Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 26 (2017) 215–223

Transportation Research Procedia

www.elsevier.com/locate/procedia

44th European Transport Conference 2016, ETC 2016, 5-7 October 2016, Barcelona, Spain

Designing capacity and service level at ferry crossings

Finn Jørgensen [a], Gisle Solvoll [a,*]

[a]*Business School, Nord University, Norway*

Abstract

This paper first deduces how the transport capacity over a ferry crossing, measured by the number of passenger car equivalents, depends on the length of the crossing, the ferries' size, their speed, their efficiency of boarding and alighting them. Such calculations are essential in order to evaluate whether the ferry material used at a service has sufficient capacity fulfilling national quality standards like meeting required transport demand during the opening hours and a stated minimum probability for users to board their desired departure. Second, the paper derives a model that shows how welfare optimal frequency at a crossing depends on its level of traffic, ferry users' waiting time costs, the cost structure of ferry operations and the length of the crossing. The model demonstrates in a clear way the influences of crossing - and ferry fleet characteristics on optimal frequency. Using Norwegian data for ferry users' waiting time costs and for the costs of operating ferry transport services, the model's results indicate that the authorities recommend to low frequency, in particular at high traffic services. It is also emphasised that the length of the crossing has great impact on optimal frequency; optimal frequency at long crossings is less than a half compared to short crossings for all levels of traffic. Lastly, the model shows that it is more serious from a welfare perspective to undersupply frequency with X units than to oversupply it with X units.

Peer-review under responsibility of the Association for European Transport

Keywords: ferry transport; transport capasity; optimal frequensy; social costs

1. Introduction

From an economic point of view, the service level in scheduled passenger transport is important for two reasons. First, important service elements, such as the quality of the transport means and the number of departures per day, strongly influence the direct and external costs of operating the services. Second, the service level influences the

* Corresponding author:
E-mail address: gso@uin.no

2352-1465
Peer-review under responsibility of Association for European Transport
10.1016/j.trpro.2017.07.022

passengers' generalised travel costs and thereby their welfare. Together these two impacts affect the social surplus of the service in question. Consequently, setting the right service level for public transport is an important task for the transport operators and authorities (Mathisen and Solvoll, 2010; Preston, 2015).

Ferry services play an important role in the national transport system in many European countries, especially those with long coastlines and many inhabited islands. This is definitely the case in Norway. In 2014, there were 121 ferry crossings in Norway served by approximately 160 ferries. A total of 19 and 102 of the crossings were regulated at state and county level, respectively. With the exception of some small ferry crossings, the crossings were operated by four shipping companies[†]. A national administration reform implied, amongst other things, that the administrative responsibility for 78 of 95 national road crossings were transferred from the central authorities to the Norwegian county councils on 1 January, 2010. Because the counties do not necessarily have to follow the current national ferry standard, the transfer of responsibility paves the way for differentiation between crossings with respect to service level and fare setting.

Even though many ferry services in Norway have been replaced with bridges and underwater tunnels during the last two decades, the ferries still have a very important function in the transport infrastructure in coastal areas. Without these ferry crossings, many settlements and enterprises along the Norwegian coastline could not be upheld. For example, analysis shows that about 75% of the Norwegian ferry crossings were profitable from a social welfare point of view but only *one* was run without subsidies (Jørgensen et al., 2011). In 2014, the ferries carried over 21 million vehicles (34.5 million passenger car equivalents; PCE)[‡] and about 42.5 million passengers (including drivers). The costs of operating the ferry services this year was about 5,000 million NOK (about 590 million €), and the revenue from vehicles and passengers was approximately 2,600 million NOK. This resulted in a subsidy requirement of about 2,400 million NOK[§].

The aim of this article is first to deduce how the transport capacity (measured by the number of PCE) depends on the ferries' size, their speed, the efficiency of boarding and alighting them and the length of the crossing. Second, we will estimate optimal frequency, defined by the level of frequency that minimises total social costs of the ferry operations, at eight ferry crossings in Norway. These calculations are based on information about the crossings' level of traffic, the cost structure of ferry operations and the passengers' waiting time costs. These estimates are compared with the actual frequency on the same crossings.

The article is organised as follows. Section 2 briefly presents the Norwegian nationwide ferry standard. Section 3 gives a discussion of factors affecting the transport capacity at a ferry crossing. Section 4 presents a model to estimate optimal frequency for different ferry services. The model results are compared with the actual frequency for some important/representative ferry services in Norway. Finally, section 5 provides conclusions and possible implications for policy makers.

2. Literature review

Optimal service level and optimal pricing for public entities have been given attention from several researchers. Many contributions have focused on the socially optimal simultaneous choice of price and service level for monopolies; see, for example, Spence (1975) for a general discussion and Jørgensen and Pedersen (2004) and Jørgensen et al. (2013) for transport companies in particular. Jansson (1993) analyses the simultaneous optimisation of price and frequency. He emphasises two important effects of frequency on passenger behaviour. The first effect is the dual behaviour indicating that for low frequency services with a reliable timetable, travellers plan their trips according to the table, whereas they, for high-frequency services, prefer to arrive at the stops spontaneously rather than consult a timetable. The second effect relates to the fact that the disutility of waiting at stops is higher than that of waiting at home or at work, and that the passengers' waiting time costs may vary with the duration of the wait.

[†] For further descriptions of the Norwegian ferry industry, see, for example, Jørgensen and Mathisen (2012).

[‡] PCE is a compound production measure introduced to handle the multiproduct problems related to transporting different types of vehicles. For example, a passenger car (< 6 m) counts as 1.025 PCE, whereas a heavy goods vehicle (> 19 m) counts as 10.682 PCE. The PCE concept is more thoroughly explained by Mathisen (2008).

[§] The numbers for costs, revenue and subsidies are relatively rough estimates given by the Norwegian Public Roads Administration.