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Water transit passenger perceptions and planning factors: A Swedish perspective

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ABSTRACT

Increased urban congestion in cities has led to suggestions for the greater use of inland waterways for passenger transit. However, there has been relatively little exploration of how water transit differs in terms of passenger service attributes compared to other transport modes and how passenger attitudes toward water transit service factors may affect overall satisfaction. The present study attempts to address this gap in knowledge in a study of water transport users in Stockholm, Sweden in order understand how water transit fares compared to other modes. Building on the literature of attitudinal studies for other transit modes, a survey was conducted in the Stockholm metropolitan area of water transit users on the primary inner-city water transit route. Details on trip characteristics, demographic and passenger's attitudes toward service attributes and their satisfaction was collected. After factor analysis, a structural equation model is proposed to explore the impact of service characteristics on global customer satisfaction. The results indicate that the latent factor comfort, including indicators such as cleanliness of vessel and environmental and scenic factors were more significant in explaining overall passenger satisfaction, above service issues such as network size and frequency. The finding supports the growing body of research highlighting the importance of such experiential factors in explaining customer satisfaction within public transport. Greater incorporation of such non-traditional service attributes can therefore give a better picture of transit user mode choice behavior and aid in future service planning ongoing policy development of the water transit network in Stockholm.

1. Introduction

While once playing a major connectivity role in cities, water transport services have declined in importance with inland migration and the increased focus on land-based transit. However, with worsening congestion there has been recent interest in the possibility for urban waterways to be used once again in a renewed public transport role. A number of cities have renewed interest in ferry services as part of adding additional transit option, such as North America (New York, San Francisco), Europe (London, Stockholm) and Asia and Australasia (Brisbane, Bangkok). However, currently there exists limited research on the development of contemporary water transport networks. Current literature in the area has focused so far on issues of planning, development rationale and land use implications of such systems (Weisbrod and Lawson, 2003; Thompson et al., 2006; Tanko and Burke, 2015, 2017), economic benefits and property value effects around terminals (New York City Economic Development Corporation, 2013; Tsai et al., 2015) and initial studies looking at passenger travel patterns (Soltani et al., 2015; Rahman et al., 2016). There have also been studies benchmarking existing water transit in terms of operating models and vessels design (International Association of Public Transport, 2016; Cheemakurthy et al., 2017).

On the other hand, research into user attitudes toward water-based public transport services is not well developed, despite similar studies on other modes becoming increasingly common. Water transport may offer a different user experience and value than other transport modes. For example, benefits such as increased ride comfort, additional on board space and scenic factors may add value to the passenger experience. Recent choice modelling approaches have shown that inclusion of such non-traditional variables in the travel experience (further to travel time and cost), can have a significant impact on passenger's subjective evaluation of the experience and hence their choice of travel mode (see Morikawa and Sasaki, 1998; Morikawa et al., 2002; Ben-Akiba et al., 1999; Johansson et al., 2006). However, while gradually these factors have begun to be included in other mode choice process, such studies have not looked at water transport specifically and how it compares in this respect to other transport modes. There are perhaps then uncaptured values that are not being included in decision making

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processes.

The intention of this paper is to fill this gap in knowledge regarding the service factors that are most important for water transport users. Stockholm County Council has recently expressed an interest in expanding its existing urban passenger water transit service into a city-wide, year-round service. How traveler attitudes and perception of service factors impact on overall satisfaction is of importance to better inform the 'soft' policy side of development, along with the development of new routes and terminal locations and is important to aid in the planning of the future water transport network.

This is especially of key importance for factors specific to urban water transport in the Nordic region, which faces unique contextual challenges such as weather and ice conditions. The paper is organized in five sections. First, is an overview of contemporary water transit and research development. Following this is a review of key research regarding attitudinal data and its relevance in mode choice models and passenger satisfaction studies. The data collection and methodology is then described. The results are then presented followed by a discussion, including suggestions for future research.

2. Urban water transit systems

With cities looking to increase public transport capacity, some are considering the option of waterborne transport along urban waterways. Contemporary water transit systems have a number of common defining attributes, including an urban scale, multiple connected stops and regularly scheduled services with a passenger focus (for a complete overview of network example and benchmark comparison see Tanko and Burke, 2017). Such services may fall into one of three operating models. Firstly, there are the most common traditional water-borne transport services which are cross river "ferry" services, which are point to point services. Secondly, there are those that operate in a linear route configuration where terminals (stops) are linked together in single route, or combination of interconnected routes. Finally, there are longer distance routes that connect suburbs to city centers, for example.

In European countries, specifically with the characteristics of ice conditions, there has been some interest in waterway transport options. Hamburg has operated a water commuting service on the Elbe river within its public transport network since 1965 (HADAG Hamburg, 2017). In Norway there is currently a concept for modular design zero emission 'urban water shuttle' (NCE Maritime CleanTech, 2017). In Stockholm, there is also a focus on developing an urban water transit concept with a focus on efficient vessel design for year-round operations in ice conditions (Stenius et al., 2014).

Along with the growth of contemporary ferry systems, there has been modest growth in research. Early studies suggested the potential for ferry service to provide additional transport capacity and stimulate economic growth in water front locations (Weisbrod and Lawson, 2003; Thompson et al., 2006; Sipe and Burke, 2011). Subsequent evidence has shown property values uplift around ferry terminals in Brisbane (Tsai et al., 2015) and in New York after a three-year initial trail (New York City Economic Development Corporation, 2013). Studies have also looked at water transit's value in a transport redundancy role in the event of natural disasters, such as in the wake of Hurricane Sandy in New York and the floods in Brisbane in 2009 (Burke and Sipe, 2014).

Recent studies have also investigated the reasons for implementing water transit in cities and effect on cities, finding that a number of additional factors such as economic reasons and tourism and city branding were factors that contributed to the decision to implement such systems (Tanko and Burke, 2015, 2017). With the use of smart card data there has been research to establish passenger commuting patterns in Brisbane (Soltani et al., 2015), and New York (Rahman et al., 2016). In Sydney, alternative routes and operating models for a well-established urban water transit network have been modelled (Sandell, 2015). However, these studies have so far focused on exploratory research or outlying technical aspects of water transit systems. Traveler perspectives have so far been absent in water transport studies so far, despite an increasing focus within other public transport modes.

3. Attitudinal choice factors in transport planning

Choice modelling is concerned with the factors that influence how passengers choose transport modes. Traditionally, predictions have been made based on simple zone-based trip attraction models based on land uses and forecast population growth. Predictions are often used in Cost Benefit Analysis (CBA) in order to decide upon the best course of action for transport investment (de Dios Ortuzar and Willumsen, 2011). A key factor in such decision-making processes has been focused on reductions in travel time, assuming that travelers will act to maximize their own utility by reducing their travel time expenditure. As a result, much research has focused on the influence of travel times and its impact on mode choices. The influence of fares has also received much attention in its effect on mode choice and in applications in order to determine appropriate fare structures.

There are however, two key problems identified with contemporary CBA processes. First is the assumption that users have all available information to make a rational decision. This assertion is increasingly being challenged by research demonstrating that many options that are viable are not reported in awareness studies, where passengers tend to be more aware of nearby rail stations, but often neglect to notice bus stops that could potentially fill their travel needs. For examples Outwater et al. (2011) found that commuters' perception of available transit options was less than the actual options available, suggesting a need to create new choice models that account for this deficiency (Outwater et al., 2011, p. 618).

Secondly, there has been increasing criticism of the inputs used, with many claiming that the predominant focus on travel times and cost not reflect real world user choices and the contemporary nature of transport choices. As noted by de Dios Ortuzar and Willumsen (2011), "a classic transport model makes trip generation inelastic, that is independent on the level or service of the transport mode, which is unrealistic" (de Dios Ortuzar and Willumsen, 2011, p. 24). Garling (1998) also note that while focusing on simple inputs produce easily tractable models, overly simplistic models also neglect individual behavioral aspects and hence such models cannot deal with apparently irrational decisions (Garling, 1998). A common problem has therefore been discrepancies between forecast and actual patronage in transport modelling applications. Until recently, the usual practice to correct such difference has been to apply a scaling factor that accommodated for the random utility part of utility equation. For example, it is assumed that rail will attract mode passengers when all other factors are controlled and so a positive factor is applied. A similar practice has occurred in Stockholm with the boat network where under-prediction of ferry passengers in Stockholm led to a factor that needed to be applied that corrected for actual patronage (RTK Stockholm County, 2005; Stockholm County Council, 2013). However, the specific factors at play are not usually overtly identified.

Recent research, however, has begun to unpack this random utility part of the equation and account for it with exploration of additional variables such as subjective indicators of passengers. Increasingly the reliance on time and cost have been supplemented by studies

investigating such other service attributes. Research has indicated which service attributes matter most to travelers on public transport. Access and egress time, service intervals and in-vehicle time (time factors) are relatively simple to quantify. Other attributes such as vehicle characteristics, interchanges between modes, service reliability, information provision, marketing and promotion) are more problematic and calculations are often derived from stated preference (SP) models based on hypothetical behavior, as distinct to revealed preference (RP) methods based on actual behavior. Inclusion of these additional factors has been shown to increase the predicting capacity of models and as a result, there is now growing literature on the collection and application of attitudinal data that is being used in transport planning and modelling processes.

Within water transport specifically, studies looking at passengers' attitudes or building demographic profiles are relatively new. Some recent studies have suggested that ferry transport offers additional amenity value when compared to other modes of public transport (Berlekom, 2014; Stenius et al., 2014; Trivector Traffic, 2014). In a market segmentation approach study in San Francisco, ferry users were found to value comfort and safety as important factors when considering boat use. In New York, surveys of boat users found that reasons for using the ferry service included that it is a less stressful way to commute and a respite from the overcrowded subway. In London surveys of boat users found similar where reason for commuting by boat included the less stressful journey (36.5%), the convenience of service (29.5%) and its reliability (14.6%) (Trivector Traffic, 2014).

Regular public transport satisfaction surveys in Brisbane and Stockholm also show that boat users to most satisfied with comfort, over-crowding and on time performance (Stockholm County Council, 2013; Translink, 2016). In a comparative study, Tanko and Burke found that users travel in excess when a choice between ferry and bus services are offered, suggested that users derive some positive utility from boat travel (Tanko and Burke, 2017). Based on these existing studies it is hypothesized that users benefit from boat journeys in terms of either aesthetic or productivity benefits. Specifically, the paper seeks to shed light on these additional factors that have shown influence on passengers' behavior. In this case the on-water environment may offer users either a passive benefit from the view alone, or it may offer additional productivity benefits as the journey can potentially be more comfortable to work in due to the presence of less lateral motion (as experienced in buses), for example The current study aims to test this theory and see which factors are most important to aid in understand water transport users better and aiding in planning of future water transit services.

4. Methodology

The study design included a survey of boat users in Stockholm to gather their opinion on what factors contribute to their choice of transport mode. The survey was completed via distributed surveys on board route 80 vessels on the Nacka route (Fig. 1). In total 859 complete responses were available for analysis, reflecting both on peak, off peak and weekend travel periods. We apply the Theory of Planned Behavior (Fishbein and Ajzen, 1975) to conceptualize the decision-making process of passengers to understand contributing factors. People's action in this case is dependent on their intention which is a factor of attitudes, perceived control, social norms, fulfilling personal needs and the contribution of specific land use in the area. In our case, perceived control (the effect of how easy or difficult it is to use a transport more and possible limiting factors) is not relevant as survey participant were recruited on board. Social norms reflect the influence of adhering to accepted travel behaviors as an explanation for travel choice. In Stockholm, for this study this factor is assumed to be minimal in effect. Land use implications are addressed through quantitative and qualitative questions measuring the relative accessibility of ferry piers to passengers to assess how much this contributed to a passenger's choice to use the boat service. Finally, personal attitudes were gathered through a thorough qualitative questionnaire addressed to identify key factors that may contribute to their travel choice.

For these questions, passengers were asked a series of questions to answer on a 10-point Likert scale from Strongly Agree to Strongly Disagree. As noted in the literature review a hypothesis of this research is that latent variables such as comfort and productivity benefits may contribute to mode choice. The survey was designed to test the theory of either aesthetic or productivity benefits which accrue to passengers. Therefore, a structural equation modeling (SEM) approach was used which allows assessment of latent variables after factor analysis. Specifically, a coefficient (C-SEM) approach was used, as this method is more suitable to the testing of a hypothesis as opposed to a Partial Least Squares (PLS-CEM) approach, which is more suitable to forecasting applications. To evaluate service quality, respondents we asked about 1 service attributes. Users expressed a rating of both importance and satisfaction for each attribute. A rate on global service in terms of both expected and perceived quality was also requested. Finally, demographic details of passengers were also gathered.

5. Results

Firstly, statistical analysis of the sample was carried out. The sample include slightly more females at 54% to 46% male. The majority were full time employees (57%), followed by pensioners (20%) and personal business owners (9%). This is also reflected in the age split with a majority of passengers falling in the 41–65 age bracket, followed by 26–40 (28%). There we comparatively few younger travelers under 26 with only 8%. Most passengers (63%) also earned above the average income. For the purpose of the trip, there was a split between those commuting for work (34%) and those for leisure purposes (37%). The most popular destination was as predicted with the key city terminus point at Nybroplan being the most popular pier for boarding and alighting. Piers and route densities are shown in Fig. 2.

Descriptive statistics and variable definitions are shown in Table 1. In terms of satisfaction with services and facilities on board, respondents rated most highly above seven in each category. There were however, a few key discrepancies between satisfaction and importance of attributes. Fig. 3 plots the importance and satisfaction of services in order to identify some preliminary factors that may be worth considering from the water transport operators' perspective as possible areas for improvement. For example, frequency of services was rated lowest in satisfaction despite its importance to passengers. Cleanliness and punctuality were also rated highly in importance, but most passengers seem to rate these factors as performing well. Factors relating to passengers' ability to work on board, such as adequate space and ride comfort were alternatively rated low in importance, despite passengers being satisfied with these attributes. In terms of what passengers stated activities on board, the majority were reading emails (36%). Interestingly, the second most popular activity on board was talking to other passengers on board (33%), greater than the next activity of checking social media (32%). Another interesting result is that although covered in the following section regarding the factor of the view on board, 100 passengers indicated that they were enjoying the view in the other activities prompt, reflecting 11% of passengers. These results indicated that the social and environmental atmosphere on board is a contributing factor to passenger's satisfaction on board.

As well as structured questions, the survey included an open-ended

Fig. 1. Route 82 boat in Stockholm Source: Sjövägen 2013.

comments request, which proved to be popular with almost half of all surveys (412) including additional comments. Over themes of comments were categorized in seven areas, as shows in Table 1. Common in public transport surveys in general high frequencies over a longer period of the day are the most common feedback for the boat services. However as currently boat services cease at 8 pm there is perhaps more required than other public transport in Stockholm, which typically operate until 12am on weeknights with night services later on weekends. A unique finding for the boat services in particular was the identification of specific vessels that were rated differently in terms of comfort and accessibility. Unlike the uniform bus and rail network, the vessels used for the water transit network are a mix of repurposed vessels, some as old as old as 40 years. As such, there is variety between older vessels and the one currently modern electric boat in the fleet. Comments were identified specifically on the services on this vessel commenting on its lower noise and high comfort on board. Further to the comfort factor alone there was also evident support of the electric boat in terms of eco conscious consumer who noted that having such electric vessels could be further motivation for expanding water transit in Stockholm in the future.

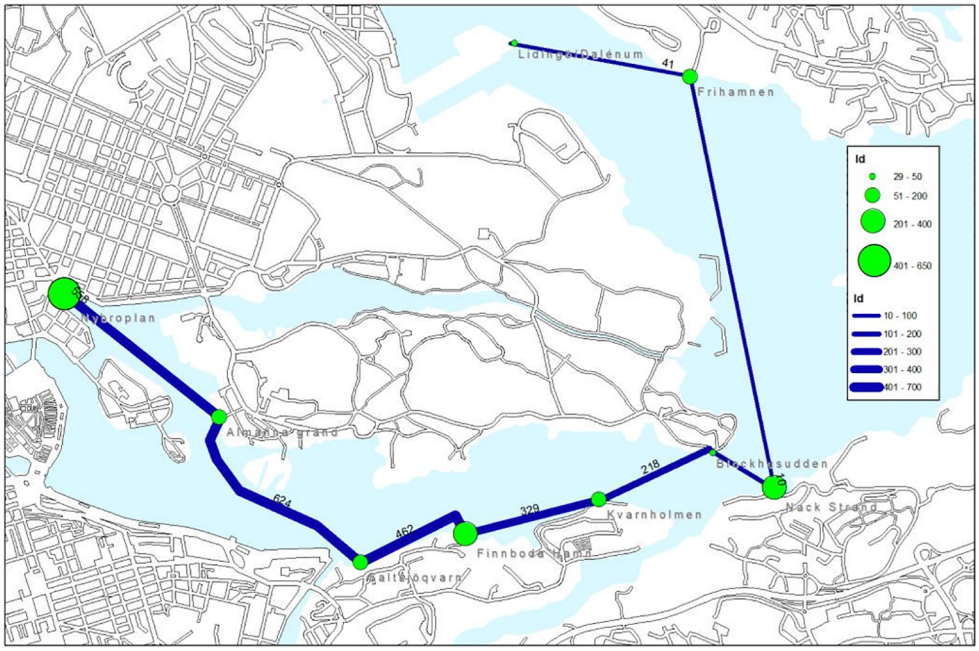

Fig. 2. Most popular piers and routes.

Table 1
Descriptive statistics of all variables.

Variable	Description	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	Minimum	Maximum
freq_i	Frequency of boat departures	7.4886	0.1182	8.0000	10.0000	2.4359	5.9335	0.0628	−0.9187	9.0000	1.0000	10.0000
punc_i	How punctual services arrive	8.2832	0.0995	9.0000	10.0000	2.0510	4.2068	2.4890	−1.5843	9.0000	1.0000	10.0000
info_i	Availability of service information e.g. maps, schedules	6.4848	0.1401	7.0000	10.0000	2.8882	8.3414	−1.0235	−0.4001	9.0000	1.0000	10.0000
near_i	Closeness of boat pier to respondents' home	7.6152	0.1281	8.0288	10.0000	2.6401	6.9699	0.2312	−1.0846	9.0000	1.0000	10.0000
access_i	Relative ease of access to boat pier for respondent	7.9351	0.1077	8.0371	10.0000	2.2203	4.9298	1.0047	−1.1909	9.0000	1.0000	10.0000
network_i	Overall network quality	7.8139	0.0999	8.0000	10.0000	2.0591	4.2400	0.8744	−1.0221	9.0000	1.0000	10.0000
clean_i	Cleanliness of boats and piers	7.9471	0.0957	8.0000	10.0000	1.9736	3.8951	1.0293	−1.0760	9.0000	1.0000	10.0000
availsea_i	Availability of seat on board boat	7.7069	0.1010	8.0000	10.0000	2.0827	4.3375	0.5154	−0.8966	9.0000	1.0000	10.0000
comfseat_i	Relative comfort of boat seating	6.5915	0.1074	7.0000	8.0000	2.2140	4.9016	−0.3147	−0.3964	9.0000	1.0000	10.0000
smcomf_i	Smoothness of ride for solely comfort reasons	6.1437	0.1167	6.0000	8.0000	2.4054	5.7861	−0.5941	−0.2967	9.0000	1.0000	10.0000
smwork_i	Smoothness of ride for purpose of working	5.0763	0.1128	5.0000	5.0000	2.3264	5.4122	−0.5053	0.0930	9.0000	1.0000	10.0000
view_i	Assessment of the view from the boat	7.8675	0.1109	8.0000	10.0000	2.2864	5.2275	0.4369	−1.0421	9.0000	1.0000	10.0000
calm_i	Assessment of calmness of boat journey	8.5907	0.0913	9.0000	10.0000	1.8817	3.5409	2.7826	−1.6552	9.0000	1.0000	10.0000
ablework_i	Assessment of the potential to do work on board	4.3432	0.1013	4.7712	5.0000	2.0876	4.3582	−0.4591	0.0479	9.0000	1.0000	10.0000
spacework_i	Assessment of the amount of space to do work onboard	3.7416	0.0867	4.0000	5.0000	1.7871	3.1937	−0.8705	−0.0494	7.9330	1.0000	8.9330
openenv_i	Assessment of importance of travelling in an open marine environment	7.9322	0.1085	8.7071	10.0000	2.2366	5.0024	0.4720	−1.0517	9.0000	1.0000	10.0000

6. SEM analysis

In the proposed structural equation model, the observed variable are the 16 service attributes as gathered in the survey instrument. Two overall service quality indicators (perceived and expected quality) were also included. Latent variables were constructed from these observed variables in a confirmatory factor analysis (CFA). Missing data was handled via a pairwise deletion process which was suitable based on the variable response parameters. There was no evidence of the influence of outliers in the data. Based on a previous paper that showed water transport users tend to display excess travel when choosing boats vs, the bus option, our hypothesis was that users' value either the passive amenity of being on board boats, or the productivity benefits from being able to work while travelling, which may not be as possible on a more crowded bus, for example. Therefore, a confirmatory factor analysis (CFA) was completed with three key factors. An assessment of the components was determined by including only those with an eigenvalue great than or equal to 1 (Kaiser, 1960). The proposed model indicates the factors of service planning (quality of the network, frequency, punctuality), comfort (calm environment, clean, view from the boat) and productivity (ability to do work on board, space to do work, smoothness of journey to work). An endogenous latent variable (Satisfaction) relates the exogenous variables to the overall latent model. The final model is shown in Fig. 4.

The model was prepared in AMOS Version 21. Model results are shown in Tables 2 and 3. In order to fit the model the construction of a parameter to 1 was required. The goodness of fit results indicates the models is appropriate with goodness of fit index (GFI) 0.935, the adjusted goodness of fit index (AGFI) 0.901 and the comparative fit index (CFI) 0.933. These figures indicate a quite good model fit. The estimates suggest that the latent contrast of comfort better at explaining overall satisfaction rather than the productivity indicators, with a coefficient of 0.501 (standardized weight). The service factor, while lower than comfort, also has a considerable impact (0.336). Regarding the three factors in total, the model indicated that a 42% of change in Satisfaction is being explained by these three factors: service, comfort and productivity. Interestingly, the association of productivity and satisfaction is negative (Table 4).

Productivity explains Satisfaction, after controlling for Comfort and Service. Therefore, after controlling for Comfort and Service, a 1 standard increase in Productivity decreases Satisfaction by 0.10 standard measure. By increasing or improving the productivity, the satisfaction would be decreased. This again indicates that productivity is not as important as passive comfort and amenity for passengers on water transport. A cluster analysis of the results was then completed suggesting two major groupings – those who rated the questions about being able to work highly and those that rated them low. This indicated separate distinct user: those who values the passive comfort of boat travel and those that value working on board. In other words, those who are high on productivity have different relationships between comfort and service and satisfaction, when compared to those who are low on productivity. These different groups of passengers are therefore gaining different utility from the services, with comfort being the most indicative factor explaining customer's satisfaction with water transit services in Stockholm.

7. Discussion and conclusions

The intention of this study was to assess how user perceptions toward water transport compared to other transport modes in order to explain traditionally uncaptured service attributes and their relative importance to passengers. A structural equation model has been proposed the show the relationship service attributes and customer satisfaction. It was found that the comfort attributes were better at explaining customer satisfaction, with services factors such as the overall quality of the boat network and punctuality for example, were less

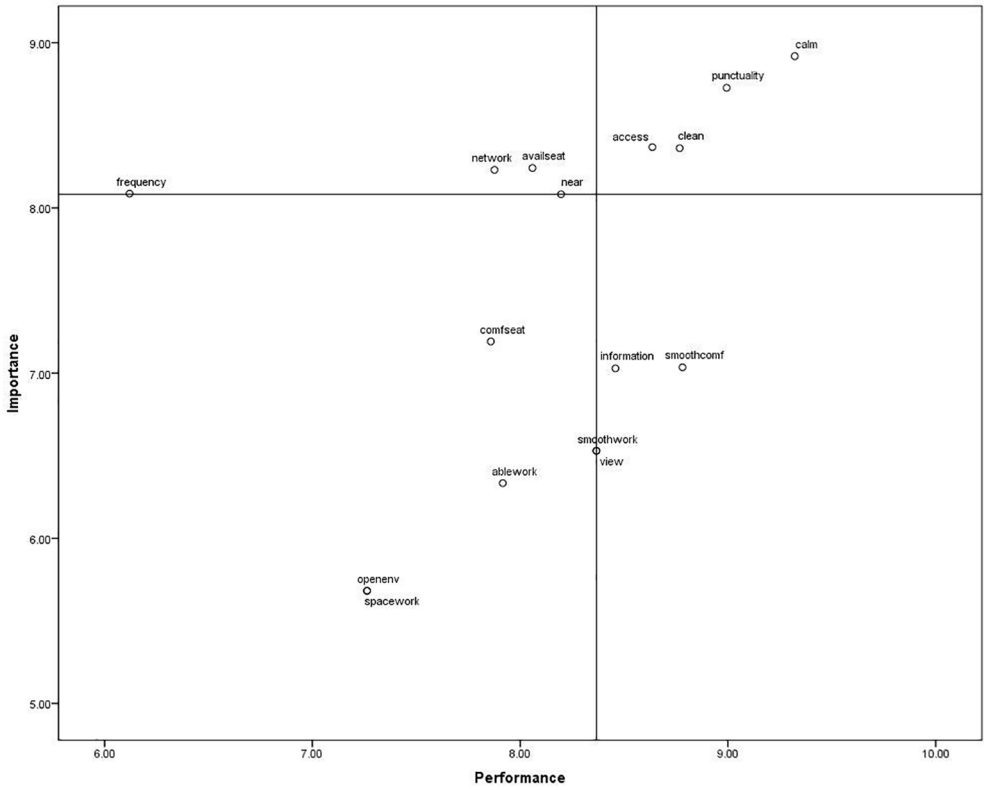

Fig. 3. Importance and satisfaction with boat service factors.

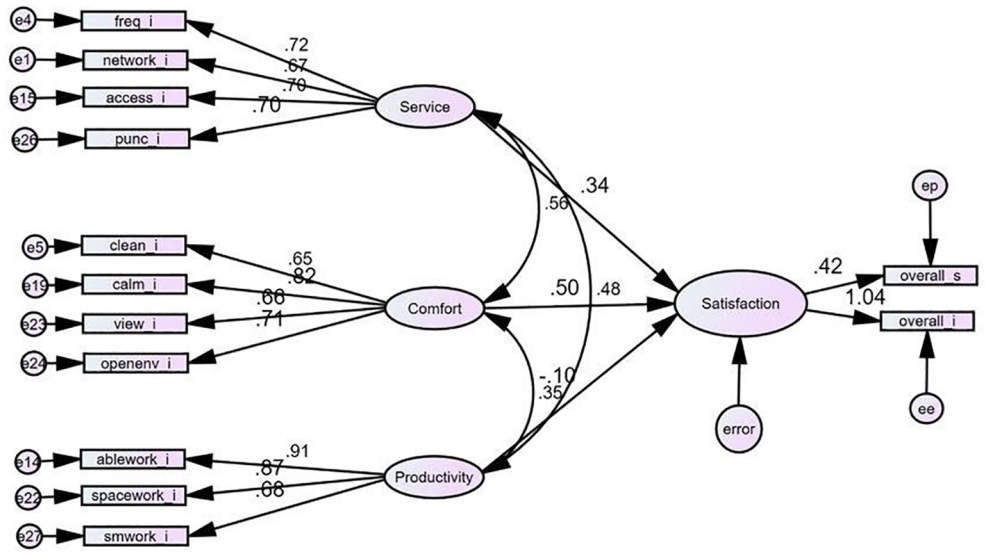

Fig. 4. Final model structure.

Table 2
Categorization of additional survey comments.

Description	Number of comments
Departure frequency/speed/more routes or stops	180
Increased service on evenings and/or weekends	110
Comfort/eco footprint/boat design/bicycle space	80
Terminals and weather shelter	13
Parking a connectivity	16
Accessibility/elderly/prams/gangway/pet access	8
Ticket price/ways to pay	5

influential. Interestingly, the ability to work on board was not important to the majority of passengers. This finding gives evidence to the proposed hypothesis that either comfort or productivity benefits were at play when explain water transport user's satisfaction with services. It indicates that comfort factors are valued by passengers and should be a consideration not only to aid in transport forecasting, but also in the importance of actively designing new vessels and facilities to cater to passenger's preferences.

However, it was also shown that service attributes were also a factor and therefore remain important. This was evident in both the result of the proposed model, as well as the high proportion of comments (in

Table 3
Parameter estimations.

		Estimate	S.E.	C.R.	P
Satisfaction ←	Service	0.142	0.026	5.527	***
Satisfaction ←	Comfort	0.155	0.025	6.270	***
Satisfaction ←	Productivity	−0.027	0.010	−2.788	0.005
network_i ←	Service	1.121	0.084	13.307	***
freq_i ←	Service	1.397	0.101	13.875	***
clean_i ←	Comfort	0.753	0.065	11.522	***
ablework_i ←	Productivity	1.367	0.114	11.998	***
access_i ←	Service	1.226	0.090	13.553	***
overall_s ←	Satisfaction	1.000			
overall_i ←	Satisfaction	2.846	0.335	8.491	***
calm_i ←	Comfort	0.872	0.069	12.695	***
spacework_i ←	Productivity	1.264	0.107	11.774	***
view_i ←	Comfort	0.891	0.077	11.580	***
openenv_i ←	Comfort	0.915	0.077	11.950	***
punc_1 ←	Service	1.068	0.078	13.613	***
smwork_i ←	Productivity	0.952	0.087	10.983	***

Table 4
Standardized weights.

		Estimate
Satisfaction ←	Service	0.336
Satisfaction ←	Comfort	0.501
Satisfaction ←	Productivity	−0.102
network_i < –	Service	0.674
freq_i ←	Service	0.724
clean_i ←	Comfort	0.651
ablework_i ←	Productivity	0.910
access_i ←	Service	0.695
overall_s ←	Satisfaction	0.417
overall_i ←	Satisfaction	1.037
calm_i ←	Comfort	0.819
spacework_i ←	Productivity	0.867
view_i ←	Comfort	0.659
openenv_i ←	Comfort	0.708
punc_i ←	Service	0.700
smwork_i ←	Productivity	0.678

excess of those concerning comfort) suggesting this is area that may need to be improved for future services. In particular, frequency of service is evidently an issue among users. This was shown in both the importance satisfaction and in the comments. It is true that services terminate early in the evening. However, a challenge is to offer these services at a cost-efficient way, as there are routes that are not popular with a lack of passengers evident. As boat travel is often more expensive to provide this is a particular challenge in the future water transit network in Stockholm.

Frequency of use in an interesting finding in that many passengers identified as using the boat often (defined as using the services 4 or more times a week). This suggests that people that have used the service have become regular patrons. One of the problems currently is that there is a lack of promotion of the service with many users unaware of the boat commuting options that are available. At present, there is only one train station that highlights where the nearest boat commuter option exists. Increasing this awareness and encouraging people to trial the service may prove fruitful in converting new leisure passengers into regular customers.

It was also evident that there is perhaps some impetus in creating a uniform network with standardized fleet and facilities at piers, for example. This is not only to improve customer satisfaction but also will be likely supported as users were found to favor the newer electric powered vessel. Having a uniform fleet would also mean there is certainly on which boat will be used instead of the currently uncertainty of boarding a potentially less comfortable boat. Evidently, a balance between improving the comfort of the services and improving the overall network is therefore needed.

There are a number of limitations to the current study. Firstly, the survey only focuses on water transit users and was not administered on the wider public transport network. Doing so would allow a better comparison between modes such as the relative importance of service and frequency improvements compared (as noted above common in all transport modes) against improvements of comfort and convenience on board. Future surveys could therefore expand these results to allow wider generalizations to be made. The survey was also only administered on one urban water transit route, and as such, there may be variation between difference areas in Stockholm that may warrant more localized interventions to improve water transport's role in the future transit plans of Stockholm.

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Appendix A. Correlations of variables used in model

	freq_i	punc_i	access_i	network_i	clean_i	smwork_i	view_i	calm_i	ablework_i	spacework_i	openenv_i
freq_i	1										
punc_i	0.553092	1									
access_i	0.470874	0.463521	1								
network_i	0.498719	0.392046	0.465664	1							
clean_i	0.201249	0.332985	0.388137	0.377112	1						
smwork_i	0.126945	0.156698	0.293662	0.184301	0.295566	1					
view_i	0.109801	0.173067	0.243373	0.161706	0.370369	0.282989	1				
calm_i	0.273409	0.297547	0.344326	0.359426	0.510896	0.178236	0.538419	1			
ablework_i	0.22136	0.123362	0.181749	0.064608	−0.02342	0.305376	−0.01594	0.026419	1		
spacework_i	0.220199	0.086043	0.068075	0.052064	−0.07135	0.204828	−0.03111	−0.06448	0.538636	1	
openenv_i	0.220167	0.248814	0.297594	0.287261	0.386261	0.119766	0.486352	0.576318	0.046307	0.026953	1

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