Short-sea shipping: Stated Intentions of Shipowners and Operators in the Southern Africa Development Community Region

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Abstract

The Southern Africa Development Community (SADC) region has a need to develop its freight transport network to achieve its development objectives, and short-sea shipping (SSS) has been suggested as a way of achieving some of these objectives. The SADC region however requires impetus in terms of strategy and policy to develop SSS. This paper explores the stated preferences of shipowners and operators (maritime carriers) towards SSS in the SADC Region. It reports on a stated intentions survey conducted with 30 maritime carriers in SADC, which is then analysed using the ordered logit model. The relative influence of the following factors on the preference towards SSS is investigated: volumes of dedicated freight, income per unit cargo carried, percentage discount in port dues, percentage discount in terminal handling charges and ship registration provisions. The results reveal that ship registration provisions and terminal handling charges are the two major factors to address in order to develop SSS in SADC. The adoption of a regional maritime cabotage system is recommended as a strategy increase the take up of SSS by maritime carriers. The results can now inform policy and strategy to develop maritime transport in SADC.

Keywords: *Short-sea shipping, Africa, stated intentions, ordered logic, Southern Africa*

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1. Introduction

Short sea shipping (SSS) is a sustainable mode of transport that can facilitate the interconnectivity of the Southern African Development Region (SADC) without the need for high infrastructure investments (SADC, 2018). The SADC region currently has insufficient capacity in its transportation network (Konstantinus et al., 2019) which contributes to high rates of road accidents (Usami et al., 2020), high transport costs (Vilakazi, 2018), traffic congestion, pollution (SADC, 2013); and polarised modal split in favour of road transport (Vilakazi et al., 2014). For this reason, it has been suggested that the introduction of SSS in SADC could assist to achieve the region's environmental and socio-economic ambitions. Namely, SSS can lead to the reduction of traffic congestion levels on the roads by adopting a better equilibrium among different modes of transport (Monios & Bergqvest, 2017), the reduction of pollution emissions (Arof, 2015), fewer accidents in terms of human safety (Musso et al., 2010), low energy consumption (Johnson & Styhre, 2015), low transport costs (Rodrique, 2017) and most importantly - the expansion of the transport network (Mokhele, 2014).

The SADC region considers the development of SSS as part of its Blue Economy initiative (SADC, 2018). In the SADC Region Blue Economy Concept paper (SADC, 2018), the region recognises that 'oceans have a major role to play in humanity's future and that the Blue Economy offers an approach to sustainable development that is better suited to [the region's] circumstances, constraints and challenges'; and accordingly lists SSS as a major opportunity to harness the benefits of the Blue Economy (SADC, 2018: 8). Of particular significance, the introduction of SSS can help achieve the region's milestones in terms of the Millennium Development Goals (UNIDO, 2008) and the Sustainable development Goals (UNECA, 2016) which SADC is currently not on track to achieve (Naude, 2009).

The development of SSS in SADC is however not without its challenges. Chasomeris, (2006) who considers South Africa's ship registration and maritime fiscal policies argues that there is a need to create an enabling business environment for ship owning and operation. Subsequently, Smith-Godfrey (2018) who considers the policy implications of SSS in South Africa, notes that maritime cabotage – which proposes reservation of local shipments to locally owned ships - face an uphill of challenges to successfully operate including: a lack of suitably qualified crew to man ships, lack of capacity to build ships and lack of capital to purchase and operate ships as major barriers to the realisation of an effective maritime cabotage system (Smith-Godfrey, 2018: 2). Konstantinus et al., (2019) finally submit that SADC ports are characterized by high port charges, long turnaround times for ships and lack of infrastructure for SSS.

Notwithstanding these challenges, the opportunity to realise maritime cabotage is enhanced at the Africa continental level in the recently passed Africa Integrated Maritime Strategy, which in Article 15 provides that "[AU] Members shall promote [maritime] cabotage and effective participation of private sector operators at national, regional and continental levels" (AU, 2015). This proposal is further enhanced by the Africa Continental Free Trade Area agreement (AFCTA), which when fully implemented, will supposedly create a single market of goods with a combined GDP of $3.2 trillion (Obeng-Odoom & Franklin, 2020). Such a market has the potential to drastically accelerate the use of SSS for inter-continental trade.

On this backdrop, the current paper explores stakeholder preference in SADC to ascertain how an enabling environment for the development of SSS in SADC could be shaped. The specific objective of this study is to assess the extent to which the determinants of SSS will influence the preference of maritime carriers to participate in SSS in SADC. The stated intentions of maritime carriers (shipowners and operators) are assessed given varying levels of freight volumes, port charges and ship registration policies in a hypothetical SSSS network. From these observations, it is important to ascertain the key decision criteria for maritime carriers when deciding to participate in SSS. Discrete choice modeling, specifically the ordered logit model (Fok et al., 2012), is employed due to its methodological flexibility to capture behavioural realism. Discrete choice modelling permits the construction of general utility functions incorporating various decision maker characteristics and choice attributes to elicit preference for services and interventions that have not yet been introduced (Train, 2002), including the contribution of feelings and sentiments of environmental concerns as latent attitudes towards the perceived utility of a transport mode, see Kim et al (2014) and Atasoy et al (2012).

The remainder of this paper proceeds as follows. Section 2 presents a literature review, followed by a discussion of the data collection and model specification work. Section 6 presents the results, while Section 7 provides a discussion of the implications of the modelling results. Finally, section 8 presents conclusions of the work.

2. Literature Review

The development of SSS has received considerable research attention in the last decade. Zakaria et al., (2020) examines the different manners in which SSS has been researched by conducting an inclusive review of papers published in well-known journals over the 2002–2019 period. That study revealed that the classification and identification of the determinants and hindrances of SSS emerged as a dominant research area. Raza et al., (2020) also conducts a systematic and detailed literature review of 58 peer reviewed journals on modal shift

towards SSS and identifies six key areas for research, namely: policy-oriented perspectives that favours SSS, environmental legislation, factors influencing the competitiveness of SSS, performance of SSS, port characteristics, and multi-agent perspectives. They further suggest that researchers should employ real life data to identify the drivers and barriers for mode shift; to SSS which the current study does. Studies employing discrete choice modelling to study SSS have also increased and spans the entire world; however most were conducted from a shipper perspective and little from a carrier perspective (Konstantinus et al., 2020; Feo-Valero et al., 2016; Kim et al., 2014; Bergantino et al., 2013; Brooks et al., 2012).

A definitive paper in the SADC region is Konstantinus et al, (2019) who studies the development of SSS in the SADC region through a theoretical analysis of the political environment, geography, trade statistics, state of infrastructure development and the general impediments to maritime transport; and conclude that SSS has the theoretical potential to work in the SADC given the large geographic region, projected freight volumes and customs and trade policies the SADC region is pursuing; however there is a need to create an enabling business environment for ship owning and operation. According to Konstantinus et al., (2019), SSS can serve three major functions: to offer unimodal freight transport between port cities, to offer the main leg of an intermodal route, and to offer feeder services to deep sea shipping in a hub-and-spoke cycle.

Following Konstantinus et al, (2019), Konstantinus et al., (2020) investigates the take up of SSS by shippers and freight forwarders on three corridors in SADC, running between Cape Town and Walvis Bay, Walvis Bay and Luanda and between Durban and Beira. That study uses stated preference with the following base variables varied: frequency of service, reliability, transit time, cost and extent of delay; and concludes that in order to successfully force a modal shift from road to SSS, SSS has to become competitive in terms of transit time and frequency of service. The results of that study also revealed that urgent shipments and shipments on the head leg of the transport journey in SADC will prefer road over SSS, and that freight mode choice is influenced by a combination of modal attributes, situational variables and that these decisions are subject to variation. That study further highlights as an area for further research, SSS must be assessed from a carriers' perspective.

Carrier preference studies have majorly focused on port choice (cf. Talley & Ng, 2013; Tongzon and Sawant, 2007; Tran, 2011). In Europe, where SSS has been aggressively pursued, a few studies have considered carrier choice for SSS. Russo et al, (2016) provides an analysis of carrier preference in a choice context in the south-eastern range of the Mediterranean with

the aim of developing strategies for SSS; however considers only competition between two types of SSS services: roll on-roll off (ro-ro) and lift on-lift off (lo-lo) SSS services, and not the preference of maritime carriers for SSS per se. Other carrier preference studies have considered general maritime determinants for port choice. Talley & Ng (2013) who studies the determinants of port choice - develops a maritime transport chain choice model using the theory of variational inequalities, wherein carriers seek to maximize supply chain profits, ports seek to maximize throughput and shippers seek to minimize supply chain logistics costs in choosing a maritime transport chain. Aronietis et al. (2017) also studies the preference of carriers - but for bunkering services. The study aim in Aronietis et al. (2017) is to ascertain what factors carriers consider when they choose in which port to take bunkers. That study employed an unlabelled binary choice survey between two hypothetical ports with different port and bunker characteristics and for analysis employed the multinomial logit model. Aronietis et al., (2017) conclude that bunker price and qualities are the most important factors.

The present research feeds into this earlier research by specifically assessing the conditions under which maritime carriers (ship owners and operators) would participate in an integrated SSS network in the SADC region. This paper's contribution to the body of SSS literature is threefold. First, this paper is a model-based contribution to research on maritime carrier preference. Alongside Russo et al., (2016) and Aronietis et al. (2017), very few choice modelling papers have considered SSS from a carrier perspective. Second, by assessing the stated intentions of shipowners and operators, the study develops new quantifiable insights to identify the optimal measures to realise maritime transport in the SADC region. Thirdly, the focus is on maritime transport as a continuation of earlier studies to study the take up of short-sea shipping in the SADC region.

3. Determinants of SSS: A carrier perspective

To assess the development of SSS, there is a need to consider the factors influencing carrier preference. According to Paixao Casaca & Marlow (2005) the development of SSS must be considered along five inter-related branches: (1) the political framework, (2) the inter-regional trades, (3) the five underlying forces of SSS, (4) the action of SSS competitors and (5) the short sea shipping operating environment. Additionally, Medda & Trujillo (2010) who studies the determinants of SSS in the context of the European Union submits that to effectively assess the viability of SSS in a region, a number determinants must be considered, namely: environmental determinants such as production trends and just-in-time deliveries; operational determinants such as product type, operational distance and type of ships; and infrastructure determinants including port readiness which is a requirement for a seamless intermodal transport system. This study considers freight volumes, port dues, terminal

handling charges and ship registration policies. These factors are also considered in this study as choice attributes during model development.

Freight Volume

Freight volume as a determinant for SSS is taken from Konstantinus et al., (2019) who submits that as a first consideration, sufficient volume of freight is required to develop SSS. The primary reason for sufficient volumes is because SSS derives its competitive advantage from economies of scale and density, which allows it to offer low freight rates compared to road and rail (Brooks & Trifts, 2008). For this reason, governments in Europe and the USA have assigned freight quotas to SSS through incentives, policies and programmes aimed at ensuring sustainability of SSS, forcing a modal shift to SSS and enhancing environmental protection (Merk, 2020).

Port dues and Terminal Handling Charges

According to Ng, (2009), the two major components of port related expenses which influence SSS expenditure are port dues, which are charged to ship operator for services; and terminal handling charges – which are charged to the shipper for cargo handling and storage. Port expenses are also key determinants in port choice and is often considered important to calibrate in order to attract carriers. A notable study is Bergantino & Coppejans (2000) who considers shipowner preference for port attributes and accordingly presents a port pricing mechanism appropriate for allocating common maritime infrastructure cost which would allow efficient allocation and one cost which takes into account demand characteristics assuring a realistic interpretation of market's behaviour.

The determinants of port choice are investigated by Tran (2011), who concludes that the selection of a port is based upon the minimization of the overall cost of the transport chain. The selection of a port by carriers and shippers depends on the services provided by the port, the qualities of these services and overall performance of the transport chain within the port (Talley & Ng, 2017). These findings are supported by Tongzon and Sawant (2007) who employ binary logistic regression to study port choice from data obtained from 31 major shipping lines in Malaysia and Singapore, and conclude that port services and port charges are significant determinants of port choice.

In the SADC context, Konstantinus et al., (2019) suggests that SADC ports can forego (or slash) revenue from receiving terminal handling charges and port dues for ships operating under SSS. These incentives may be done under new or existing regional instruments. For example, SADC's 2003 Regional Indicative Strategic Development Plan (RISDP), sets out a 15-year roadmap for regional integration in SADC, and recognises trade and economic integration as

one of the four priority areas of SADC integration (Isaksen, 2004). Through the Trade Protocol, member states may agree to reduce tariffs and other barriers to trade within the region, and to establish a free trade areas among themselves.

Maritime policies in favor of SSS

The regulatory environment generally requires reformation for SSS to become viable. This is generally done by reforming ship registration and maritime fiscal policies (Marlow & Mitroussi, 2011) and by direct outright promotion of SSS (Medda & Trujillo, 2010). These factors have long been considered as key determinants of SSS. For example, Brookes et al., (2012) considered the potential competitiveness of SSS between Australian flagged and foreign flagged vessels and the potential impacts of carbon taxing on the take up of SSS; and Konstantinus et al., (2019) argues that there is a need for policy reform if SSS is to be developed in SADC.

The act of ship registration provides a title to a ship, which allows it to operate and trade. Under the Law of the Sea Convention (UNCLOS): Art 91 stipulates that ships have the nationality of the state whose flag they fly, and the state [flag state] must set the conditions for the grant of its nationality of ships (UNCLOS, 1982). The flag state is also termed a registry and there are different classification of ship registries with the two main types being closed registries and open registries (Chasomeris, 2006). Closed registries allow only ships owned by nationals to register, whereas open registries (also known as flags of convenience – FOCs) have virtually no restrictions as to who may register with them (Bergantino & Marlow, 1998). Ever since World War II, there has been a migration of shipowners from closed registries to FOCs. The driving force behind this migration has been the risk-return trade off which most closed registries have not been able to offer. FOCs will typically provide fiscal advantages, lower crew costs, and reduced regulation and administration (Mitroussi & Argyrou, 2016; Merk, 2020). However , at times FOCs also present the risk of causing huge environmental damage and the exploitation of seafarers by shipowners compared to closed registries (Kavussanos and Tsekrekos, 2011).

Linked to ship registration are maritime cabotage policies. Konstantinus et al., (2019) argues that the development of SSS in Europe was achieved majorly through maritime cabotage, in particular the expansion of the maritime cabotage area in 1985 and later with policies that outright promoted the use of SSS. The expansion of the European cabotage market to date is said to have come from the partial liberalization of European shipping services in 1985 (Pallis, 2002). Liberalisation in Europe meant maritime cabotage services was extended to all regional shipowners and countries in Europe, a move, which opened up a larger market in which SSS

could operate, and thus ensured sufficient freight volumes to sustain SSS (Konstantinus et al., 2019). It was only in the year 2000 that the European market was entirely liberated. This protracted time frame of protectionism between 1985 and 2000 ensured that European shipowners-maintained control of the market share, and this made it difficult for non-European carriers to enter the market when the SSS market was liberated. Accordingly, one might argue that a similar approach be taken in SADC.

Lastly, transport policies that favor SSS may also be considered. Globally, different national and regional authorities, such as the US Maritime Administration (MARAD) and European Commission (EC), have funded several projects and have put in place initiatives aimed at strengthening the competitiveness of SSS and achieving a modal shift to SSS (EC, 2006). The success of European SSS is said to be attributable to outright political actions taken to improve the competitiveness of SSS (Medda & Trujillo, 2010). Today in Europe, the main policies for SSS include policies dedicated to funding SSS transport infrastructure (TEN-T projects) and those dedicated to supporting SSS operations and activities (PACT and Marco Polo I and II) (Konstantinus et al, 2019). Marco Polo and Motorways of the Sea, which are parts of the Trans-European Transport Network (TEN-T) program, Energy Law (HR 6) and Short Sea Shipping Co-operative Program (SCOOP) are some initiatives that represent the intent of European and US policy makers to promote a modal shift towards SSS. In the context of SADC region, similar policies and initiatives must be considered from the context of the SSS operator.

4. Methodology

To investigate the preference of maritime carriers, the study develops a stated intentions (SI) survey which is a kind of stated preference survey with ordinal responses. To analyse the data, the study employs the ordered logit (OL) model.

4..1 Stated Intentions

Stated Intentions (SI) surveying is a type of stated preference survey technique that is used to predict the future behaviour of a certain population (Sun and Morwitz, 2010). In a SI survey, respondents' answers are used to predict the future behaviour of a certain population. However, unlike stated choice surveys which require respondents to make choices (Hensher et al., 2015), stated intention surveys just capture hypothetical intentions (Sun and Morwitz, 2010). These intentions are captured were respondents are asked to indicate the action they would take given a certain scenario. The scenarios employed are usually systematically designed and developed through an iterative planned experiment design process (cf. Hensher et al., 2015 at Chapter 6).

With our aim of estimating mathematical models on the data, we decided to employ a d-efficient experiment design which is able to produce more efficient designs with more reliable parameter estimates from a small sample size (cf. Huber & Zwerina 1996; Rose & Bliemer, 2009). The final experiment design for this study yielded twelve choice scenarios with a target minimal sample size of 27 respondents. The sample size was confirmed by the s-error of the design output and this reveals the minimal sample size required to obtain a statistically significant design (Hensher et al., 2015: 266).

4..2 Ordered Logit

The OL model employs random utility maximization, which falls under the compensatory decision-making framework (Hensher et al., 2015). The OL model is a regression model for ordinal response variables which is based on a series of cumulative probabilities of the response variables, where, the logit component of each cumulative probability is assumed to be a linear function of the covariates, while the regression coefficient is kept constant across response categories (Fok et al., 2012). If we consider the example in this study (see section , the probability for response alternative (*Yes*) being selected, given no other alternative was chosen is expressed as follows (Hess and Palma, 2019):

$$P_{Y_{n,t=k}} = \frac{\exp(\tau_k - V_{nt})}{1 + \exp(\tau_k - V_{nt})} - \frac{\exp(\tau_{K-1} - V_{nt})}{1 + \exp(\tau_{K-1} - V_{nt})} \qquad (1)$$

where P_Y is the probability of alternative *Yes* being selected given no other selection is made; τ represents the vector defined by the *k* thresholds parameters employed in the model; and, *V* is the systematic component of the utility function in equation (equations 3 and 4).

The likelihood *L* of obtaining a final ranking of choice *Yes* in choice set *K* is subsequently a product of *t* logit probabilities estimated in a partial likelihood procedure as depicted below (Hess and Palma, 2019):

$$L_{Y_{n,t}} = \sum_{k=1}^{K} \delta_{(Y_{n,t=k})} \left[\frac{\exp(\tau_k - V_{nt})}{1 + \exp(\tau_k - V_{nt})} - \frac{\exp(\tau_{K-1} - V_{nt})}{1 + \exp(\tau_{K-1} - V_{nt})} \right] \qquad (2)$$

where for normalization $\tau_k = +\infty$ and $\tau_0 = -\infty$, such that $P_{Y_{n,s}} = 1$ is given by: $\frac{\exp(\tau_k - v_{ns})}{1+\exp(\tau_k - v_{ns})}$.

All model development and estimation was conducted in R using the Discrete choice modelling software package Apollo (Hess & Palma, 2019).

5. Survey Development

5.1 Study Setting

The survey was framed around the hypothetical situation where a regular SSS service is offered between the following port cities: Luanda, Walvis Bay, Cape Town, Port Elizabeth, Durban, Beira, Dar es Salaam. The average distance between the selected ports of the proposed SSS network is 1,400km, which is the threshold level at which SSS becomes competitive (Konstantinus et al., 2019). While some of the distances in the proposed network are below this threshold, including between Durban and Port Elizabeth (900km) and between Cape Town and Port Elizabeth (800km), the freight volumes on these routes justified their inclusion.

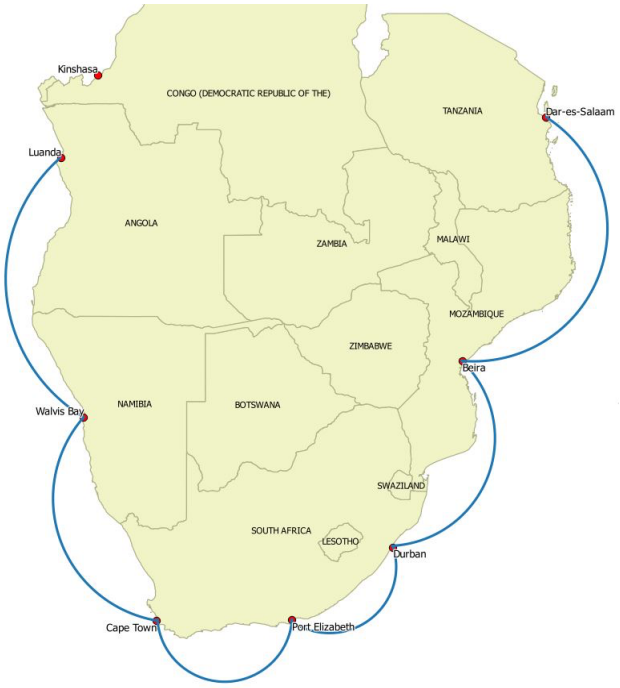

Figure 2: Hypothetical SSS operations network in SADC

In this SSS system, interviewees were informed that containerized shipments would be transported by sea for the longer legs of the journey, and by road or rail for the remainder of the journey. The carrier for the entire transport chain would be a single entity, which means door-to-door carriage. That also means, a single carrier would also be responsible for all costs pertaining to the transportation of the container (including terminal handling charges). Participation in the proposed SSS system would be voluntary. Carriers who are willing to participate could be offered discounts and numerous incentives by governments in SADC.

5.2 Choice Attributes

Table 1 presents the choice attributes, descriptions and their levels. Figure 1 offers an example of one of twelve choice tasks employed in the study. The attributes were determined from literature, and this was additionally augmented by semi structured interviews held with maritime industry experts that included ship operators and ship agents. The base levels for

the attributes were obtained from local shipping companies and port authorities and these were supplemented by focus group discussions (see section 4.3). A local coastal shipping company Ocean Africa Lines and the Namibia Ports Authority assisted much to set the attribute ranges, as they availed their service levels and by how much they could realistically be adjusted if SSS became a political initiative.

Table 1. Choice attributions

Attribute	**Description**	**Attribute levels***
Choice attributes used in experiment design		
Transport charge	Income per TEU in USD for door to door transport between 2 adjacent port locations	$1500 - $2000 - $ 2500
Freight volumes	Dedicated freight volumes in TEU numbers given to carrier per week	50-150-200-250 TEU's
Terminal handling discount	Percentage discounted from terminal handling charge	0% - 15% - 30% - 45%
Port dues discount	Percentage discounted from port dues	0% - 15% - 30% - 45%
Flag requirements	Ship registration restriction. Carriers are allowed only the presented option.	Flag of convenience (FOC) Any closed registry Any SADC registry

Attribute	Value		
Transport Charge (door-door):	US$ 1,500		
Dedicated Container Volumes per week:	50 TEU units		
Port Dues discounted by:	45 %		
Terminal Handling Charge discounted by:	0 %		
Flag requirement:	Ship must register in any closed registry		
*Would you operate your vessel?	Yes	Not sure	No

Figure 1. Example of choice scenario in the study

5.3 Survey layout

The questionnaire consisted of three sections: (1) Perceptions on maritime policies, (2) Stated Intentions (SI), and (3) Respondent Characteristics. The attitudes and perceptions section of the questionnaire used binary questions (i.e. yes and no) to capture the perceptions of maritime carriers regarding policies to grow maritime transport in SADC. Notably, the proposal for Flags of Conveniences (FOCs) in this study was not particularly focused on the establishment of the 'genuine link' as required in Art 19 of UNCLOS (UNCLOS, 1982), but rather the detachment of all inland laws from shipping laws, relaxing of employment and ship owning requirements, and the introduction of tax incentives across countries in SADC.

The second section is the core of the survey. Participants were asked to indicate whether, given varying levels of the choice attributes, they would or would not operate their vessel. They could also indicate that they were not sure. Respondents were presented with twelve

such choice scenarios, as shown in Figure 2, and some diagnostics questions that assessed how serious the respondents took the survey. The third section captured the characteristics of respondents including sea service (deep sea or coastal), nationality, company size, and shipping sector.

5.4 Survey Piloting and Refining

The initial survey was piloted during a focus group discussion, which was held with the Namibia Ports Authority and two maritime carriers in Cape Town. The pilot survey was necessary to check the adequacy of the questions, respondents' understanding of the choice setting, the adequacy of attributes and levels and whether the number of choice tasks can be managed by the respondents (Hall et al. 2004). The focus group meetings also helped to refine the survey, the attributes and the attribute levels. In addition, considering that similar studies hadn't been conducted in SADC before, the pilot survey was critical as an a priori survey to provide data on which to estimate initial models to produce coefficient estimates that were employed as priors for the final experiment designs (cf. Rose & Bliemer, 2009).

Considering the development of the proposed SSS system centers on policy suggestions, it was necessary that respondents reflected their true preferences. To increase the probability of respondents reflecting their true preference during the SI part, the opening statement of the choice scenarios was phrased such as to incorporate the theory of 'truth in consequentiality'. This theory suggests that truthful preference revelation is possible, provided that participants view their decisions as having the chance of influencing policy (Vossler et al., 2012). Fittingly, at the start of the SI section, respondents were first asked to indicate their understanding of the wording and then how they understood the choice scenarios. Respondents were then reminded that their choices could influence transport policies and were asked to make their choices in earnest. It was also resolved that interviewers were to use the same precise wording for all interviews.

5.5 Sample size considerations

It was anticipated that, due to the specificity of the respondent type for this study, the small target market, and the nature of business studied, data collection would be cumbersome and hence a small sample size was expected. This is not uncommon in freight research, especially maritime research, where the number of operators is often small, and there is in addition often reluctance by operators to participate in surveys due to concerns about confidentiality (cf. Bergantino et al., 2013). Bridges et al. (2012) submits that sample sizes of as little as twenty (20) can be feasible and functional for conjoint analysis. Furthermore, Lancsar and Louviere

(2008) provide that one rarely require more then 20 respondents per questionnaire version to estimate reliable models.

6. Data

A region wide survey was conducted between November 2017 and May 2018 with maritime carriers in SADC, who own, manage or operate ships. The respondents were delineated by nationality, flag of ship, service sectors, size of companies in terms of number of employees and in terms of fleet sizes. The data was collected through Pen and Paper Interviewing (PAPI) in eight major cities across SADC, including: Durban (South Africa), Cape Town (South Africa), Walvis Bay (Namibia), Windhoek (Namibia), Luanda (Angola), Matadi (Democratic Republic of Congo), Dar es Salaam (Tanzania) and Zanzibar (Tanzania). These cities, with the exception of Windhoek, are known to be major shipping hubs in SADC. For the purpose of data collection, three interviewers were recruited and trained for data collection. The interviewers were required to have industry experience to ensure that they could describe the study setting properly and address all questions that arise in the interview. Additionally, given the language barriers that exist across the different countries of SADC, the interviewers had to be fluent in Kiswahili, English or Portuguese, depending on the region.

Table 2 presents an overview of the data. We collected data from a final sample of 30 respondents, 25 shipowners and 5 ship operators, whose fleet sizes ranged from 1 to 5 ships, and whose maritime operations ranged: deep sea only (43%), deep sea & coastal shipping (43%) and coastal shipping (13%). The shipping sectors were as follow: Containers 43%, Dry bulk 13%, General cargo 7%, Offshore 27% and wet bulk 10%, while ship nationality was 65% FOC, 20% Closed registries and 15% were SADC registries. In terms of company nationality, 17% were European, 20% Asian, 60% SADC, and 1% other. A total of 360 choices (30 respondents, 12 choice tasks each) where made from which 44 percent said 'yes' they would participate, 18 percent said they were 'not sure', and 39 percent said 'no'. In terms of perception on maritime policies, the responses to the two-opinion poll questions indicate that there are diverse views when it comes to the introduction of maritime cabotage, with 54% of respondents agreeing with the policy. For ship registration policies, 83% indicate SADC should introduce FOC provisions.

Table 2. Sample Statistics

Attribute	**Characteristics**	**Count**	**Percent (%)**
Perceptions on maritime policies			
Maritime cabotage should be introduced to SADC.	Yes	16	54%
	No	14	46%
SADC members should become international registers.	Yes	25	83%
	No	5	17%

Choice decisions			
	Yes	158	44%
Will you operate your ship?	Not Sure	65	18%
	No	137	39%
Respondent Characteristics			
Type of decision maker	Shipowner	22	73%
	Ship operator/agent	8	27%
Company Sizes in terms of fleet sizes	Minimum	1	
	Maximum	5	
	Mean	3	
Shipping Sector	Container	13	43%
	Dry Bulk	4	13%
	General Cargo	2	7%
	Offshore	8	27%
	Wet Bulk	3	10%
Maritime Service	Coastal	4	13%
	Deep sea	13	43%
	Deep sea & coastal	13	43%
Business Nationality	European	5	17%
	Asian	6	20%
	SADC	18	60%
	Other	1	3%
Ship Nationality	FOC	19	65%
	Closed	6	20%
	SADC	5	15%
Total number of respondents		30	100%

7. Results

7.1 Model development

The model development starts with the base model, which is an OL model employing only the choice (base) attributes. The base attributes are the attributes presented in the SI choice game including: freight volumes, transport charge, terminal handling charge discount, port dues discount and flag requirement. Covariates, the decision-maker characteristics, are subsequently added to the base model, and now named the OL model which accounts for heterogeneity. All the attributes are employed as continuous variables, except the attributes for flag requirement and decision-maker characteristics, which were employed as dummy variables. The systematic part of the utility of the ordinal alternative *j* for the decision maker *n* in choice situation *t* is defined for the three models as follows:

Base model

$$V_{jnt} = \tau_1 + \tau_2 + \beta_{\text{vol}} \times \text{Volume}_{jnt} + \beta_{\text{chr}} \times \text{Charge}_{jnt} + \beta_{\text{THC}} \times \text{THC}_{jnt} + \beta_{\text{PDues}} \times \text{PDues}_{jnt} + \beta_{\text{flag}} \times \text{Flag}_{jnt} \quad (3)$$

OL model

$$V_{jnt} = \tau_1 + \tau_2 + \beta_{\text{vol}} \times \text{Volume}_{jnt} + \beta_{\text{chr}} \times \text{Charge}_{jnt} + \beta_{\text{THC}} \times \text{THC}_{jnt} + \beta_{\text{PDues}} \times \text{PDues}_{jnt} + \beta_{\text{flag}} \times \text{Flag}_{jnt} + Z_{\text{DM}} \times \text{Shipowner}_n \quad (4)$$

with j representing the ordinal alternative (*Yes, Not sure, No*), τ_1 and τ_2 representing the ordinal differences between the alternatives *Yes, Not sure* and *No*, and β representing the parameter estimates for the base attributes: freight volume (Volume), transport charge (Charge), terminal handling charge discount (THC), port dues discount (PDues) and flag requirement (Flag). Z_{DM} represents the covariate of respondents that are not varied between selections. The deterministic component together with the error term, ε_{jt}, will now make up the random utility $U_{jnt} = V_{jnt} + \varepsilon_{jnt}$.

7.2 Modelling results

Table 3 shows results of the base OL model and the final OL model. The upper part of the table shows the base variables, followed by the decision-maker (DM) characteristics, opinion polls, and in the last part shows the model statistics. The shipper characteristics captured the type of carrier (shipowner or charterer). The baseline preference for SSS captured by τ_1 denotes the difference in preference between the alternatives 'no' and 'not sure' and τ_2 denotes the preference difference between 'not sure' and 'yes'. The significance of the attribute parameters was tested with the t-statistics and the likelihood (LR) ratio test.

The model statistics in Table 3, namely: the final loglikelihood, r-square, AIC and BIC scores shows that the *Final OL model* - which is associated with generic and decision-maker attributes, resulted in a higher value of the log-likelihood than the *Base OL model* - which only has the generic attributes. Both models also recorded improvements in terms of goodness of fit meaning that the general behavioural implications are valid, despite the small sample size employed. Moreso, the results for both the *base OL model* and the *Final OL model*s are essentially the same, with the primary differences being variations in standard errors and coefficient levels.

Table 3: Modelling Results

	Base OL model			*Final OL model*		
Attribute	Coeff.	r.s.e	rt-r	Coeff.	r.s.e	rt-r
τ_1	3.0897	0.7108	4.35***	3.2437	0.7701	4.21***
τ_2	4.0625	0.758	5.36***	4.2376	0.8338	5.08***
Freight Volume	0.586	0.1176	4.98***	0.5759	0.1309	4.4***
Transport Charge	0.0711	0.0371	1.91*	0.0673	0.0381	1.76*
Discount % THC	1.4477	0.6693	2.16**	1.4954	0.7177	2.08**
Discount % Port Dues	0.8887	0.5539	1.6	0.8371	0.5558	1.51
Flag Closed	0	NA	NA	0	NA	NA
Flag SADC	0.6	0.3712	1.62	0.6667	0.3731	1.79*
Flag Open	1.4697	0.329	4.47***	1.5832	0.3141	5.04***
DM characteristics						
DM_Shipowner	-	-	-	0	NA	NA

DM_Ship operator/agent	-	-	-	0.7171	0.4099	1.75
Model statistics						
Decision makers	30			30		
Observations	360			360		
Parameters	8			9		
LL(start)	-1207.643			-1207.643		
LL(0)	-395.5004			-395.5004		
LL(final)	-296.4918			-292.5446		
Rho-square (0)	0.2503			0.2603		
Adj.Rho-square (0)	0.2301			0.2376		
AIC	608.98			603.09		
BIC	640.07			638.06		

***Notes:* coeff = coefficient, rob.s.e = robust standard error, rob.t-r = robust t-ratio, * indicate statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

The *final OL model* fits was also compared to the *base OL model.* There are three common tests that can be employed to do this: the LR test, the Wald test, and the Lagrange multiplier test (Johnston and Dinarco, 1997:150). The LR test is generally favoured over the other two alternatives (cf Train (2009) and Hensher et al, (2015); and accordingly the LR test was employed in this study.

The LR test essentially compares the fit of one model to the fit of a subsequent model by comparing the loglikelihoods of two models, one being a restricted model with fewer estimated parameters (see equation 5) as follow:

$$LR = 2(\log L|\text{unrestricted model} - \log L|\text{restricted model}) \qquad (5)$$

The resultant LR *t*-statistic will have chi-square distribution with degrees of freedom equal to the number of restrictions. If the difference in the *LR* is statistically significant, then the less restrictive model is said to have significantly better model fit than the more restrictive model. Table 4 shows the results of the LR test and confirm indeed that adding the *Decision maker (DM_shipowner)* variable provide better fit to the data than just employing generic variables.

Table 4: Comparing model goodness of fit

	Base model versus Ordered Logit
LL (Final)	-292.5446
Δ *(dof)*	1
X^2	7.89

***Notes:* Δ *dof*= Change in Degrees of Freedom, X^2= Chi-square

7.3 Results implications

The baseline preference for SSS is positive. The statistically significant and positive coefficients for τ_1 and τ_2 across all models mean there were distinct differences between the choice alternatives. Therefore, the higher magnitude for τ_2 across the models indicates a stronger utility for SSS, meaning there was more distinct difference between the alternatives 'not sure' and 'Yes', as opposed between 'not sure' and 'No'.

The results show that all base attributes and covariates, were statistically significant except *Port dues discount.* All the base attributes further had the expected signs in all the models. We can thus deduce that SADC carriers are positively influenced by: freight volume, port dues and terminal charges. The implication of this on the development of SSS may be understood as follow: increasing freight volumes, and reducing port dues and terminal handling charges will increase the take up of SSS. Terminal handling charge discount has a significant contribution towards utility for SSS and this outcome coincides with Konstantinus et al., (2019) who submits that cargo handling in SADC ports is the most expensive in the world and thus action to make SSS attractive must start by making port services affordable.

In terms of ship registration, flags of convenience had the biggest impact on carrier preference as opposed to SADC flags and closed registries. This was only natural given FOC flags offer more incentives to register ships. The transport charge (income from freight) did not have a huge influence as initially anticipated, and this is potentially because respondents believe the question of how much to charge will be driven by the market (demand versus supply) and no authority can dictate the price.

Finally, with regard to decision-maker characteristics, shipowners showed lesser preference to participate in SSS compared to ship agents (operators, agents and charterers). Therefore, ship agents (who don't own ships of their own) are *ceteris paribus*, more likely to choose to participate in SSS compared to ship owning carriers, who currently deal with the financial burden of operational expenses and ship mortgage. Similarly, the strong preference for FOC status observed might be attributable to the higher perceived risk by shipowners, to commit to a system that is new and has no surety of success.

8. Recommendations and Conclusions

This study considers the development of SSS in SADC. Developing SSS in SADC has numerous potential benefits including: achieving a more balanced share of freight transport, obtaining flexibility within the transport network, decreased unit cost of transport, maintenance of vital links within the transport chain and increased competitiveness for the port hinterland. To that end, this study assessed the stated intentions of shipowners and

operators for a hypothetical SSS system in SADC. The ordered logit model was employed to examine the influence of the following factors on carrier preference: freight volumes, terminal handling charges, port dues, income from freight and ship registration provisions varied between FOCs, closed registries and SADC flags. The results of the study shows that if SSS is to be realized in the SADC region, there is a need to create an enabling business environment and to subsidize maritime transport in order to compensate for the high cost of operating a ship in SADC. In particular, the results reveal the need to consider subsidies in terms of freight volumes, ship registration and terminal charges. These outcomes all point to the economic considerations of operating ships in SADC. Any recommendations must subsequently speak to these outcomes.

Firstly, there is a clear need to put up a comprehensive package of ship registration measures that has the SADC shipowner at heart. Ship registration policies must consider the fiscal regulations, the ease of doing business, and the need to increase the number ships on SADC based ship registries. SADC ports can also forego (or slash) revenue from receiving terminal handling charges operating under SSS. Added to this, the objective of SADC governments must be to induce enough freight volumes for SSS. The easiest would be to give local carriers preference in terms of trade via maritime cabotage policies. These cabotage policies can also be introduced strictly for SADC carriers for a certain time period, and later relaxed when the SSS markets have matured enough to allow local carriers to participate evenly with non-SADC carriers. These results can now inform strategies to develop SSS in SADC.

There are several limitations in this study that guides future areas of research. First, SSS is cited as a mode of freight transport only. Future areas can consider the development of SSS as a strategy to a blue economy to increase the long-term benefits of the sustainable use of marine resources, and ensure sustainable development incorporating uses for tourism and passenger transport. Secondly, the study revealed differences in the preferences of SSS of shipowners and charterers. Future areas of research could consider the preference of shipowners only, seeing it is them actually owned ships. Lastly, seeing the study was constrained by a restricted sample due to limited funding and a language barrier, future research can attempt a similar study with a much bigger sample with surveys translated into all major languages in SADC.

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