

## *Original Paper*

# Analysis of the Impacts of Freight Subsidisation on Transport Mode Selection: An Assessment of the Tasmanian Freight Equalisation Scheme

Richard J. Wise<sup>1\*</sup> & Peter D. Fanam<sup>1</sup>

<sup>1</sup> University of Tasmania-The Australian Maritime College, Launceston, Australia

\* Peter D. Fanam, University of Tasmania-The Australian Maritime College, Launceston, Australia

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### **Abstract**

*The objective of this research is to identify the key selection criteria that form the basis of a shipper's selection of freight transport mode. The study is undertaken in the context of sea freight. The study is localised to Tasmanian shippers who are, or are potentially, recipients of freight subsidisation through the Tasmanian Freight Equalisation Scheme. Data collected through an internet-based survey is described, and influential mode choice selection criteria are reported with the use of descriptive statistics. The findings indicate that Tasmanian shippers are conscious of cost, service, and cargo characteristics.*

*Median responses indicate that cost, service, and cargo are equally significant in the selection process. The findings indicate that cost and cost flexibility are influential cost-based criteria. The findings also indicate that transit time, service capacity, and service flexibility are influential service-based criteria. Shipment size, cargo weight, and cargo volume are also identified as influential cargo-based criteria. This study provides insight into mode choice selection for Tasmanian shippers. In this function, it may assist existing air and sea carriers operating in the Tasmanian market to evaluate their performance and strategy by providing an analysis of shippers' transport mode choice process. Tasmanian shippers themselves may benefit from the potential expansion of their existing freight transport mode choice process. New shippers of freight into and out of Tasmania may benefit from the perspectives of existing shippers of freight into and out of Tasmania.*

### **Keywords**

*key selection criteria, shipper's selection, freight transport, Tasmanian Freight Equalisation Scheme, cost-based criteria, cargo-based criteria*

## 1. Introduction

The decision-making process employed by shippers when selecting transport mode has received considerable attention in the literature. Shippers use various decision criteria when selecting a mode of transport for shipment of their cargo. Shippers can be limited in which transport modes are available to them.

The presence of freight subsidisation can create a market where one mode of transport is given preference by shippers on cost-based criteria alone. This, understandably, may create a market environment which is detrimental to carriers who rely on alternative transport modes.

However, it is suggested that the transport mode choice selection process for shippers is underpinned by three primary decision alternatives, each with various component criteria. These can be divided into cost-based, service-based, and cargo-based selection criteria. Price-based criteria concerns the level of the transport cost. Service-based criteria concerns transit times, terminal time, availability, capacity, flexibility, frequency, reliability, logistics procedures, and land-based integration. Cargo-based selection criteria concerns cargo value, product cubic value density, cargo size in terms of volume and weight, shipment size, likelihood of damages, market demand, seasonal variations, and market timing.

Transport research has examined mode choice selection criteria over several decades. Research has been conducted in various localised contexts. These will be examined in literature review. At present, there is an abundance of academic literature examining mode choice selection criteria in an Australian context, though it is scant in a Tasmanian context. The purpose of this paper is to evaluate and discuss the transport mode choice of shippers in the context of the Australian island state of Tasmania.

The Tasmanian Freight Equalisation Scheme (TFES) was first introduced in 1976. The TFES provides financial assistance for costs incurred by shippers of eligible non-bulk goods moved by sea across Bass Strait. It was borne out of a desire of the Government of the time as a means of alleviating the freight cost disadvantages incurred by shippers of goods between mainland Australia and Tasmania (BITRE, 2021).

Over its lifetime, the TFES has been a contentious subsidy. Stakeholders involved in the operation of Hobart Airport and Launceston Airport, respectively, have argued that the TFES creates an imbalance in the Tasmanian freight market because sea transport has an advantage over air transport. Furthermore, it has been argued that the TFES has inhibited private investment in the aviation freight transport sector in Tasmania because it is suggested that the TFES creates a market environment which has little incentive for airlines to enter (Production Commission 2014).

The literature provides insightful and credible insight into the transport mode choice behaviour of shippers when choosing from competing modes of transport. While there is certainly the insightful study of Fanam and Ackerly (2019) which explores choice selection for Tasmanian shippers, this study is limited to ocean carrier choice selection. Beyond publication of data by Australian Government

bodies and agencies, there has been little attention in the literature given to the Tasmanian Freight Equalisation Scheme, or to Tasmanian freight mode choice selection.

To the best of the author's knowledge, the research problem has not been addressed in the literature. This is understandable due to Tasmania's insignificant trade volume and value by world standards. Nonetheless, Tasmania is unique in Australia owing to its total reliance on sea and air for freight transport in and out of the state, with a freight subsidy arrangement which caters to just one mode of transport. Thus, an assessment into the decision-making process of shippers when selecting from competing modes of transport in a Tasmanian context appears warranted.

The primary objective of this paper is to assess the impact of freight subsidization on transport mode selection in Tasmania. And, to determine what role sea freight subsidies have had in influencing the shippers' choice of transport mode for freight to and from Tasmania. The following questions have been established to form a basis for this objective:

- 1) Is the TFES the primary determinant for the selection of ocean transport as the mode of transport choice for shippers who utilise the TFES?
- 2) What other attributes are of importance to Tasmanian shippers utilising the TFES when selecting between sea and air freight?

## **2. Factors Affecting Transport Mode Selection**

Transport mode selection for shippers has attracted considerable attention in the literature. This attention spans several decades. Freight transport mode choice is a part of the decision-making process in freight transportation and involves the selection of an alternative based on relevant transportation performance variables (Meixell & Norbis, 2008). Arguably, the increasing importance of freight movement in logistics management and supply chains reflects a long-term shift in shippers' needs and expectation. Consequentially, the factors influencing shippers' mode choice in freight transport may have changed alongside the shippers' needs and expectations.

The impact of cost on mode selection has attracted considerable attention in the literature. In one early study, Stock & Londe (1977) found that cost is a critical factor which influences transport mode selection. Although considerable attention has been given to freight transport mode selection criteria, cost is still considered important in mode choice selection (Sun & Wandelt, 2021). The flexibility of transport cost in response to unexpected service demands influences mode choice selection (Beuthe & Bouffieux, 2008). The preference of shippers for standard pricing suggests that cost stability is an important cost-based selection criteria (Rodemann & Templar, 2014).

In one early study, Wilson, Bison and Kobia (1986) studied the factors influencing mode choice decisions of shippers in Canada. As well as identifying distance as a key factor which influences mode choice selection, the study identifies transit time is a significant factor. This study gives weight to

service-based criteria being highly influential in mode choice. In support of this, Wilson, Bison & Kobia (1986) found that shipping cost significance in influencing freight transport mode selection depends on cargo related variables such as cargo sensitivity to transportation costs, with service-based criteria, such as transit time and reliability, having greater significance than cost-based criteria.

It can hardly be disputed that the service quality of the transport mode influence transport mode choice. Transit time, service frequency, service availability, service capacity, and service reliability are commonly identified as influential service-based mode choice selection criteria (Cullinane & Toy, 1999; Brooks et al., 2012; Fanam, Nguyen, & Cahoon, 2016; Jung, Kim, & Shin 2018; Shin, Comi, & Polimeni, 2020). As well as transit time, the speed of the transport mode in terms of terminal time and transshipment time has also been identified as important (Cullinane & Toy, 1999).

Service flexibility has also been identified as influential (Bolis & Maggi, 1998). Flexibility is the ability of the transport system to accommodate variations or changes in traffic demand (Meixell & Norbis, 2008) the number of unplanned shipments which are made without excessive delay (Tavasszy, Kaa, & Liu, 2020). The degree of integration and coordination with other modes of transport is a significant factor in effective multimodal freight transportation, particularly between sea or air and land transportation (Behdani et al., 2016). Arguably, given Tasmania's reliance on multimodal freight transport, the integration and coordination between sea/air and land is important in freight transport mode selection.

Early studies such as that of Roberts (1971) and Cunningham (1982) identified that the characteristics of the cargo itself influence freight transport mode choice. When choosing between air and sea freight, shippers will consider the characteristics of the cargo in terms of the likelihood of damage as well as the ability and extent which the mode of transport can handle the cargo (Matear & Gray, 1993).

In one study, Lewis (1994) assessed the freight mode choice between air transport and sea transport. This study developed a comparative logistics cost model using cargo value, transit time, loss of product value and frequency of shipping as its criteria. The study found that the product cubic value density, product demand rate, market timing, demand variability are important factors which influences mode choice selection. Lewis study is considered important to this paper as it reinforces earlier findings that the importance of mode selection criteria can differ depending on the needs and expectations of the shipper in relation to the type of cargo being carried. Furthermore, in support of its significance, the study assessed a comparison of the two modes of transport of contextual relevance to this paper.

Larson (1988) developed a model to determine optimal transportation mode and freight quantity for shipping considering the inventory, order, and shipping costs. This study is significant because it makes a distinction between the cost trade-offs of air freight and sea freight based on the cargo type and shipment size, which is of similar contextual relevance to this paper as Lewis (1994) is.

Decades on from these earlier studies, cargo type is still found to be a significantly influential factor in

mode choice selection as evident in several studies such as Kök and Deveci (2019) as well as Mommens, Lier and Macharis (2020). Shipment size has still been found to be an important influence on mode choice for shippers in recent studies (Veras et al., 2021).

Each transport mode available to shippers has different characteristics, advantages, and risks. Shippers tend to characterise short sea shipping as both slow and complex (Chang & Thai, 2017). A study by Medda and Trujillo (2010) found disadvantages inherent in short sea shipping which contribute to this perception include the slow frequency, low reliability, a higher risk of damages to goods, and complicated logistics procedures. These disadvantages can be caused by sea transport's greater sensitivity to externalities such as weather than other modes of transport. Despite the disadvantage, risks, and heightened sensitivity to externalities, short sea shipping demand is generally inelastic to changes in the relative cost of alternative transport modes without impractical amounts of subsidisation of alternative transport modes (Merkel et al., 2021).

Arguably, the literature give weight to a view that Tasmanian short sea shippers select sea as the transport mode due to more than just cost related criteria, that is, the presence of the TFES subsidy scheme, and that cheaper air freight would do little to increase demand for air freight in to and out of Tasmania.

### **3. Methodology**

Data collection was undertaken using a webpage survey which was built in Google Forms (Google, 2022). To gather a list of respondents, information was obtained from publicly available sources including the Buy from Tasmanian Directory (Brand Tasmania, 2022) and publications from relevant from Australian Government bodies such as the Bureau of Infrastructure and Transport Research wherein potential respondents are identifiable.

The survey undertaken organised transport mode selection criteria into Likert-type questions. The questions utilised a five point scale ranking of importance. The survey was distributed to respondents via an email link. The survey included an accompanying information sheet and consent form. Consent was implied by the respondents' participation, given that the respondents were anonymous and no requests were made for company-sensitive data.

The sampling strategy is a self-selection sampling strategy. When using this strategy, the researcher uses their judgement in identifying those who are most likely to be able to provide data for the research (Williams, 2007). The study is publicised to these potential participants wherein they are invited to contribute to the study. The potential respondent is not obligated to participate in the study. Requests to participate may be declined if a potential participant feels as if they cannot make a valid contribution to the study or if they have no interest in being a participant.

#### 4. Findings and Discussions

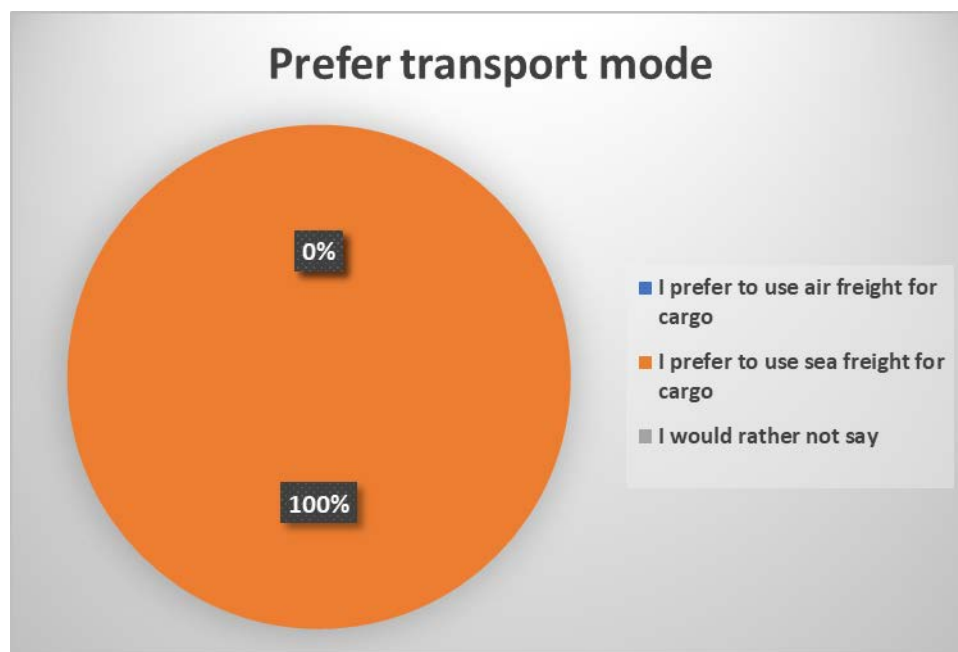
The aim of the analysis is to attempt to determine the level of influence on shippers of the transport mode selection criteria presented in the survey. Testing was done to determine the internal consistency of each category, which are cost, service, and cargo.

Descriptive statistics was used to report the influence of each criterion on transport mode choice selection. Findings were reported in the following groups: freight transport mode preference, shipping experience, experience with Tasmanian Freight Equalisation Scheme, cost-based criteria, service-based criteria, and cargo-based criteria.

A total of 55 survey responses were obtained from a total population of 216, representing a return rate of 25%. The author acknowledges that cold surveying via email may have resulted in low participation rates. This may be survey recipients having an aversity to unsolicited email contact of a non-business nature, a lack of time to respond, or a lack of interest in participation.

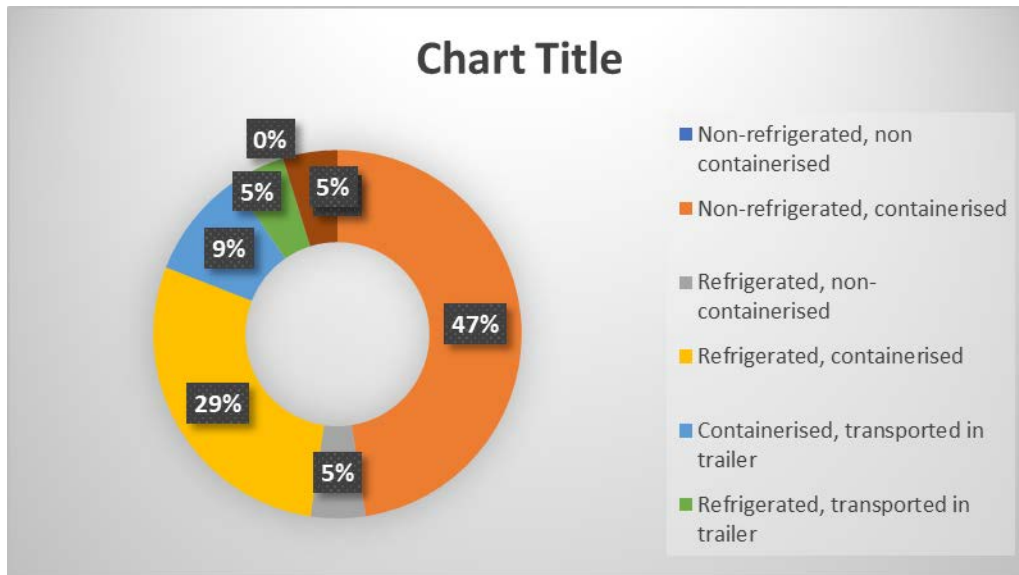
As shown in Figure 1 survey respondents were asked to procure their preferred method of freight transport in and out of Tasmania, either through air freight or sea freight. Responses to this question revealed that 100% of respondents prefer to use sea freight for cargo.

The findings concur with the prevalence of sea transport as the primary mode of transport for freight in and out of Tasmania (Productivity Commission, 2006; Productivity Commission, 2014). There is a possibility that shippers who use, or are possibly using, the Tasmanian Freight Equalisation Scheme frequently use both modes of transport and elected to choose their most utilised mode of transport.



**Figure 1. Frequency of Freight Transport Mode Preference Responses**

Survey respondents were asked to describe their cargo in terms of its transport requirements. Responses to this question demonstrated a variety of cargo amongst the respondents. As depicted by Figure 2 cargo is mostly non-refrigerated, containerised cargo (47%) or refrigerated, containerised cargo (29%).



**Figure 2. Frequency of Cargo Type Responses**

This higher frequency of non-refrigerated, containerised cargo was also evident in the data with a response rate for containerised cargo transported in trailer (9%) and refrigerated cargo transported in trailer (5%). One respondent declined to provide this information. It is suggested that containerised cargo is much more prevalent than non-containerised cargo. It is also suggested that cargo is more likely to be non-refrigerated cargo than refrigerated cargo.

As shown in Table 1 survey respondents were asked to describe their years of experience with shipping freight in/out of Tasmania. 13% of the respondents have been shipping freight for over ten years, 38% between five and ten years, 27% between one and five years, and 15% for less than a year and with 7% respondents declined to provide this information.

Arguably, the data suggests that the majority of respondents are sufficiently experienced in shipping freight in/out of Tasmania and are mindful of cost, service, and cargo concerns when shipping their freight.

**Table 1. Frequency Table of Shipping Experience Responses**

Experience with shipping cargo in/out of Tasmania				
	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 1 year	8	15%	15%	15%
Between 1-5 years	15	27%	27%	42%
Between 5-10 years	21	38%	38%	80%
More than 10 years	7	13%	13%	93%
I would rather not say	4	7%	7%	100%

Survey respondents were asked to describe if they were claimants of the Tasmanian Freight Equalisation Scheme. The data results in Table 2 revealed that 20% of the respondents said yes, 55% of the respondents said no, 23% of the respondents said that they did not know, and 2% of the respondents declined to provide an answer to this question. Arguably, the respondents who use the Tasmanian Freight Equalisation Scheme enrich the study by providing a valid insight into to what extent costs influence their decision to use sea freight.

**Table 2. Frequency of Experience with Tasmanian Freight Equalisation Scheme Responses**

Experience with Tasmanian Freight Equalisation Scheme				
	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	11	20%	20%	20%
No	30	55%	55%	75%
I don't know	13	23%	23%	98%
I would rather not say	1	2%	2%	100%

#### 4.1 Analysis of Freight Transport Mode Selection Criteria

Analysis required coding of data. There are numerous statistical software alternatives of varying degrees of capabilities available (Ozgur, Kleckner, & Li, 2015). Coding of data in the research was undertaken using IBM SSPM, one of the most widely used statistical software in studies (Masaudi et al., 2021). The summarisation of Likert scale data in IBM SPSS was done through merging the variables using the method of (Kostoulas, 2014).

An important part of coding the data was determining the levels of internal consistency. Internal consistency expresses the degree to which the items of a survey produce similar scores (Anselmi, Colledani, & Robusto, 2019). It is a useful means of checking on the quality of data (McCrae et al., 2010). There are several measures which can be applied (Anselmi, Colledani, & Robusto, 2019). Internal consistency of the data in the research was tested using Cronbach's alpha in IBM SSPS. The



results of this indicated that there was an acceptable level of internal consistency in each category as per Table 3.

**Table 3. Cronbach's Alpha Test of Internal Consistency**

Category	Cronbach's alpha
Costs	.836
Services	.791
Cargo	.708

The literature identified cost as a common mode choice selection criterion for shippers. Cost-based criterion identified in the literature include freight costs (Stock & Londe, 1977), cost flexibility (Beuthe & Bouffioux, 2008), cost stability (Rodemann & Templar, 2014) as well as relative cost of other transport modes (Merkal et al., 2021). Cost flexibility and cost stability, respectively, were explained to respondents as:

- Cost flexibility: The consistency of freight costs.
- Cost stability: The potential for bulk discounts, or last-minute booking costs.

The data indicated in Table 4 revealed that the cost of the transport mode is an important selection criterion for Tasmanian shippers, with data consistently reporting a mode of 4 (important). Of the five criteria, the freight price itself demonstrated considerable importance with 53% and 33% of respondents identifying it as important and very important, respectively.

Respondents predominately identified stability of freight price to be either important (72%) or very important (14%). With a mode of 5, flexibility of freight price was found to be influential, with 24% of respondents identifying it as important, and 53% identifying it as very important.

The data for cost-based criteria was summarised in IBM SPSS Statistics by merging the variables through computation (Koustoulas, 2014). The summarised category in Table 5 had a median response of 4 (Important) which indicates that cost is considered important to Tasmanian shippers.

The lack of respondents identifying air freight price as important in mode choice selection (0%) appears to be congruent with the findings in the literature review sea shipping demand is generally inelastic to changes in relative costs of transport (Merkal et al., 2021).

**Table 4. Frequency Table for Cost Responses**

Cost	Not important		Slightly important		Moderately Important		Important		Very important	
	Count	Row N	Count	Row N	Count	Row N	Count	Row N	Count	Row N
Freight price	5	9%	0	0%	3	5%	29	53%	18	33%
Stability of freight price	5	9%	0	0%	3	5%	39	72%	8	14%
Flexibility of freight price	5	9%	0	0%	8	14%	13	24%	29	53%
Air freight price	55	100%	0	0%	0	0%	0	0%	0	0%
Sea freight price	0	0%	0	0%	18	33%	29	53%	8	14%

Thus, arguably, the investigation into to what extent alternative transport costs influence Tasmanian sea shippers is justified.

**Table 5. Descriptive Statistics for Cost Responses**

Cost	Freight price	Stability of freight price	Flexibility of freight price	Air freight price	Sea freight price
N Valid	55	55	55	55	55
Missing	0	0	0	0	0
Median	4.00	4.00	5.00	1.00	4.00
Mode	4	4	5	1	4

Service-based criteria was identified in the literature as a very influential mode choice selection criterion for shippers. Service-based criteria identified in the literature include transit time, terminal time, availability, capacity, flexibility, frequency, reliability, and integration/coordination with land transportation (Bollis & Maggi, 1998; Cullinane & Toy, 1999; Meixell & Norbis, 2008; Brooks et al., 2012; Behdani et al., 2016; Kök & Deveci, 2019).

Service availability, capacity, flexibility, frequency, and reliability were explained to respondents as:

- Service availability: How often the service is available.
- Service capacity: The shipping capacity of the mode.
- Service flexibility: The capacity for planned shipments without excessive delays.
- Service frequency: How frequently the service runs.
- Service reliability: How often the service is on time.

Table 6 shown the analysed results of the service-based criteria. Transit time was frequently reported as being a major selection criteria in freight transport mode selection for Tasmanian shippers, with 18% respondents identifying it as very important and 55% as important.

**Table 6. Frequency Table for Service Responses**

Service										
Not Important	Slightly		Moderately		Important		Very Important			
	Count	Row N	Count	Row N	Count	Row N	Count	Row N	Count	Row N
Transit time	0	0%	10	18%	5	9%	30	55%	10	18%
Terminal time	0	0%	16	29%	16	29%	21	38%	2	4%
Service availability	0	0%	8	14%	26	48%	18	33%	3	5%
Service capacity	0	0%	8	14%	16	29%	26	48%	5	9%
Service flexibility	0	0%	8	14%	18	33%	26	48%	3	5%
Service frequency	0	0%	8	14%	29	54%	13	23%	5	9%
Service reliability	0	0%	0	0%	13	23%	34	63%	8	14%
Logistics procedures	5	9%	24	44%	16	29%	10	18%	0	0%
Land based integration	3	5%	5	9%	26	48%	13	24%	8	14%

This concurs with its prevalence in the literature review as a common mode choice selection criterion of importance. Significantly, service capacity was identified by 48% as important, suggesting that the capacity of the transport mode is important in mode choice selection for Tasmanian shippers, as is flexibility, with 48% identifying the capacity for unplanned shipments without excessive delays as an important criteria.

The data for service-based criteria was summarised in IBM SPSS Statistics by merging the variables through computation. This summarised category had a median response of 4 (Important) which indicates that service based criteria are considered important to Tasmanian shippers. This observation is in strong support of the findings of other researchers identified in the literature.

The literature identified cargo as a very influential mode choice selection criteria for shippers. Cargo-based criteria identified in the literature include cargo value, cargo value/weight ratio, cargo size in terms of weight and volume, product demand, market timing, seasonal variability, shipment size, and the likelihood of damage (Roberts 1971; Cunningham 1982; Larson 1988; Matear and Gray 1993; Lewis 1994; Kök and Deveci (2019).

Table 7 shows that the most important cargo-based freight mode selection criteria to Tasmanian shippers is shipment size, with 49% of respondents identifying shipment size as very important. Cargo size by weight was identified by 29% of respondents as very important and 43% as important. Cargo size by volume was identified as important by 77% of respondents. Likelihood of damage and cargo were also highly ranked in importance.

**Table 7. Frequency Table for Cargo Responses**

Cargo										
Not Important			Slightly Important		Moderately Important		Important		Very Important	
	Count	Row N	Count	Row N	Count	Row N	Count	Row N	Count	Row N
Cargo value	0	0%	10	18%	16	9%	21	55%	8	18%
Value/weight ratio of cargo	2	4%	13	23%	16	29%	22	40%	2	4%
Cargo size (volume)	0	0%	8	14%	5	9%	42	77%	0	0%
Cargo size (weight)	0	0%	8	14%	8	14%	23	43%	16	29%
Shipment size	0	0%	2	4%	8	14%	18	33%	27	49%

Likelihood of damage	0	0%	5	9%	2	4%	36	69%	10	18%
Market demand	0	0%	2	4%	13	23%	40	73%	0	0%
Seasonal variations	0	0%	10	18%	16	29%	29	53%	0	0%
Market Timing	0	0%	5	9%	13	23%	34	62%	3	6%

## 5. Conclusions

Common cost-based, service-based, and cargo-based selection criteria have been examined in the context of Tasmanian shippers. Service-based and cargo-based criteria returned a similar median response score to cost. Some Tasmanian shippers may see any combination of the three categories as important in equal measure.

The data provided valuable insight into the mode choice selection process for Tasmanian shippers. The findings of this paper concur with the findings of previous researchers. It can be implied that Tasmanian shippers go through the same mode choice selection process as other shippers worldwide and are well aware of the cargo characteristics and service/cost characteristics that form their expectations when choosing a transport mode.

The findings of the paper revealed that the number of respondents who identified as being a claimant of the Tasmanian Freight Equalisation Scheme is small which shows that TFES is not the key determinant for the mode choice for Tasmanian shippers.

The results of this study provide valuable insights for policymakers, carriers, and other stakeholders involved in the freight transportation. The findings highlight the importance of carefully considering the trade-offs involved in freight transportation mode selection and the impact of subsidies on these trade-offs. Future research could build upon this study by examining the impact of freight subsidization in different geographic regions, transportation modes, and economic conditions. The continued study of the impact of freight subsidization on transport mode selection will be essential for improving the efficiency and sustainability of the freight transportation system.

In conclusion, the impact of freight subsidization on transport mode selection is a complex and multifaceted issue that requires careful consideration. This study aimed to evaluate the effect of freight subsidies on the overall transport mode choice decision making of Tasmanian shippers and to identify the trade-offs involved in the mode of transportation selection. The research findings showed that freight subsidies can have some impact on transport mode selection and can promote the adoption of specific modes of transportation. However, it is important to understand that it is a complex

decision-making process for the shippers.

The paper acknowledges the limitations of a quantitative research method. Employing a mixed method would have enriched the study. Additional insight could be gained by interviewing Tasmanian shippers in a mixed method study.

Future research is recommended. Specifically, a connection could be made between TFES users and cost-based criteria to better examine the role of freight transport costs. Additional research into cargo size, likelihood of damage to cargo, and market demand in the context of freight transport mode selection for Tasmanian shippers is warranted due to the response provided to this study.

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