Abstract: The world is experiencing the issues of negatives impacts of delivering and collection of goods in urban areas as urban freight distribution is rapidly increasing over the recent years. Although urban goods distribution is essentially contributed to the economic and social development, the seemingly unsustainable impacts of urban freight transport result in an extensive research for a more sustainable urban freight distribution strategy. Numerous innovative solutions have been proposed and implemented both successes and failures. The objective of the paper is to review the current measures or initiatives implemented in urban freight distribution. The major measures or initiatives implemented will be presented. The case study of urban freight distribution in the City of Adelaide, South Australia will be introduced with some preliminary observations. In conclusion, the lesson learned from previous studies and some successful factors that need to be taken into consideration for future implementation will be discussed.

Key Words: urban freight distribution, urban freight transport, logistics

1. INTRODUCTION

City centre is the hub of economic and social activities and majority of population also reside in the urban areas. The modern society could not survive without the massive flow of goods between and within cities. Urban areas greatly rely on freight facilities to import food, consumer goods and construction materials and to export the region’s products and necessary commodities within the region. An efficient and reliable freight transport distribution systems is required as it plays a significant role in the competitiveness of urban areas.

In recent years, the rapid growth of urban freight distribution has resulted in significant increase in freight transport volume. Urban freight transport account for a substantial share of traffic in urban areas as urban freight is mainly carried on trucks (Ogden, 1992). Although freight distribution essentially contributes to city’s economic and social development, it is a major
cause of congestion, traffic and environmental problems in the urban areas (Debauche, 2007, Finnegan et al., 2003). Moreover, the severe negative impacts of urban freight distribution such as emission pollution, noise, visual intrusion, safety, hindrance to pedestrians lead to reduction in the quality of life and attractiveness of city areas. Shop and businesses are less appealing and less competitive due to poor accessibility and environmental issues. The critical negative effects of urban freight transport together with increasing focus on sustainable development, led to extensive research and experiments aiming to search for measures to mitigate the problems.

This paper presents an overview of previous studies on urban freight distribution and the main measures or initiatives proposed or implemented. A few different measures and initiatives are discussed. Preliminary observations regarding the Adelaide case study and the proposed research method are presented. To conclude, the success factors to be considered in the implementation of urban freight distribution measures are discussed.

2. OVERVIEW OF URBAN FREIGHT DISTRIBUTION

2.1 Definitions

From literature reviewed, urban freight distribution has a few definitions depending largely on the scope and purpose of the study. Ogden (1992) broadly defined urban goods movement as ‘the movement of things (as distinct from people) to, from, within and through urban areas’. Organisation for Economic Co-operation and Development (OECD) working group (OECD, 2003) on urban freight logistics described urban goods transport as ‘the delivery of consumer goods (not only by retail, but also by other sectors such as manufacturing) in city and suburban areas, including the reverse flow of used goods in terms of clean waste’. While Allen et al. (2000) used a much detailed definition for urban freight transport that includes ‘(1) all types and sizes of goods vehicles and other motorized road vehicles used for goods collections and deliveries at premises in the urban areas, (2) all types of goods vehicles movements to and from urban premises including goods transfer between premises, ancillary goods deliveries to urban premises, money collections and deliveries, waste collection and home deliveries made from urban premises to customer, and (3) service vehicle trips and other vehicle trips for commercial purposes which are essential to the functioning of urban premises’.

The commonality of the definitions given in previous studies is that urban freight transport concerns the delivery and collection of goods by road transport in urban and suburban areas.

2.2 Development of Urban Freight Transport and Sustainability

The interest in urban freight transport has been inconsistent in the past. Urban freight transport received much attention in the 1970s and early 1980s, however there was little research in the late 1980s and early 1990s (Ogden, 1992). In the late 1990s, urban freight transport was recognized again as a crucial issue as there was an increasing concern on its social and environmental impacts that threaten the livability of the cities (Quak, 2008).

In Europe, with its characteristic of historical city centre and high density living areas, the issue of freight traffic has been dealt with as problem for a long time on all level of government and the European as a whole. There was a coordinated project COST321, by the European Cooperation in the Field of Scientific and Technical research, a 4 years project completed in 1998; the establishment of a thematic network Best Urban Freight Solutions (BESTUFS) by the European Commission in 2000 (Bestufs, 2007). Later in 2003, the OECD has published on urban freight transport, “Delivering the Goods -21st Century
Challenges to Urban Goods Transport” (OECD, 2003). Furthermore, there were the establishment of the urban goods movement special interest group at the World Conference on Transport Research Society and the founding of the Institute of City Logistics in 1999 (Quak, 2008).

In the past, freight transport has had an insignificant role in transport planning in most cities although freight transport operations represent a substantial proportion of pollution emissions. Most attention has been paid largely on passenger and public transport. A major reason is the complexity of urban freight transport operation itself that involves several stakeholders with different individual interests. Today, a wide range of developments in society influence urban freight transport (OECD, 2003). The move towards intellectual society together with the variations in demographic such as aging and individualization lead to changes in overall consumer behavior as a consequence increased numbers of shipments and deliveries. The increase in aging population will also create a challenge for the labor market in freight transport. At the same time, the development of urbanisation and growth in traffic movements lead to traffic congestion and environmental issue.

Urban freight distribution operation is mainly concerned with couriers and transport carriers using light commercial vehicles (LCVs) and medium sized trucks. The number of LCVs tends to increase due to increase in delivery and access restrictions for large trucks in urban area (OECD, 2003). For example, in Australia the LCVs have significantly grown 21.4 % from 1.95 million to 2.37 million, in the 5 years from 2004 to 2009 (Australian Bureau of Statistics, 2010b). Although freight transport operations in cities account for 10% to 18% of vehicles, it contributes 40% to air pollution and noise emissions (European Commission, 2006).

Urban freight flow can be classified according to operational characteristics into two main categories:

- The movement of goods into and out of urban areas which tend to be flow in large shipments, using specialised vehicles such as rail, heavy truck or ship. In addition, due to large shipment size specialised equipment may involve and require transport mode changes. Majority of these goods flow through terminal facilities;
- The distribution of goods within an urban area which is characterised by small shipments with variety of products. Hence, large number of freight vehicles is required to service the area.

The concept of sustainable development has become increasingly influential in urban freight policy consideration in recent years. A comprehensive definition of sustainable urban freight has been developed by Behrends et al. (2008) as follows:

A sustainable urban freight transport system should fulfill the following objectives:

- To ensure the accessibility offered by transport system to all categories of freight transport
- To reduce air pollution, green house gas emissions, waste and noise to levels without negatives impacts on the health of the citizens or nature;
- To improve resource and energy efficiency and cost effectiveness of transport of goods, taking into consideration the external costs;
- To contribute to the enhancement of the attractiveness and quality of the urban environment, by avoiding accidents, minimising the use of land, without compromising the mobility of citizens.
In addition, a key issue to implement an achievable sustainable strategy is determining the parameters of measurement which will result in more sustainable cities and urban freight transport system within that city (Anderson et al., 2005).

2.3 Issues Associated with Urban Freight Transport
There are several issues concerning the movement of goods within the urban areas. Accessibility problems occur due to insufficient urban freight transport infrastructure (such as loading and unloading areas), increasing access restriction and local government regulation such as time windows, environmental zones and congestion. Traffic congestion is becoming more of an issue in urban areas, partly because of increased freight traffic such as rising number of LCVs used for delivery and this is causing transport costs to increase. Higher energy consumption may also result from congestion. Freight transport, especially large diesel trucks significantly contribute to exhaust emission such as CO, CO₂, NOₓ, particulates, lead, PM₁₀, traffic noise, vibration and physical hindrance. The size and weight of freight vehicles also raises traffic safety concerns as freight vehicles, due to their greater mass, are likely to cause serious consequences when involved in accidents with passenger cars or pedestrians.

At the same time, freight transport operators are also confronted with great challenge including traffic congestion, traffic regulation and policy measures which affect the efficiency of operation (Allen et al., 2000). Businesses are highly competitive and attempt to increase the efficiency of goods distribution by lowering inventory and moving towards just-in-time delivery. Freight operators have to also adjust to changes in customer demand in order to provide just-in-time deliveries, reliability, frequency, speed, flexibility and capacity (Ogden, 1992). Furthermore, the negative impacts caused by urban distribution have become more critical with the growth in electronic-commerce, which has low density of customers with high geographic dispersion. Such a trend may generates an increase in distribution costs.

2.4 Stakeholders Involved in Urban Freight Distribution
During the movement of goods from origin to destination, there are different decision makers who decide how freight should be transported. Several stakeholders are involved directly or indirectly in urban freight transport with diverse perceptions, objectives, constraints, and options (Ogden, 1992). Besides Noortman (Ogden, 1992, p. 51) also pointed out that ‘the urban goods movement problem seems to be to find an acceptable balance between these conflicting interests’ thus it is crucial to attempt to understand these different views. According to Taniguchi et al. (2001) the stakeholders can be classified into four main groups with their own specific interests as in Figure 1.

![Figure 1 Major stakeholders in urban freight transport (modified: Taniguchi et al., 2001)](image-url)
Shippers are the customers of freight carriers who either send (receive) goods to (from) other companies or consumers. The shipper attempt to maximize levels of service, at the minimum total logistics costs. Freight carriers are interested in accessibility and strive to maximize profit by reducing costs related to pickup and delivery of goods to customers. However, freight transport companies are facing great challenge in their operation due to traffic congestion. Residents or end-consumers, whose main interest concern on timely delivery and availability of products but are not satisfied with large trucks delivering in the area. As a result, they are interested in minimizing negatives impacts cause by goods transport such as air pollution, noise, congestion and accidents in the urban areas. The administrator, especially local government concerns with attractiveness of the city for both residents and visitors while state and federal government interest in increase employment opportunities and economic development by promoting more efficient and reliable urban freight distribution systems. The government at all levels aims to improve traffic congestion, road safety and the environment within urban areas. In many cases, administrators also play a crucial role as a financial supporter to assist during the initial implementation stage or establishment of freight facilities. Therefore, administrators play the most important role to resolve the conflicts among other key stakeholders.

3. CURRENT INITIATIVES

As cities are suffering from the negative effects of urban freight transport, innovative solutions for better urban freight transport operation have been initiated. The purpose of these measures is to reduce the consequences given by the interactions between goods vehicles and other infrastructure users (Russo and Comi, 2010). The measures discussed hereafter are some of the approaches that have been initiated and implemented.

3.1 Time Windows
Time windows are one of the most common measure implemented in Europe. This measure fundamentally aims at avoiding the conflict of interests between different groups of stakeholders thus maintaining streets or areas free of freight traffic during particular times. Freight delivery vehicles are allowed to enter certain parts of the city during specific time periods (Munuzuri et al., 2005). However, this measure require a good surveillance system to prevent any possible violation (Russo and Comi, 2010). This measure has been implemented at the Rundle Mall Precinct, Adelaide which will be described in details in the next section.

3.2 Vehicle Weight and Size Regulations
Weight based on axle load and/or vehicle weight and size restrictions aims to limit the physical damage that freight vehicles cause on existing infrastructure. For instance, Antwerp and Brussels, Belgium, have banned trucks from some of their urban roads. Rome, Italy, has implemented Limited Traffic Zone in the inner city area which heavy vehicles (more than 3.5 tonnes) are permitted to access and park during 8 pm to 7 am window while light vehicles are permitted access and parking during 8 pm to 10 am and 2 pm to 4 pm. Milan and Brescia consider vehicle length (whether they are longer than 6 or 7 metres) and Piacenza consider width of 2.20 metres to enter into inner cities (Russo and Comi, 2010).

3.3 Night Time or Off Peak Delivery
Night delivery is a form of time window that could reduce the concentration of traffic during peak hour and lead to better utilization of infrastructure. However, the opposition for this measure is on the actual operation that could disturb the residents in city areas. As a result, the
development of quieter operation is required, including vehicles, loading and unloading operation. This solution may not be useful for small retailer as the staff has to present to receive the delivery thus increase in costs. Night time delivery was a trial measure implemented in the city of Dublin as well (Russo and Comi, 2010). In France, some cities have argued that truck and delivery noise impacts are too high and night time deliveries should be banned.

PIEK program in the Netherlands examined a range of technical modifications to delivery vehicles and related equipment to keep noise at an acceptable level (Finnegan et al., 2005). The solutions included modifications to vehicles greater than 7.5 tonnes to comply with low-noise standards. Onboard and external equipment were also modified while non-slamming doors and silent reverse and signaling systems were added to vehicles. Electric, hand-operated carts were suitable for the final distribution on pavements.

The investigation of stakeholders’ perceptions and challenges for off-peak delivery initiatives to congested areas in New York City (NYC) (Holguin-Veras et al., 2005) revealed a number of incentives and important factors for successful implementation; receivers’ willingness to take part in off-peak deliveries (after 7pm - 6am), carriers’ deliveries permit will offer an incentive for carriers to persuade receivers to participate, shippers that transport their own goods have high probability to carry out off-peak deliveries, tax incentives to receivers accepting off-peak deliveries would promote involvement; and large traffic generators that generally receive full truck loads of goods and have delivery facilities should become the foundation of off-peak deliveries to NYC.

3.4 Urban Consolidation Centre
Urban consolidation centre refers to the use of facility in which goods flows from outside the city are sorted and consolidated to bundle the inner city distribution. It is usually based on only one mode of transport (road transport) and aim to improve load factors of delivery vehicles since the facilities can be accessed by trucks and goods are then transferred to smaller vehicles for final delivery which now have to cover shorter distances. A well-known consolidation centre initiative is in Monaco which was started by the government in 1989 in combination with strict truck regulation and provision of considerable subsidies. This makes the results hardly transferable to other cities (Patier, 2006).

Another urban consolidation centre was established in 2001 with a significant initial subsidy, using electric vehicles to supply the historical city centre of La Rochelle, France. However, the issues of lack of enforcement for heavy goods vehicles to enter the city and limited capacity of electric vehicle resulted in more trips and increase in urban congestion. In addition, it is illegal to deny access for non-urban consolidation centre users as long as they satisfied the vehicle restrictions and time-windows. Later on, no one responded to the tendering for the urban consolidation centre management. These issues led to unsuccessful implementation (Patier, 2006).

Schoemaker’s study (cited in Van Rooijen and Quak, 2010) pointed out some failure factors for the project failed in Leiden, Germany. The issues include insufficient number of customers to reach the break even volume and parcel companies decided not to join the initiative, as they were not willing to collaborate with their competitors.

The concept of logistics terminals has also been proposed in Japan to reduce traffic congestion and improve environmental, energy and labor costs (Taniguchi et al., 1999). The model
developed was applied to an actual road network in Kyoto-Osaka areas to determine the optimal size and location of public logistics terminals. This network is planned for the year 2010 and 16 candidates for logistics terminal are specified along with several planned expressways. The advantages of using urban consolidation centre are the utilization of large truck for long haul and light commercial vehicles for city centre distribution, reduction in number of trucks especially in urban areas, freight transport costs, traffic congestion from both moving and parked trucks, reduce fuel consumption, lower level of emission and noise and less interference with pedestrian. In addition, Taniguchi et al.’ 1995 study (as cited in Taniguchi et al., 1999) concluded that truck traffic can be reduced by adopting cooperative freight transport systems.

Although urban consolidation centre offers several advantages, one of the main drawbacks of this measure is the introduction of a new transshipment in the logistics chain with additional costs and delays involved. However, an extensive use of these terminals might improve traffic and freight delivery in the city. The concept of public logistics terminals still needs more intensive investigation in several areas such as their function, size, location, management as well as the role of public sector.

3.5 Low Emission Vehicles and Alternative Fuels
This measure aims at maintaining the quality of life in urban areas. Regulations such as the European engine emission standards, Euro-4 and Euro-5, are a driving force for innovation in emission control for diesel engines. The implementation of these standards for heavy vehicles will have a significant impact on level of emissions (OECD, 2003). The use of electric vehicles and trucks on alternative fuels such as compressed natural gas (CNG), liquefied petroleum gas (LPG) has been assessed in different countries.

The use of electric vehicles as an alternative for city distribution has been evaluated in the Electric Vehicle City Distribution (ELCIDIS) project. The project tested different possibilities based on existing or new urban distribution systems in 6 European cities (Rotterdam, Stockholm, La Rochelle, Erlangen, Lombardia Region and Stavanger). In general, the purpose of the project was to prove the feasibility of electric vans and trucks for urban distribution, in combination with the use of urban distribution centre. The project succeeded in confirming the benefits of using electric vehicles for urban distribution concepts (Vermie, 2002).

3.6 Road Pricing Systems
This access charging for vehicles entering certain areas in a city is the most direct way of internalizing the external costs generated by traffic congestion (Munuzuri et al., 2005). This measure is mainly aimed at regulating passenger traffic. The key effect of this policy is the reduction of traffic volume entering congested areas of a city. However, this measure affects most of the stakeholders as it influence the cost of transport and therefore the cost of products. The congestion charging schemes in London and Stockholm are applied to both passenger and freight vehicles. In London, discounts are offered for residents and exemptions for certain vehicle using alternative fuels such as electric, CNG, LPG and hybrid (Russo and Comi, 2010).

3.7 Dedicated Space for Loading and Unloading
The reservation of curb side parking spaces to be used by delivery vehicles for loading or unloading freight in urban areas is widely implemented in most cities. However, the lack of space and the increased in urban deliveries make it desirable to find other spaces for delivery vehicle parking. The introduction of building regulations on the requirement for loading zones to be located inside the building can be used to re-organise such demand. In Rome, the
authorities are developing a new inner city plan and are considering the introduction of about 700 new areas for handling operations, all equipped by information and communication technology (ICT) to manage and control their usage. In addition in the city of Stuttgart, the MOSCA project use electronic management of loading/unloading zones (Russo and Comi, 2010).

### 3.8 Cooperative Delivery System

Cooperative freight transport system aims to increase vehicle load factors, reduce freight distribution costs and provide higher levels of service to their customers by joint service of several shippers or carriers.

In Germany, experiences in many cities with consolidated delivery called City-Logistik, a joint service by different transport companies for urban deliveries did not lead to successful implementation. Transport companies withdrew their participation in the projects mainly for commercial reasons but also because of lack of public policy support. On the other hand, in Monaco and the city of Fukuoka, Japan, cooperative delivery systems are operational with support from local authorities (OECD, 2003).

The experiment of cooperative delivery system inside a building has been attempted in Japan. The study reveals that the potential solution is to shorten the parking time of trucks by allocating two workers at the parking area in the building to support the driver by delivering the goods to the final recipients. This arrangement allows the driver to immediately continue to the next delivery destinations (Sinarimbo et al., 2007). The study also provides a guideline regarding what cooperative delivery system design is suitable depending on the building density of the central business district (CBD).

However, coordinated goods distribution systems have to be adjusted to the local context and user requirements (Ljungberg and Gebresenbet, 2004). Important areas for consideration are the implementation strategies and how to manage the sharing of initial and running costs as well as potential cost savings.

### 3.9 Technology

Measures related to information and communication technology (ICT) use may enhance the effectiveness and efficiency of logistics flows and also reduce negative externalities as well as improve enforcement efficiency and broadening scope of enforcement (Russo and Comi, 2010). Regarding urban freight transport, Intelligent Transport Systems (ITS) components could include Advance Traveller Information Systems (ATIS), Advanced Traffic Management Systems (ATMS) and Advanced Vehicles Control Systems (AVCS). These systems are considered to be part of an in-vehicle navigation system which uses advanced ICT to manage traffic, advice drivers and control vehicle flow. The use of ITS make it possible to connect different modes of transport together as well as optimize distribution systems.

Examples of the use of ITS in freight transport management systems are: computerized vehicle routing and scheduling to improve planning efficiency by transport operators to plan vehicle loads and journeys, and navigation systems and traffic control which provide specific routing guidance and real-time information on vehicle location, traffic incidents and changes in customer requirements (Bestufs, 2007). The benefits of ITS for the companies are reduction in operation costs, improvement in journey reliability and time, dealing efficiently with unanticipated incidents.
4. CASE STUDY: RUNDLE MALL PRECINCT, ADELAIDE

Adelaide is a mid-size city, comprising of 1.19 million population, 73% of the total population of South Australia (1.62 million) (Australian Bureau of Statistics, 2010a). By 2036, the population of Greater Adelaide is projected to increase to 1.85 million (Department of Planning and Local Government, 2010). In 2006, the population in the area governed by the Adelaide City Council was 17,630. An increase of over 14,000 people to 31,765 is expected by 2021 and to 41,131 by 2031 (Adelaide City Council, 2010c). The dominant economic sectors in the City are finance and insurance and property and business services, together accounted for 38% of the city’s economy while retail trade accounted for 3.7 % of total value added (Blandy, 2008).

4.1 Overview of Rundle Mall Precinct
Rundle Mall precinct is Australia’s oldest pedestrian shopping mall since it was established in 1976. As shown in Figure 2 the Rundle Mall precinct is located in the heart of Adelaide’s CBD and visited by many thousand people every day. The Rundle Mall precinct is bounded by North Terrace, King William Street, Grenfell Street and Pulteney Street as in Figure 2. The Mall is ideally located and connected to major public transport and several undercover car parks within 100 metres. At present, Rundle Mall precinct is managed by the Rundle Mall Management Authority. The Rundle Mall precinct offers a wide range of facilities including 3major department stores, 15 arcades and centres, 700 retail stores and more than 300 non-retail services and offices.

The Rundle Mall precinct comprises of a variety of access route types as indicated on Figure 3. These include the primary pedestrian mall areas, covered arcades as well as both public and private vehicle access road. Vehicles are not allowed to access to, from and within the Rundle Mall precinct from 10 am to 5 pm Monday to Saturday and 11 am to 5 pm on Sunday. Outside of these hours, vehicle access is allowed under permit only. At present, all vehicle traffic is banned in the Mall and the northern half of James Place at all times without a permit which can be obtained from Adelaide City Council, as circled in Figure 4. Permits are varies from a single entry, hour or up to a maximum of 1 year. Vehicles with a current Rundle Mall permit are not allowed to be in or pass through Rundle Mall after 10 am. However, after leaving the Mall they are permitted to remain in the northern half of James Place until 10.30 am (Adelaide City Council, 2010b).
Commercial vehicles carry out services and deliveries to premises located in the Rundle Mall precinct can park at on-street loading zones, dedicated off-street loading facilities. The survey data was collected of on-street vehicle movement in Gawler Place in July 2009 from 7am-7 pm by Adelaide City Council. The survey included identification of the number of movement related with servicing or delivery vehicles (utilising on-street loading zones). As shown in Figure 5, majority of commercial vehicle movement, 136, took place in Gawler Street (South) whereas only 16 such movements occurred in Gawler Street (North) (Adelaide City Council, 2010d).
In term of policy, the Federal government plan to extend the O-Bahn bus route through the Adelaide CBD which will lead to the removal of some of the existing on-street parking or loading zone along Grenfell and Curries Street. This plan will certainly effect the goods delivery operation in the Rundle Mall area. At the same time, a Masterplan which aims to bring together all stakeholders with a unified vision for the future development of the Rundle Mall precinct is also being developed and due for completion by early 2011 (Rundle Mall Management Authority, 2010). In addition, one of the policies in the Draft 30-Year Plan for Greater Adelaide is to revitalize Rundle Mall to build on the strengths of existing key public spaces (Department of Planning and Local Government, 2010).

4.2 Direct Observation of Current Freight Distributions

From observation, majority of goods deliveries to the retail outlets are currently carried out in the early morning as delivery vehicles have access to the Mall. The delivery vehicles are parked in the Mall as shown in Figure 6. Light commercial vehicles and mid-sized trucks are mainly used to transport goods in Rundle Mall precinct. The majority type of goods delivered are clothes and fashion accessories. Clothes are hanged on clothes hanger while other products are packed in boxes. In most of the cases, the drivers is responsible for unloading products into a hand cart or trolley and manually push it down the street to the individual shop in order to complete the delivery.
However, during the peak business hour, delivery vehicles have no access to the Rundle Mall precinct. The drivers have to find available space to park vehicles such as loading zone or on-street parking along the laneways. The vehicles may be parked a distance from the premises that the goods will be delivered to, as a consequences, drivers spend more time to complete deliveries as in Figure 7.

This study aims to investigate the measures of urban freight distribution and logistics that have been implemented or initiated nationally and internationally. The study focuses on the city centre goods distribution, delivery and collection of consumer goods with Rundle Mall precinct, Adelaide, South Australia as the case study. Various research techniques have been proposed for data collection. Firstly, a questionnaire survey will be conducted for the businesses located in the study area to understand the current goods distribution process and organisation, its impact on environment and accessibility and the perspective of businesses on freight distribution. Face-to-face interviews with freight transport operators will be carried out together with direct observation of the present operations to understand and be able to identify the characteristics of goods distribution and barriers. Potential measures or initiatives will then be selected and a few scenarios will be evaluated to search for solutions that would offer the most sustainable urban freight strategy for Adelaide. The case study also takes into consideration economic, social and environmental issues. Subsequently, the consultation with policy makers and experts in the field on the perspective of potential solutions for urban freight distribution will be undertaken. Finally, an urban freight distribution strategy that supports the concepts of sustainable development and economic strategy will be proposed.

From the literature review, there are no existing measures suitable for direct implementation in the Australian cities. Australia represents a low density urban development which makes Australian conditions different from Europe or Japan. Therefore, this is a good opportunity to
propose an urban freight distribution strategy that supports the concepts of sustainable development and economic efficiency, and is adapted to the Australian urban context. The urban freight initiatives presented in the previous section offer a good basis for discussion and further research into developing a coherent distribution strategy for the Adelaide case study. As discussed before, not all the measures reviewed have been implemented successfully. A successful strategy comes not with one single policy alone, the likeliness of success is higher if combined measures are used that complements each other. Anderson et al. (2005) agreed that a combination of private and public policies will be necessary in developing a sustainable urban freight transport system. As in the case of urban consolidation centre in Monaco, the initiative has been implemented in combination with strict truck regulation and government subsidies. In addition, the study by Banister (2008) focused on sustainable mobility, also states that willingness to change and communication among stakeholders are important.

The successful implementation and recommendations from cities with distinct characteristic like Monaco, may not be a template that can directly apply to the others. The long term perspective considering the economic, social and environmental benefits is important when designing urban freight transport policies. The target group should be identified which will facilitate the design and implementation of solutions as individual initiative may not bring benefit to all group of stakeholders. For instance, the use of low emission vehicles would improve the quality of life in urban areas but would come at significant costs for transport operators. In addition, any initiative should be assessed prior to implementation as weight or time restriction could be counterproductive and result in more vehicles as the same amount of goods need transporting in less time or with smaller vehicles as a result generate more emissions. Urban consolidation centres seem to be a promising solution for the Adelaide case. However, further investigation is required to assess the benefits and risk involved feasibility of implementation, additional costs and time spent in the distribution chain.

5. CONCLUSIONS

Urban freight transport is crucial for urban economic and social development. Many initiatives have been proposed and implemented but there is no one best solution. The causes and impacts of urban freight distribution are similar in all cities however, the problems are different according to characteristics of particular cities. The implementation of any initiative has to consider the conflicting objectives and interests of different stakeholders involved in urban freight distribution. Only few of the project evaluations present and explain the shortcomings and issues with the proposed measures implementation. The lessons learned from previous refer to a number of factors that should take into consideration for successful implementation:

- The involvement of all stakeholders from the beginning of the project.
- Strong political willingness and involvement.
- Cooperation and communication among stakeholders.
- Identification of target group for the measures or initiatives to be implemented as some of these specific initiatives benefit a certain group of stakeholders but affect negatively on the others.
- Enhance knowledge, understanding and awareness in the sustainable urban freight transport. The information from previous implementation should be shared from both failed and successful cases in order to achieve a sustainable urban transport system with possibilities for long term improvements.
The evaluation phase is crucial for finding the possibilities and negative effects of the implementation measure. Identification of costs and benefits of implementation and operation including the distribution of costs and benefits of the stakeholders involved.

Countries have different experiences and different approaches regarding urban freight transport policies. Therefore, the analysis and selection of implementable measures has to consider interest of all stakeholders involved in urban freight transport and find an optimal compromise between the interests of all the stakeholders involve. Furthermore, issues such as laws and regulations, politics, finance, infrastructure and culture, practical concerns, technology and impacts have to take into consideration.

The future work of this study will involve the data collection, including questionnaire survey, face-to-face interview and direct observation of the current operations of the case study to understand the current goods distribution process and organization, its impacts on environment and accessibility and the perspective of businesses on freight distribution.

A concrete conclusion is yet to be explored as the management of urban freight distribution is a complex issue. Finding sustainable urban freight distribution solutions will continue to be a challenge for researchers, policy makers and stakeholders in years to come.

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REFERENCES