live and environment within their area of responsibility. In relation to last mile logistics, the main role of the administration is to control and reduce the negative

impacts of the freight transportation. STELLE (2006, P. 3), states in terms of the objective of an urban freight transportation system, from an institutional perspective:

“The safe, reliable and efficient movement of freight and servicing trips to, from, within and, where appropriate, through London to support London’s economy, in balance with the needs of other transport users, London’s environment and Londoners’ quality of life”.

Customers interests	
Tangibility	Service price
	Types, weight and size of delivery goods
	Lead time
	Delivery time window
	Delivery frequency
	Delivery destinations
	Pick up distance
	Costs for pick up
Reliability	Deliveries on time
	Damaged deliveries
	Lost deliveries
	Deliveries to the right drop point
	Waiting time for service respond
Responsiveness	Availability and friendliness of service point
	Availability of attendant delivery
	Range of services in terms of time and place
	Tracking of delivery good
	Availability of “green”, “express” or other special deliveries
	Availability of reverse logistics
Assurance	The competence of the employees
	Availability and type of insurance

Figure 4. Interests of Customer

Despite the variety in demographic and geographic factors as well as the infrastructure of urban areas, most of the challenges are common for the majority of cities, e.g. problems of accessibility, congestion, environment and safety are intensified through

urban freight movements, due to their significant contribution to the total traffic within the urban area (SONNTAG AND MEIMBRESSE 2008). MUÑUZURI ET AL (2005) and RUSSO AND COMI (2011) have reported studies on the main issues in European cities, the implementation of freight transportation policies and their results in relation to expected goals. The named goals represent the main problems within the urban area and can be categorized (see figure 5) using the STEEP (*social, technological, economic, ecological and political*) framework.

The *social* aspects contain transportation outputs, which have a direct impact on human health. Hence critical outputs, such as congestion and road accidents, which are caused by the number of operating vehicles, are important within this dimension.

The improvement of the used *technology* usually reduces the negative impacts of an operating system. The technology can be distinguished as hard- and software. In relation to hardware, the increase of low-emission vehicles is a main goal for the institutional stakeholder as is the utilization of up-to-date software, such as routing software.

A much discussed issue is the negative impact of transportation on the *environment*. Especially within urban areas is it very important to reduce effects as much as possible, due to the very high population density. Pollutants, such as greenhouse gas emissions and noise emissions are the most evident outputs. Their calculation depends highly on the length of the vehicle trip. Further indicators are the land use, recourse use etc.

The *economical* aspects are represented by the costs for the community, caused through the freight transportation. The removal of these factors is a common interest for the institutional stakeholder as well as for the industrial stakeholder. Strategies such as the reduction of the freight volume, travel time, load and unload time, stop time, interferences and the increasing of the revenue and speed improve not only the community costs but also the performance of the last mile logistics provider. Unitary cost factors are used to calculate

the community costs, multiplying them with the value of the negative environmental impacts, such as noise, congestion etc.

Political issues stress the responsible, cooperative and supportive behaviour of the freight forwarder to the institution. The industry does not only have to conform to the regulations, it is also challenged to better the norm (FROTA NETO ET AL. 2008) and take an active part in improving quality of life.

Institutional interests	
Social	Reduction of congestion
	Reduction of road accidents
	Reduction of operating vehicles
Technological	Increase low-emission vehicles
	Traffic network integration
	Routing software innovation
Environmental	Reduction of land use
	Reduction of resource use (fuel, water, other energy)
	Reduction of noise emission
	Reduction of pollutants
	Reduction trip length
Economical	Reduction freight volume
	Reduction load/unload time
	Reduction travel time
	Reduction of interferences
	Speed increasing
	Decreasing of own account/invest
	Increase revenue
Political	Responsible behaviour
	Creation of new employment opportunities
	Raise social live quality

Figure 5. Interests of the Institutional Stakeholder

Case Study Selection

The pilot case study approach used as part of this research involving the operation of a *Consumer Choice Portal and Package Consolidation Centre (PPCC)* involving a portal which enabled consumer choice in the delivery of packages to the home, supported by a packaging consolidation centre, located adjacent to a densely populated urban environment.

The consolidation centre concept empowers the consumer with respect to the delivery method in the 'last mile' of the package journey, and also enables supplies to be consolidated upstream and downstream of the centre. Failed deliveries significantly reduce the productivity of the logistics provider and increase congestion and pollution. Consumers are aware that deliveries to their home may fail repeatedly; however, no effective mechanisms exist to engage with the supply chain. Lack of integration means that many courier firms are engaged in multiple drops to the same urban area each day, with no value added to the consumer. The total UK postal services market was valued at £11bn in 2007/2008, including £4bn in courier and express delivery items, and £1.5bn in parcels. The UK delivery market currently exhibits a higher degree of fragmentation than those countries (e.g. Germany) who have adopted similar schemes.

The geographical area selected for the piloting of the PPCC was in the South-East of the UK, operating in the SS14 and SS15 postcodes, delivering to a potential customer base of approximately 50,000 households, reflecting a potential market size of ~250k packages. With 30% of deliveries missed first time, this translates to 600 parcels/day out of the 2,000 delivered daily in the specified geographical area.

The case study was also specifically chosen due to the novelty of the project in the web-based consumer portal enabling consumer choice integrated to a parcel consolidation and scheduling centre, and its ability to capture the perspectives of a series of key stakeholder

groups, e.g. final customers, parcel delivery organization and the local authority, within a collaborative supply network. In summary, the PPCC project involved:

- Development of a web-based portal that provides *consumer choice features* including *time* and *mode of delivery* (e.g. sustainable vehicle solutions) and *parcel traceability*
- *Local* urban consolidation centre providing *easy consumer access*, consolidation facilities for primary suppliers, efficient transfer to *last mile couriers* with *dynamic scheduling*, and *packaging recycling*

Stakeholder Identification

A semi-structured interview method was used in this study, based on stakeholder interests identified in the academic literature and summarized in figures 3-5. *Figure 6* summarizes the correspondents interviewed as part of this research. The interviewees and selection criteria are summarized as follows:

- The PPCC operating company represents the industrial perspective with respect to this study.
- *ECC* is the local authority responsible for the geographical area in which the PPCC operates. The mission of the ECC states a dedication ‘to improving the lives of our residents’ and an ambition ‘to deliver the best quality of life in Britain’ by ‘providing high-quality, targeted services that deliver real value for money’. ECC is an active supporter of the PPCC pilot study and represents the ‘institution’ within the scope of this research.

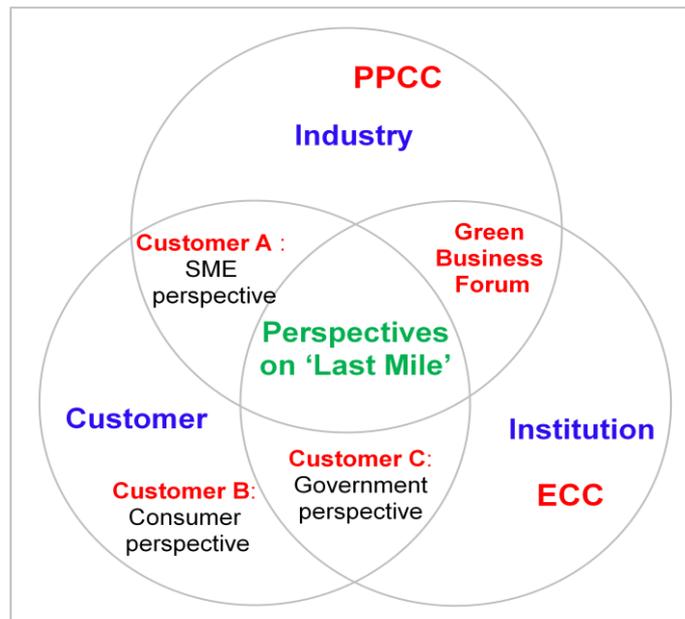


Figure 6. Case study interviewees and their relationship in terms of Customer, Industrial and Institution

- The *Green Business Forum* is a partnership between local businesses and the local authority within the geographical area of the pilot case study. The aims of the forum are to promote environmental awareness and best practice within the local business community with the aim of promoting e.g. improved efficiency, better environmental performance and subsequent cost savings. The *Green Business Forum* was chosen specifically to represent an industry-‘institution’ overlap within this research.
- Customer A had used the PPCC for some personal goods delivery but predominantly uses the ‘pick-up’ service in the context of his small-to-medium sized enterprise (SME) run from his home residence. Hence, customer A was chosen to represent the overlap of ‘customer-industry’ within this research.
- Customer B had used the PPCC exclusively for personal goods delivery and has used both the ‘delivery’ and ‘pick-up’ services of the PPCC. Hence, customer B was chosen to represent a typical customer-‘consumer’ within this research.

- Customer C had used the PPCC exclusively for personal goods delivery using the sustainable vehicle service due to a strong ‘green’ political affiliation. Hence, customer C was chosen to represent a customer-‘institution’ overlap within this research.

Summary of Results

Table 1 summarizes the outputs from the interviews conducted and captures the perspectives of the individual stakeholders involved, e.g. the customers (A, B, C), parcel delivery organization (PPCC) and the institutional actors (ECC, Green Business Forum) and their common areas of interests, in terms of STEEP, Cost, Quality, Time, Flexibility, Reliability and additional statements (e.g. convenience). A generic set of measures are suggested in order to capture these areas of interest and will inform the development of performance measures to support this evaluation approach for ‘last mile’ solutions as part of the next phase of this research.

In terms of the PPCC pilot, 99.99% of packages dispatched to customers were delivered first time within the November 2011-February 2012 timeframe.

Table 1. Summary of interview results capturing the perspectives of the individual stakeholders

Dimensions	Interviewees						Measures
	Customer SME	Customer Government	Customer Consumer	Industry	Green Business Forum	Institution	
S ocial		X		(scale) X	X	X	Reduce the negative aspects on infrastructure
		X		(scale) X	X	X	New service creation
		X		(scale) X	X	X	Improve the infrastructure
T echnological		X		X	X	X	Support innovation
		X		X		X	Use of new technology
E nvironmental		X	X	X	X	X	Reduction of emissions
		X		X		X	Optimize resource use
E conomical				X		X	Reduce the community costs
		X		X	X	X	Support local business and job opportunities
					X	X	Create new business opportunities
P olitical						X	Target fulfillment (in terms of social, technological, environmental and economical aspects)
		X		X	X	X	Green
	X	X	X	X		X	Improve the quality of life
				X		X	Reputation
C ost				X	X	X	Sustainable
	X	X	X	X	X	X	Focus on cost optimization
Q uality	X	X	X			X	Information
				X		X	Material flow
	X	X	X	X		X	Service - Customer satisfaction
T ime				X		X	Performance
F lexibility	X						Cost
	X	X	X	X			Time
		X		X			Destination
	X	X	X				Parcel size and weight
R eliability	X	X	X	X	X	X	Time
	X	X	X	X	X	X	Undamaged
A dditional	X	X	X	X			Convenience

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