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Stakeholder decisions shaping urban freight

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Abstract

The demand for urban freight transport is growing and the main mode of carriers is on-road freight vehicles. Due to the limited resources and prevailing constraints impeding stretched facilities, it is essential and timely to look at how efficiency can be improved in the urban freight industry.

Consideration of the costs and benefits to all stakeholders is important when policy decisions are made. The acceptability of a policy by stakeholders is important and the sustainability of a policy relies upon the net benefits to each stakeholder followed by their level of acceptance. However, decision-making power in supply chains is usually limited to one dominant stakeholder and identifying such a dominant player in the supply chain is essential for policymakers.

This study aims to identify the objectives and priorities of key stakeholders involved in this urban freight. Attention is paid to freight route selection, usage of toll roads and their present perception to identified conditions. The outcome from a discrete choice experiment was used to determine freight drivers' willingness to pay toll charges to use toll roads in the urban context. This information is necessary for traffic assignment and no such data can be found in the literature. Overall, this study sheds light on identifying various urban freight stakeholders and what factors are prominent in their decision making processes.

Keywords: urban freight, decision-makers, objectives, stakeholders, survey, Discrete Choice Experiment

1. Introduction

Recent freight industry forecasts conclude that there will be rapid growth in freight volumes in near fututre in Victoria, Australia, aligned with the rapid expansions taking place in citites and suburbs in and around Melbourne (Productivity Commission, 2017; Transport for Victoria, 2018). Further, studies have identitifed that the demand for urban freight transportation is expected grow rapidly between 2014 and 2051 and priorities have been set by the government to achieve more efficient, safe and sustainable freight movement (Transport for Victoria, 2018). In the urban context, road transportation can be considered as the main freight transportation mode in Australia (Brodie, Lyndal and Elias, 2009; Perera, Thompson and Chen, 2018) and thus more attention is now being paid to road freight and heavy trucks. On the other hand, less attention has been paid on the development of new transportation infrastruture which can accommodate new modes of transport such as rail, mainly due to the high cost of construction. Land is a scarce resource in and around the city of Mebourne, which can limit new development

including transport infrastructure (Productivity Commission, 2017). This background leaves fewer options for transport planners narrowing down the focus to efficient utilisation of exisiting transport infrastructure. As a result, policies to improve the efficiency of road transport, given exisitng constraints have been examined by authorities (Productivity Commission, 2017). Among the priorities declared by the government is to, "Align future toll road contracts with Government's freight efficiency and congestion management objectives" (Transport for Victoria, 2018).

When making a policy decision in the freight industry, there will be many affected stakehoders, and thus, knowing the cost and benefits to all stakeholders is vital to find the right balance. The acceptability of a policy by stakeholders and the sustainability of a policy relies upon the net benefits to each stakeholder (Perera and Thompson, 2021). Even though there are many stakeholders in this context, the decision-making power in the supply chain is usually limited to one dominant stakeholder. Identifying the dominant player in the supply chain and developing a policy for receiving their acceptability is important for policy-makers to make it a reality in practice. There is a large body of evidence from the past that some policies have not been accepted by users/stakeholders and have not been implemented.

There are many aspects that can be considered in the decision making process of the urban freight industry but the scope of this study is limited to the decision paramaters associated with toll roads, aligining with the sub-priority of the authorities as mentioned above. Therefore, the objective of this study is to understand, 'who is the main decision-making body?' and 'how specific decisions are made?' in toll charges related to freight activities in urban conditions. This understanding would be more helpful for planners and policymakers when formulating policies and making them more acceptable for stakeholders. It is true that research has been carried out in other parts of the world to identify the decision-makers (in the supply chain) and to understand the behavioral patterns in the urban freight industry, but the Australian context could be different due to geographical, demographical and economic variations.

A survey was carried out in Melbourne consisting of three sections (Part A, B & C) covering various stakeholder objectives and their behavioral response to various scenarios in urban freight transport. These conditions were selected based on the literature to understand the Australian context. In brief, Part A and Part B of the survey investigate the decision-making behavior of Victorian freight users. Part C of this survey is intended to find the remaining stakeholders' objectives, other than freight users, such as the government, residents and toll operators.

2. Survey objectives, design and implementation

The main objective of this survey is to understand Australian urban freight movements and to support the development of an urban freight movement model considering economic, environmental and social factors. Australian specific information would help to investigate more suitable and sustainable toll schemes and policies for urban freight in Australia in the future (Perera and Thompson, 2020).

Since urban freight movement has multiple stakeholders it is a necessary to gather information from key stakeholders to implement effective city logistics solutions. Thus, specific survey objectives were formulated reviewing existing information from the literature.

Specific survey objectives are;

- To collect information regarding the key stakeholder objectives, their rankings and relative weightings.
- To collect the information regarding the route preferences of freight users (between tolled and highways) given the toll charge, travel times, and distance for different route options.
- To collect the information regarding the decision-making process (who and how) of freight users under various behavioral conditions.

Different behavioral conditions considered included route selection, toll road selection and congestion avoidance by freight operators and relative importance of decisive factors for each selection.

Due to the involvement of multiple stakeholders in this study and a large number of questions asked in total, the main survey was divided into 3 parts as Part A, Part B and Part C. This division was made considering the key stakeholder types and specific survey objectives.

Part A of the survey was designed for fleet managers or freight operators who would take a collective decision on behalf of their entire fleet behavior. Part B of the survey was a Discrete Choice Experiment (DCE) to capture the sensitivity of toll charges concerning travel times and travel distances when it comes to route choice selection. Thus, this part of the survey was aimed at freight (truck) drivers. Part C of the survey was designed to investigate the various objectives and their priorities of key stakeholders involved in city logistics, except for freight operators (since they are covered in Part A and B). The government, toll operators and residents (including non-freight road users) were the targeted key stakeholders and one question for each stakeholder inquired about their objectives.

2.1. Part A: For fleet/ freight operators

The first two questions of the survey were intended to cover the ownership type of the fleets, fleet composition and line of business (owner-driver, for-hire or both) along with the commodities being transported. The third question was aimed at understanding priorities in freight operators' objectives, which is very useful when making policy decisions. The objective listing was done by a group of professionals representing government, industry and the academic field. Any ambiguity or misrepresenting objectives were revised during the pilot survey before the commencement of the main survey. The remaining questions in this part of the survey were focused on route selection, toll road usage, congestion avoidance and delivery times.

Most of the survey questions in this part were designed to look at a specific problem or behavior highlighted in city logistics studies. Most of the literature is either from Europe or the USA and thus there is a gap determining whether the same behavior applies in the Australian context, despite having different geographical conditions, population size, or population dispersion. As a result, the intended purpose of this part of the survey is to understand how such behavior applies to the Australian urban context as mentioned earlier. Each question was designed and reviewed by professionals in the industry before the pilot survey was carried out. More details and associated research background for each question are presented along with the analysis. For questions three to eight, respondents were asked to allocate 100 points among the listed options for each question. This way the options are ranked and at the same time options are relatively measured by assigning a weight.

The major respondents for this part of the survey were members of the Victorian Transport Association (VTA) that has many large and medium-size transportation and logistics companies as members. With the permission of the Chairman, VTA, this survey was send to the membership as an online a survey. With the great help of Mr Peter Anderson (Chairman, VTA), over 100 responses were received and further details about the responses are given in the results section.

2.2. Part B: For freight operators/drivers

The initial questions of this part of the survey were intended to collect general details of the respondents such as vehicle type and commodity type(s) being transported and so on. Since it is evident from the literature that such general details determine the heterogeneity of freight vehicles and hence the need to validate with Australian data. Afterward, eight discrete choices were given to each respondent randomly picked out of the two blocks generated. In both blocks, there are eight choice sets in each block and each choice set is comprised of three options, namely, 'Highway', 'Toll Option A' and 'Toll Option B' to select. Apart from the highway option, two toll options are used to reduce the total number of responses required for this part of the survey. This is an advanced method where one highway option and two toll road options are compared at once. This will reduce the number of choices (questions) to be asked from a respondent. Same attributes (3) and same attribute levels (4) (described below) are used for both toll roads (A & B). A subset of such attribute levels is used for the highway option to make all options realistic (e.g. distance/travel time is more than 120 kmph does not represent a realistic scenario for highways). In addition, dominant answers (one option having all attribute levels favorable compared to other two options) were removed from the choice sets since it's a primary rule to avoid bias answers. Attributes and attribute levels for Toll Option A & B are: Travel Time {12 min, 10 min, 7 min, 5 min}, Travel Distance {14 km, 12 km, 10 km, 7 km}, Toll Charge {A$ 10, A$ 8, A$ 5, A$ 3}. For the highway option: Travel Time {12 min, 10 min, 7 min, 5 min}, Travel Distance {14 km, 12 km, 10 km}, and there are no toll charges.

Since Part B of the survey was mainly targeted at freight drivers, the survey was mainly conducted off-road including loading/unloading bays in the CBD, wholesale markets and fuel stations with truck rest areas. Given the complexity of the survey questions and factors related to the respondents (drivers), such as the physical state of the driver (fatigue, tired), the time they can spend on a survey (based on their schedule) and human factors were the real challenges and lessened participation for this survey. However, visiting several locations many times and talking to truck drivers boosted the participation rate. In total 97 drivers responded, 51 to block A and 46 to Block B. As a result, the total number of choice responses received was 1,552 (97*8*2). The analysis of this part of the survey is presented below.

2.3. Part C: For government officials, toll operators and residents / road users (non-freight)

Similar to Part A, one question was given to each stakeholder type to identify their objectives and their relative importance. More details about the survey structure and respondent's feedbacks are given under the analysis section. Details of the individual questions given to each stakeholder are provided below.

Part C (Q2): Relevant officials (Transportation planners or traffic engineers) from Transport for Victoria, City Councils (Dandenong, Monash, Knox, Maroondah, Maribyrnong, and Casey) and VicRoads were the main participants. Officials from Transport for Victoria and VicRoads

were reached using personal contacts. Each City Council official was contacted first over the phone and then an appointment was made to explain the survey one-to-one. Subsequently, the online link to the survey question was emailed. The possibility of biased response was reduced by surveying many government organizations. However, responses from higher officials at the government level (e.g. ministry level) would have led to more accurate results.

Part C (Q3): There are two major toll roads in the City of Melbourne, namely, CityLink and EastLink, operated by TransUrban and ConnectEast, respectively. Both roads were built under Public-Private Partnership (PPP) and both roads are operating well at present conditions. The survey was sent to both operating companies but both companies refused to respond to the survey due to their data privacy policies in control. As a result, no responses were received for the question three in Part C of the survey.

Part C (Q4): The fourth question was designed for residents or road users and the main participants for this question were members of the Maribyrnong Truck Action Group (MTAG)(MTAG, 2016). The survey question (online link) was emailed to the membership through the MTAG secretary. Since all the members in the MTAG group have a very good knowledge about truck movements, their negative impacts and the government's involvement in their problems, it is believed that more realistic feedback was received for this survey question. However, by choosing members from a specific group there is a possibility for a biased response as well. On the other hand, responses received from such a group of people have more weight compared to a response given by a random resident who may not have such an understanding of the problems under discussion.

Once the survey design was completed, a pilot survey was conducted to identify any possible errors practical difficulties. Based on the feedback received, all three parts of the survey were revised prior to execution of the final survey.

3. Results and discussion

3.1. Part A

Heterogeneity in the freight industry is one of the main difficulties faced by transport planners. When proposing a policy to different types of freight users (LCV or HCV users) who have different attributes (e.g. vehicle operating cost, the value of time, willingness to pay, etc.) may react differently (de Magalhães, 2010; Holguín-Veras and Cetin, 2009). Therefore, to start with, the classification based on the ownership was asked of respondents and the distribution is described below.

In total 102 operators responded to the survey but some of the responses were incomplete and had to be disregarded. Finally, 71 responses were left for analysis. 'For-hire' percentage in this sample was found to be higher (45%) compared to both 'owner-driver' percentage (24%) and 'both' percentage (who's partially hiring their vehicles) (31%). Out of 31%, respondents in the 'both' category 10% of the respondents hire their vehicles more than 80% of the time. Therefore, this sample has more representation from the 'for-hire' category than the 'owner-driver' (ancillary) category. Number of trucks owned under different ownership types by respondents were also collected. Irrespective of the ownership type, owners tend to operate large fleets having more than 10 trucks whereas having 2-5 trucks in their fleets found to be a little unusual in this sample.

The survey revealed that how respondents use different truck types to transport different commodity types. For transportation of general freight and other commodity types, all truck

types are being used and for the remaining commodity types [Food (Refrigerated & Non-refrigerated), Construction or Raw Materials, Petroleum/Chemical Products/Liquids, Other Manufactured Products, Waste]. There is a tendency towards using larger trucks (6 axle articulated and B-Doubles) for freight transportation. A study by Hassall and Thompson, (2011) found that 2 and 3 axle rigid trucks, super B Doubles, A Doubles, and semi-trailers are potentially having high productivity gains in urban freight transportation. According to the survey results, 2 axles and 3 axles rigid truck usage is comparatively less but B Doubles and semi-trailers (6 axle articulated) are used somewhat often. Thus, it can be stated that the Performance-Based Standard (PBS) scheme [for more information about PBS refer to Thompson and Hassall, (2014)] is not quite yet implemented in Australia.

Figure 1 below depicts the freight operators' response to their individual objectives prioritized based on the cumulative points for each objective. Percentages on top of each bar show the overall mean value (all types of fleet ownerships together) for each objective.

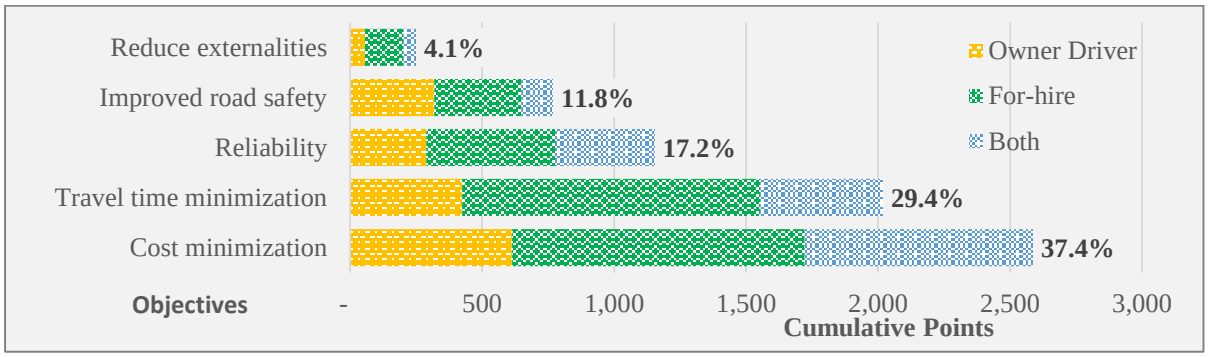

Figure 1: Objective of freight operators

A closer look at the individual bar would reveal that the cost minimization objective is the most common objective followed by the travel time minimization. However, it can be observed from the figure that for owner-drivers cost minimization is the most important objective while for for-hire operators travel time minimization was found to be the main objective. This is because for-hire operators can make multiple trips if time is saved, but for owner-driver operators, they don't have such intentions (since they transport their goods only) but to reduce cost which has to be paid out of their pockets. Reliability is also received a reasonable level of response (17%) but road safety has received an unexpectedly lower response rate. The reduction of externalities seems to be the least concerned objective amongst freight operators. Therefore, any new policy on improved road safety or reducing externalities has to go a long way to receive user acceptance. Since cost minimization was found to be the main objective among freight operators, freight operators would like to use any route which will minimize their costs irrespective of travel time or other factors. In other words, it can be argued that toll routes (routes with toll roads) are not the most preferred route for freight vehicles since toll roads are mainly used for saving travel time saving but not for saving costs. However, since travel time has some impact on cost, these two factors cannot be considered fully independent. Refer to studies done by Yang et al., (2016); Perera and Thompson, (2020) and Perera, Thompson and Yang, (2016) for more details on costs and toll charges in Australia.

Figure 2 below summarises the response received for route selection options by freight operators and Figure 3 summarises the decisive factors for route selection.

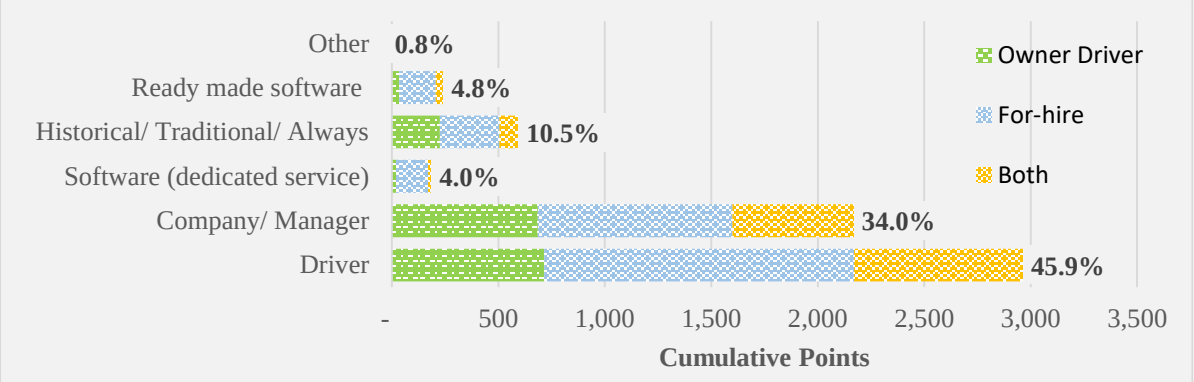

Figure 2: Route selection by freight operators

Overall, the majority of the route selection is done by the driver (46%) followed by the company/manager (34%). About 10% just use the traditional route they used to travel and about 9% use advanced software to find the optimal route for the delivery(s). However, whether drivers still use their experience/knowledge to decide the route or are they use any readymade software package like Google Maps is not known. With this greater flexibility shown in route selection choice, there is a greater chance to influence the truck operators to change their road usage behavior with some incentives such as low roadway charges during off-peak as proposed by Forkenbrock, (2005). Or as proposed by Chen, Perera and Thompson, (2018), an advanced method that considers multiple parameters such as tolls and externalities can be used for urban freight routing for improved efficiency.

The most important criteria for route selection among those listed is delivery/departure time which explains receiver dominance in the delivery process as discussed in many past studies. Further, when looking at the individual mean percentages obtained by ownership type it reveals that "for-hire' truck owners are more concerned (29%) with delivery/departure times compared to other two categories, 25% and 20% for 'owner-driver' and 'both' respectively. Trip distance and vehicle operating cost and toll charges are also considered to a certain level, whereas externalities produced are given very less priority in such decision making. Trip distance is mostly concerned by 'both' ownership types and vehicle operation cost was least considered by 'for-hire' type according to mean values obtained (figures not presented here).

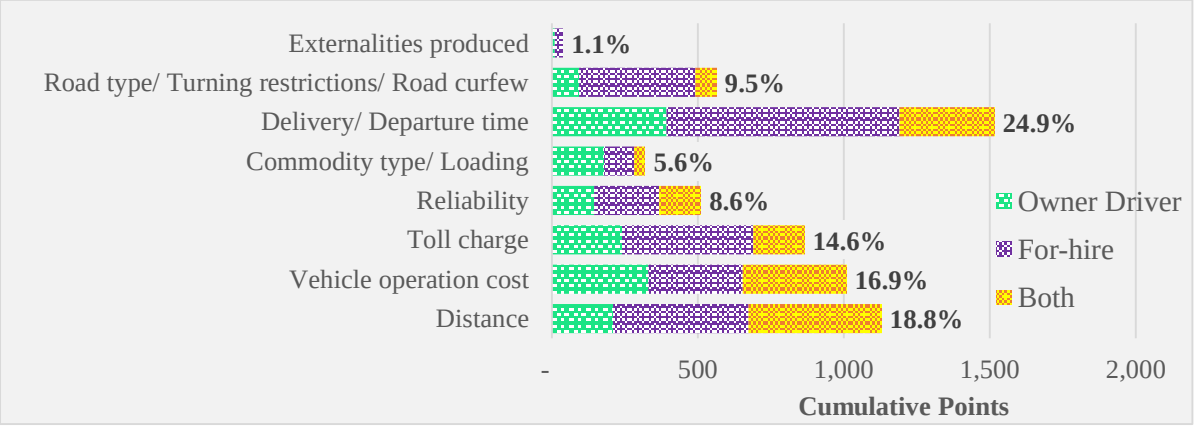

Figure 3: Factors considered when deciding routes by operators

Toll road usage by freight operators was tested in the next question and the responses are summarised in Figure 4. Only 64% of the operators said that they always used toll roads. Meaning there is a large percentage of trucks (36%) whose primary selection is not toll (quality) roads. The present high toll prices for trucks on CityLink and EastLink could be the governing

factor for such an outcome. Refer to a study done by Perera, Thompson and Yang, (2016) for more details on toll charges in Melbourne. Further increases in toll prices may reduce the numbers in the 'Always' category. Less than 20% (in total) responded that they are using toll roads either only when a customer requested (5.6%) or when the truck is loaded (6.6%) or during congested times (6.4%). 'both' ownership type is more tempted to use toll roads when requested by a customer and during congested times, whereas 'for-hire' owners are more responsive to toll roads when trucks are loaded. Only the 'owner-driver' category responded to never use toll roads option and the overall percentage is less than 2%.

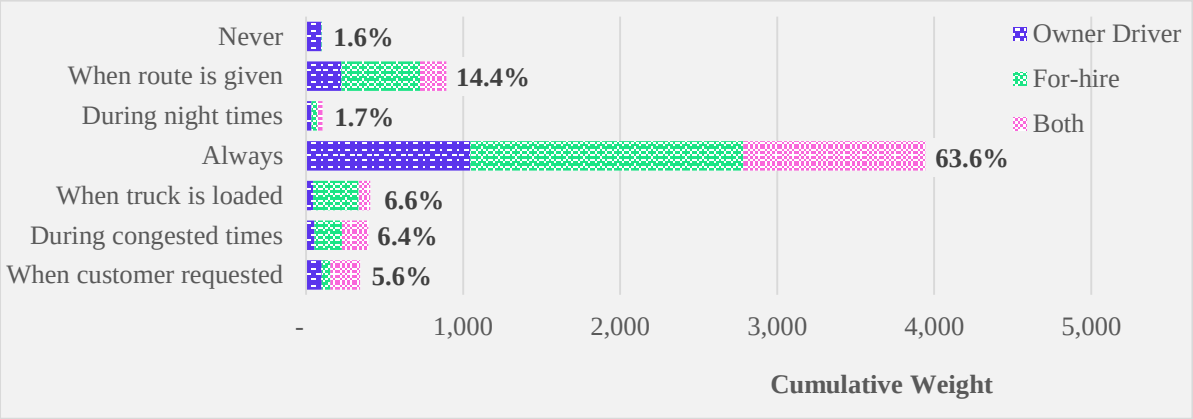

Figure 4: Usage of toll roads by operators

A study carried out by Holguín-Veras et al. (2005) indicated that trucking companies did not consider tolls when making route and delivery time decisions, which is found to be different in the Melbourne context. At the same time Holguín-Veras, (2011) has mentioned that only a handful of industry segments are sensitive to tolls, but such detailed information cannot be revealed from this survey and thus the validity of the statement cannot be tested.

In conclusion, this survey confirms that there is a significant negative perception of the current toll charges in Melbourne. Therefore, there is a necessity to look at ways to bring more freight vehicles to toll roads (quality roads) since they produce more externalities and create other negative impacts while driving on sub-standard roads. This has been considered to a great extent by Perera, Thompson and Wu, (2020); Perera, Thompson, and Wu, (2021) in their studies explaining how an optimal toll scheme can be determined based on various objectives.

There is on-going discussion in the literature regarding the decision-making body or in other words trying to find out who is the dominant player in the supply chain. This is an important factor to know because the success of any policy introduced in city logistics will be determined by such a dominant party based on the benefits they receive. Thus, finding answers to the prevailing questions such as, 'who has the decision-making power for the delivery time?', 'Is there flexibility for carriers (freight operators) to decide their own delivery times?', 'Whether off-hour deliveries are an option to daytime congestion?' are critical.

Based on the studies carried out in other countries (e.g. U.S.A. and Europe) researchers have concluded that receivers are the strongest player in the supply chain and do not wish to change the manner in which they receive their goods (dell'Olio et al., 2017). Especially when there is an additional cost for receivers, receivers would not like to show any flexibility in goods receival time. However, the heterogeneity of the commercial sector may act differently to the general perception. New goods distribution policies such as Off-Hour Delivery policy (OHD) and distribution system using an Urban Distribution/ Consolidation Centres (UDC or UCC)

have received some positive response irrespective of the additional cost involved (dell'Olio et al., 2017). Considering all the points mentioned above, questions seven and eight were included in the survey to gain an idea about how it works in the Australian context. Responses are summarised in Figures 5 and 6.

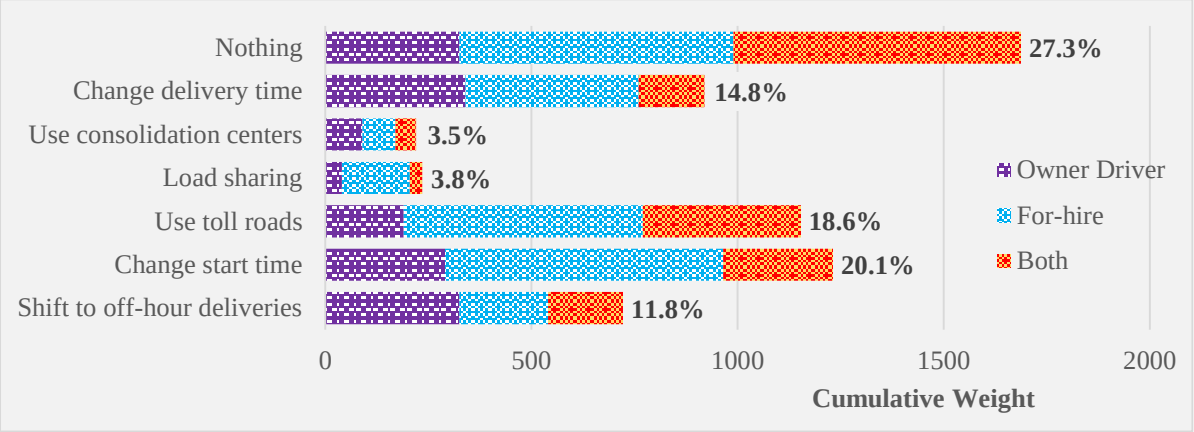

Figure 5: Strategies used by operators to avoid congestion periods

About 15% of the freight trips have the flexibility to change their delivery time, among which the 'owner-driver' category shows more flexibility over the other two ownership types. Similarly, about 11.8% of the freight operators showed some flexibility to shift to OHD where the 'owner-driver' group was again dominant. About 20% responded as they can change the start time (of the delivery) to avoid congestion. This decision was led by the 'for-hire' category. This probably means that freight operators (mostly 'for-hire' type) have no choice to change the delivery time instead of making the trip early and waiting for the delivery to avoid congestion. Load sharing and using consolidation centers (eg. UCC) to avoid congestion are equally popular among freight operators, but overall mean percentages are not significant (around 4% each). The load sharing option is more popular among the 'for-hire' category and usage of UCC is mostly preferred by 'owner-driver' compared to other ownership types. Nearly one-fifth of the operators are willing to take toll roads to avoid congestion compared to other given options such as load sharing, usage of UCC, shifting to OHD, etc. Among operators, the 'owner-driver' group shows the least interest in using the toll roads to avoid congestion. The majority of the respondents (27.3%) do nothing to avoid congestion and this is something that needs further investigation. Because congestion is a negative externality that needs to be minimized and thus if the majority of the freight operators have no option to avoid congestion, then there is a serious problem in city logistics in Melbourne.

Urban Consolidation Centres (UCC) are considered as a practical solution to reduce traffic and environmental problems in cities (Aljohani and Thompson, 2018; Browne, Allen and Leonardi, 2011; Lin, Chen and Kawamura, 2016; Perera, Thompson and Chen, 2018; Taniguchi, 2014). Similarly, load sharing is also an innovative solution for city logistics and practices in many countries including Europe and Brazil (de Magalhães, 2010; Quak, 2012). However, when looking at the high percentage of respondents selecting 'do nothing' option and low response percentages for UCC and load sharing options, Australia seems to be still lacking in innovative thinking and awareness or infrastructure to implement such innovative practices. In conclusion, Melbourne is currently not using any innovative approaches to city logistics like other countries. Therefore, its high time to think more about executing some innovative approaches for improving the sustainability of freight transportation in the future.

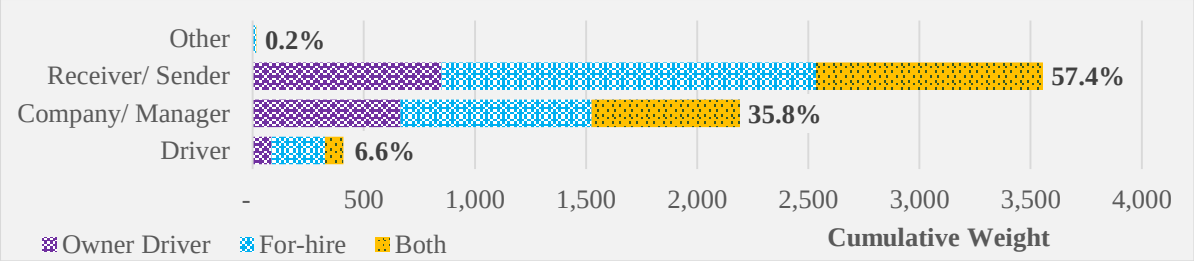

Figure 6: Who decides the delivery time for operators

Overall, answers to the above question revealed that there are plenty of openings that need to be filled to shape the urban freight transportation in Melbourne, which requires more focused studies to identify specific problem(s) in city logistics and application of innovative solutions with better awareness.

Question eight provides a much straightforward answer to the decision-making agent for deliveries in the Melbourne context. From the results, it is clear that either receiver/sender decides the majority (57%) of the delivery times where the company/manager has some autonomy (36%) to make such a decision. Drivers are having much less opportunity (7%) to decide on delivery times.

Considering the fact that the receiver has a greater influence on delivery times, past researchers have looked at policies fostering switching truck traffic to off-hours by encouraging the receivers to accept OHD by providing different incentives (Holguín-Veras et al., 2008). Even though this initiative seems to be a good and viable option at a glimpse it may have two sides. The request to make OHD will provide the opportunity to carriers to avoid the congestion (savings from vehicle operation cost), avoid tolls or fewer toll charges (if nighttime tolls are discounted) but increase driver costs due to night working hours. The greatest problem in such an initiative is more freight vehicles will be avoiding toll roads at night since highways are free to travel, with higher speeds at night time. The condition could be worse when the night time tolls are applied such as in Melbourne. Overall, noise and other externalities associated with OHD is a major obstacle to implement such an initiative (Holguín-Veras et al., 2005). Therefore, planners must be careful when looking at such policies by primarily looking at only direct outcomes.

Finally, by looking at the overall response made by freight operators it can be concluded that freight movement in Melbourne is somewhat similar to the world context where receivers are the major decision-maker with respect to delivery times and thus transportation/freight planners should be aware of this when proposing new initiatives to reduce congestion or improve city logistics.

3.2. Part C: Officials from government or local authorities, toll operators and residents

3.2.1. Officials from government or local authorities

There were 16 completed responses for question two of the survey, which was designed for government officials. Relevant officials (Transportation planners or traffic engineers) from Transport for Victoria, City Councils (Dandenong, Monash, Knox, Maroondah, Maribyrnong, and Casey) and VicRoads were the main participants. Responses are summarized in Figure 7.

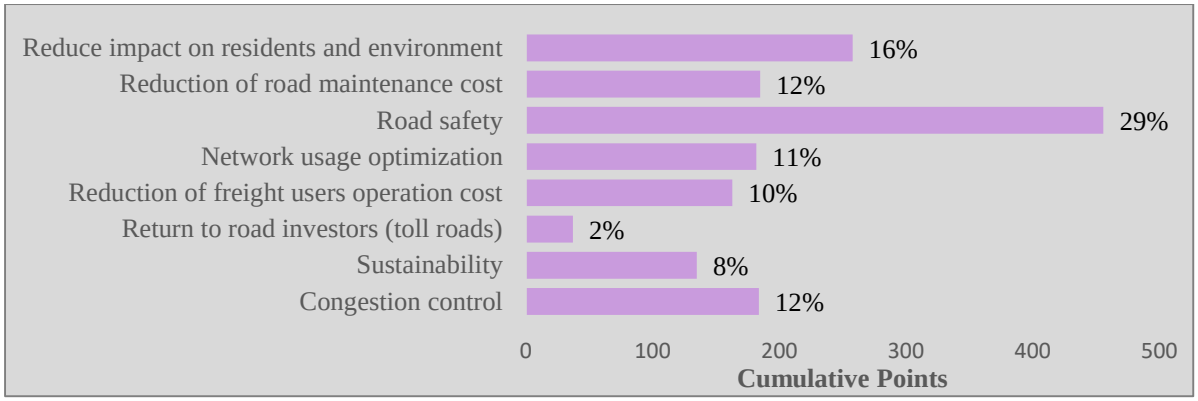

Figure 7: Government objectives towards freight transportation and their priorities

Based on the response from government officials it's clear that government's main objective is to improve road safety and their least concern is about the payback to road investors. Most of the other objectives received almost an equal number of response, with a slightly higher response rate for reducing impacts on residents and the environment.

It is surprising to see the low response rate received for the 'Return to road investors' because in theory it is one of the government's main responsibilities to protect the investors (otherwise the whole PPP will collapse) and toll prices are determined collaboratively. According to Hensher (2018), toll prices are prescribed by the government (possibly at a higher level) and indexed over time by the consumer price index. This provides logical reasoning for why the government officials at an operational level do not really care about returns to the investors, since it is pre-arranged. On the other hand, pre-determined toll prices (linked to the consumer price index) are making sufficient returns for the investors and thus may be the reason why investors are not keen to explore options to optimize user benefits or to minimize negative impacts. By receiving more or less the same percentage for all the other objectives (except road safety and return to investors) it is clear that government officials are trying to safeguard all stakeholders reasonably. For example, the reduction of freight users' operating costs also received a similar number of responses as congestion control and sustainability.

3.2.2. Residents/ road users

Question four of this survey, which was designed for residents or road users received about 126 responses, out of which 94 responses were considered for analysis. Figure 8 depicts the summarised results based on residents'/road users' responses.

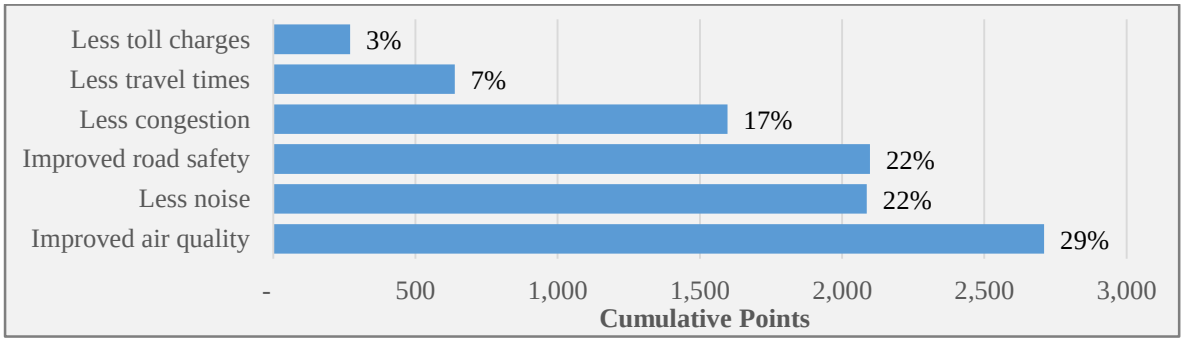

Figure 8: Residents and road users' objective concerning freight transportation

Air quality received the maximum priority (29%) among all the objectives for residents. Secondly, both less noise and improved safety were ranked equally as 22% each. However, it

is important to highlight that residents'/road users do not pay attention to the toll charges as well as the travel times. But some concern has been shown towards congestion reduction. This again illustrates that car users (non-freight vehicle users) are not so concerned about the toll levels even though the present toll charges are found to be high in Melbourne. This was the argument brought up in toll elasticity discussion where car users either have a higher willingness to pay or to use highways, but freight vehicles do hesitate to pay extra money for high tolls.

In conclusion, new policies need to look at three major aspects concerning residents, namely, improved air quality, noise reduction and improving road safety. In reality, several initiatives have been taken to reduce emissions or to control air pollution from truck exhaust such as the 'Cleaner Freight Initiative' launched in Melbourne, recently. When it comes to road safety, it receives good attention from all policymakers since road safety is in the priority list of all transportation modes, and not limited to freight transportation. This can be proven by looking at the government response to the survey where road safety has been ranked as one of their primary objectives. However, no such initiative has been taken towards noise control in Melbourne (for more information regarding transportation noise, its impacts and remedial measures readers can refer to Andersson and Ögren, 2011; Cik, Fallast and Fellendorf, 2012; Day, Bateman and Lake, 2006; Forkenbrock, 1999). Thus, there is a gap to filled by understanding how important noise control is and how it can be reduced or controlled especially for heavy vehicle movements.

3.3. Part B

Since this part of the survey was conducted via paper-based method, both field data editing and supervisory editing were carried out on-site and as a result, several responses were discarded. The total number of choice responses received was 1,552. Considering the attributes used and choice sets developed, mixed multinomial logit (MMNL) model was used to analyze the results. Thus, the deterministic component of the model can be written as;

$$V^i = \beta_{TT} x_{TT}^i + \beta_{TL} x_{TL}^i + \beta_{TD} x_{TD}^i$$

Where; $x_{TT}^i, x_{TL}^i, x_{TD}^i$: observable components for travel time (TT) in minutes, travel distance (TD) in kilometres and toll charge (TL) in A$. $\beta_{TT}, \beta_{TL}, \beta_{TD}$: are coefficients, respectively.

Table 1 shows the mixed logit results obtained from R software.

Table 1: Results from mixed logit model

Variable	Coefficient	Std. Error	Significance
TT	-0.219	0.025	<2e-16 ***
TL	-0.271	0.020	<2e-16 ***
TD	-0.046	0.034	0.1737

Log-Likelihood: -645.76
Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Therefore, the values for travel time and travel distance can be calculated as:

$v_{TT} = \beta_{TT}/\beta_{TL}$ = (-0.219)/(-0.271)=0.81=81 cents/min

$v_{TD} = \beta_{TD}/\beta_{TL}$ = (-0.046)/(-0.271)=0.17=17 cents/km

Based on the model results the value of travel time can be calculated as 81 cents per minute, which is A$ 48.6 per hour. This rate is more than the time value of money obtained considering the wages of freight drivers and this rate is more appropriate to consider as the willingness to pay factor in the main model. However, it is important to note that model results show that travel time (TT) and toll charges (TL) variables are very significant but travel distance (TD) is less significant based on the real preferences made by the respondents. This may be due to the lower value perceived by the freight drivers per kilometer (17 cents per km). As a result, for any traffic assignment model developed for Melbourne, the travel distance can be neglected, and traffic assignment can be purely done considering travel time only.

4. Conclusions

This study mainly focuses on identifying the objectives of key stakeholders of urban freight transport and their priorities. In addition, their perception of certain conditions was also tested to identify how strategies can be developed to improve the efficiency of urban freight.

This study revealed that many decision-making processes and methods used for urban freight are somewhat traditional and there is a huge gap compared to world practices. Therefore, the information collected and analyzed through this study is more useful to develop suitable strategies for Victoria to determine the implementation process considering various stakeholders. Since most of the findings are common and not specific to Victoria, the outcomes of this study can also be used in all states in Australia.

In the future, Australia needs to focus more on using performance-based standard schemes to gain more efficient transport service and also there is a need to implement an efficient routing systems for freight considering all costs and externalities. Modern concepts such as using consolidation centers, load sharing options are yet not popular in Australia where still more traditional approaches are followed. The introduction of OHD needs more background work to be done before implementation since the awareness, as well as the benefits to respective stakeholders and to the industry as a whole, is not well known to the users. A systematic strategic planning and implementation process can be developed based on the information gathered. Since decision making done by various operator types and what objectives they have (when planning policies) with their priorities are known, strategies should well fit into their line of thinking in order to get a high level of acceptance. At the same time, government officials' perception towards urban freight as well as what residents demand is also revealed form this survey which would be again more helpful to create a win-win situation.

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