ECONOMIC BENEFITS OF IMPROVEMENTS TO INFREQUENT LIFELINE SERVICES: A CASE STUDY OF AIR SERVICES IN THE HIGHLANDS AND ISLANDS

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1. THE HIGHLANDS AND ISLANDS CONTEXT

1.1 The importance of travel for remote and rural communities

People who live in remote and rural areas rely on transport links to connect them with a variety of essential or desirable opportunities. This is particularly the case for people who live in island communities as they must either fly or travel by ferry to reach the mainland. While many services and facilities are available on the islands - particularly the larger ones such as Orkney and Shetland - many people still require to travel to the mainland in order to undertake activities, such as health appointments, leisure activities and business related activities, such as marketing, conferences and training. Transport services connecting these communities to the mainland are regarded as lifeline links and are vital to the social and economic future of the region.

The dynamics of island communities are continuously changing: the number of elderly residents is increasing at a higher rate than for Scotland as a whole. Population forecasts predict that by 2016 there will be a 50% increase in the number of elderly people living on Shetland for example (General Register for Scotland, 2001). The Western Isles are set to experience a 14% decrease in population, while a 40% decrease within the 15 - 29 age category is forecast. Maintaining island populations is key to their continued viability.

1.2 Travelling to the mainland: key issues

Travelling by ferry can be time consuming with journeys between particular islands and the mainland lasting up to twelve hours in each direction. Other islands do not have daily services and residents and business travellers can only travel to the mainland on particular days of the week. Similarly, bad weather conditions during the winter months can result in cancelled services and reduced reliability, which can result in missed appointments, additional costs associated with extra nights away from home and general frustration and annoyance.

Most island communities have the option of travelling by air to the mainland. The journey time is significantly quicker than travelling by ferry and allows people to travel to a wider range of destinations through interlining opportunities. However, it is evident that the high cost of air fares and, for certain routes, the lack of day return opportunities or limited frequencies act as a deterrent to residents and businesses alike. Residents and businesses must absorb the additional costs and inconvenience associated with the required overnight stays and additional time spent away from home and / or work. Such inconvenience includes having to fit one's life around the air service timetable – for example a young mother with a hospital appointment may have to arrange for after-school and overnight care for her children so that she can attend that appointment. Such a situation would not be faced by a peer living in Inverness. Such inconveniences are considered to be one of the factors underlying a general migration from remoter parts of the Highlands and Islands to urban centres such as Inverness.

A recent study commissioned by HITRANS (Aviation & Travel Consultancy Limited, 2003) concluded that with initial revenue support from the Scottish Executive it would be possible to develop an enhanced air network for the Highlands and Islands that included cheaper air fares, increased frequencies and the ability to make a day return trip to the main urban centres. However, to receive Scottish Executive support there was a need to demonstrate that the proposals give a positive economic return. Such a requirement is notoriously difficult to provide for lifeline links given their low traffic volumes, and can be responsible for either the stalling of the proposals in the planning stages or their downgrading before implementation.

1.3 Key aim of this paper

The key aim of this paper is an examination as to what extent the economic value of improving the frequency of lifeline links is captured using existing methodology and practice. We draw from the existing literature on the subject and an in-depth case study of a recent appraisal exercise of an enhanced air network for the Highlands and Islands.

2. SCHEDULING COSTS AND ECONOMIC APPRAISAL

2.1. Current Practice

In Scotland transport initiatives are appraised using rules set out in the Scottish Transport Appraisal Guidance (STAG) (Scottish Executive, 2003). This guidance has many similarities with the appraisal guidance for England and Wales as embodied in the Guidance on the Methodology for Multi-Modal Studies (GOMMMS) (DETR, 2000), as well as being consistent with the Green Book (HM Treasury, 2003). STAG and GOMMMS are appraisal frameworks in which the economy forms one of the appraisal criteria.

The impact on the economy is measured using an economic efficiency indicator and Economic Activity and Location Impacts (EALI) indicators. The key differences between the two measures are that the economic efficiency indicator measures the economic impact of a transport initiative within the transport market, whilst the EALI indicators measure the impact at the final point of impact (e.g. changes in wages and employment). Both need to be forecast over time. Only the economic efficiency indicator provides a single estimate of the total economic benefit (e.g. Present Value of Benefits), as the EALI indicators contain some double counting, for example between the indicators of employment and GDP. Obviously there is also double counting of economic benefits between the economic efficiency indicator and the EALI indicators.

Scottish guidance (STAG) indicates that economic efficiency benefits should be calculated through a consideration of:

- User benefits (comprising travel time savings, user charges, quality benefits and reliability benefits);
- Benefits to transport operators (comprising of investment costs, operating and maintenance costs, revenues and grant and subsidy payments);
- Accident benefits; and
- Costs to Government.

Given certain conditions this measure of transport economic efficiency (TEE) is a true representation of the total economic impact of a transport project (Mohring and Williamson, 1969; Dodgson, 1973; Jara-Diaz, 1986). By total economic impact, we mean simply the aggregate change in social welfare (see for example Mackie *et al*, 2001). However, whilst the TEE is an accurate measure of total economic impact it does not provide sufficient information regarding who the final economic impacts of the transport project will accrue to (SACTRA, 1999). It is for this reason that the EALI measures are used alongside the economic efficiency measures within an appraisal.

It is therefore quite clear that fundamental to any economic appraisal is the robust analysis of transport user benefits. In the case of our example, frequency enhancements to daily air services, transport user benefits would conventionally be calculated through a consideration of journey time - including time spent in the plane and time spent waiting at the airport - fares and any other out of pocket costs (e.g. overnight accommodation). Quality (comfort) and reliability impacts should also be included if they are improved by the proposals, though their measurement is difficult (Scottish Executive, 2003). The economic appraisal would not therefore include the inconvenience that a traveller may experience having to re-arrange their activity schedule around the flight timetable, nor the time they may spend ‘hanging-around’ waiting for the aeroplane at either their destination or on the day that they are travelling. For the majority of transport project appraisals in Scotland this might be considered an acceptable assumption in that any costs associated with such inconveniences may not be that large as such projects typically consider improvements to services that operate at much higher frequencies (e.g. two hourly, hourly or even half hourly) and for which viable alternatives may also exist (e.g. the bus is an alternative to the train). At the low frequencies of our example we would expect that the inconvenience of the flight timetable would be much more significant. What, however, is unclear is exactly how significant they are. The first step in answering this question is a consideration of any comparable data in the literature.

2.2. A review of the evidence

A day's activities typically comprise a wide range of activities: sleeping, eating, working, watching TV, participating in sport, socialising, tasks associated with the household (food preparation, getting children up and to school, grocery shopping, DIY, etc.), work and importantly travel. Travel occurs as activities are dispersed, not only in time, but also in space. We should also not forget that work itself comprises of a number of different tasks - also dispersed in time and sometimes in space. Life is therefore made up of large number of choices regarding what activities to do, when to do them and where to do them. The consumer develops a personal schedule of activities (or consumption patterns) by taking account of preferences (eating before work, doing exercise twice a week, sleeping more than the minimum required, etc.) and constraints (time needed for household tasks, eating at certain times of the day, socialising in the evening, the need to arrive at work on time, travel time, the budget constraint, etc.).

Our interest is in the manner that travel constraints - particularly those associated with restrictive public transport services, arising through either low frequencies or short hours of operation - can affect those schedules, and whether the alleviation of the travel constraints is beneficial. The literature contains a number of different references to such costs / benefits: inconvenience costs (Bråthen and Hervik, 1997); schedule delay (Small, 1982) and scheduling costs (Wilson, 1989). Bråthen and Hervik define inconvenience costs to be the willingness to pay (WTP) for full travel flexibility (e.g. 24 hr access and no timetable restrictions). Small defines schedule delay to be the difference between the preferred arrival time (PAT) and the actual/planned[1] arrival time. Wilson on the other hand uses the term scheduling costs to relate to the general inconvenience of scheduling constraints - whether they arise through travel constraints such as public transport timetables or institutional constraints such as work start times. Inconvenience costs and schedule delay are therefore particular instances of the more general scheduling costs. We therefore need to look at each of these themes within the literature to obtain an understanding of the value of improvements to infrequent lifeline services.

There have been a substantial number of studies on the value of headway (for a review see Wardman, 2001) and departure time choice (for a review see De Jong et al, 2003). At low frequencies (large headways) the valuation of changes in headway can be interpreted as a change in scheduling costs. The departure time choice models typically use the Small formulation of schedule delay as do the journey time variability studies (for a review see Noland and Polak, 2002). Table 1 summarises some of the key studies from this literature regarding valuations for headway, departure time choice and the value of replacing ferry services with fixed links. For presentational and comparability purposes the valuations in these studies have all been converted to equivalent in-vehicle time minutes (IVT-mins). The valuations presented relate specifically to scheduling costs or the costs of not having complete travel flexibility.

As can be seen from Table 1 there is substantial variation in the values. Values vary by whether the trip is work related or non-work related and importantly also with distance. The longer the distance travelled the lower the value that a traveller places on improvements in frequency (or reductions in headway). Wardman (2001) and ASEK (2000) explicitly separate values by distance, but the results from Bates et al (2000) can also be considered to exhibit some variation by distance. This is because train operators such as Virgin cater for the long distance market, whilst train operators such as Connex cater for the short distance market. In the context of our example, infrequent air services, then valuations of frequency improvements for short distance trips is largely irrelevant. This would suggest a potential range of values from 2 to 15 IVT-mins per hour of headway for non-work trips and from 7 to 29 IVT-mins per hour of headway for work trips (for road, rail and ferry modes). No comparable headway data is available for air trips though SPASM[2] values for frequency suggest that improvements from 1 flight per day to between 2 and 5 flights per day would be equivalent to between 15 and 48 IVT-mins.

Using the SPASM values of time for UK business and leisure air travellers this would suggest that the reductions in headways of air services would be valued as set out in Table 2. As can be seen from this table such values appear reasonably significant ranging from £9 to £60 for business trips (1998 market prices and values). This would suggest that the exclusion of such benefits may underestimate the economic impact of flight frequency enhancements.

TABLE 1: LITERATURE SURVEY: VALUE OF HEADWAY REDUCTIONS

Study		Units	Equivalent In-Vehicle Time (mins)	
			Work Trips	Non-work Trips
Brathen and Lych (2004)	Proposed guidance for Norwegian ferry and fixed link appraisal	Car veh-mins	Ferry to city centre: 2.2 Other ferry: 6.9	Ferry to city centre: 4.4 Other ferry:13.8
Equivalent in-vehicle time for a change in frequency				
Scott Wilson Kirkpatrick (2004)	SPASM - UK air demand forecasting and evaluation model	Mins per dep	From 1 to 2 departures/day: 15 / From 1 to 3 departures/day: 29 From 1 to 4 departures/day: 39 / From 1 to 5 departures/day: 48	
Equivalent in-vehicle time for a 1 hour reduction in headway				
Daly et al (1998)	Great Belt Bridge, Denmark	Person-mins	16	No data - Frequency model
COWI et al (unknown)	Oresund Bridge, Denmark	Person-mins	Long distance trips 2	Long distance trips 2
FTC (1998)	Fehrman Belt Bridge, Denmark	Person-mins	19	15
Wardman (2001)	Headway valuations from 143 British studies (Wardman, 2001)	Car person-mins	Trips 2km length: 53 Trips 200km length: 15	Trips 2km length: 43 Trips 200km length: 12
ATOC (2002)	UK rail guidance (PDFH): Penalty costs with headways > 1hr	Person-mins	Full fare: 24 Reduced fare: 12	
ASEK (2000)	Swedish appraisal guidance	Person-mins	Regional: 37 Inter-regional: 29	Regional: 17 Inter-regional: 13
Equivalent in-vehicle time for a 30 minute reduction in schedule delay (equivalent to a 1 hour reduction in headway)				
De Jong et al (2003)	Departure time choice study (Netherlands)	Person-mins	30 - 45	
Bates et al (2000)	Punctuality and reliability study for UK rail services	Person-mins	7 (Central) to 29 (Connex)	2 (Virgin) to 19 (Central)

TABLE 2: POTENTIAL VALUATIONS OF HEADWAY REDUCTIONS FOR AIR SERVICES

	Value of reduction in headway (1998 market prices and values)			
	Range from literature review (see Table 1)			SPASM
1 hr headway reduction				
Non-work	£0.23	to	£1.75	N/A
work	£0.81	to	£3.37	N/A
12 hr reduction in headway (1 flight daily to 2 flights daily)				
Non-work	£2.79	to	£20.94	£1.81
work	£9.77	to	£40.48	£13.06
16 hr reduction in headway (1 flight daily to 3 flights daily)				
Non-work	£3.72	to	£27.92	£3.32
work	£13.03	to	£53.98	£23.94
18 hr reduction in headway (1 flight daily to 4 flights daily)				
Non-work	£4.19	to	£31.41	£4.57
work	£14.66	to	£60.73	£33.01

Note: Value of In-Vehicle time sourced from SPASM (Scott Wilson, 2004): work trips £50.40 per person-hr; and non-work £6.98 per person-hr (1998 market prices and values). Values of headway reduction sourced from literature.

The studies discussed above, whilst valuing scheduling costs indirectly, do not specifically focus on the costs or benefits of activity re-scheduling, that is the specific costs or benefits of altering the time when an activity is undertaken, the duration of that activity or even the replacement of that activity with another activity. Such issues are specifically addressed within the literature on activity analysis. For example, Wilson (1989) analysed the costs to workers who started work in the off-peak and found that allowing them to adjust the time they start work towards the peak had a similar value to that of travel time savings. Thus a shift of say 30 minutes earlier in their work activity schedule was comparable to a 30 minute travel time saving. Thus transport projects that allow an adjustment of activity schedules can give rise to significant benefits. Wang (1996) developed an activity model that allowed people to alter their activity schedules in response to changes in travel time. Such models however are complex and very data intensive.

Another feature about the studies reviewed is that whilst Table 2 has considered the values in the context of changes in low frequency services, none of the studies specifically relate to low frequency services, nor do any of the studies consider the implications of permitting day return trips. The creation of day return trip possibilities through timetabling improvements will arguably give rise to significant reductions in the scheduling costs experienced by travellers. The lack of data on the value of low frequency services is illustrated by Wardman's review. He reviewed 143 value of time studies from the UK and identified 49 studies that considered headway - giving rise to 149 valuations of headway. However only 5 of these valuations were associated with headways of 1 hour and none were associated with headways over 2 hours. There is therefore a need for valuation data that specifically relates to enhancements to low frequency services. A number of approaches offer themselves for such valuations. Principally these fall into two camps:

- Measuring scheduling costs indirectly through a survey of the willingness-to-pay for frequency and timetable flexibility (which permits day return trips); or
- A direct model of individual's activity scheduling.

Activity models are very data intensive and expensive. It was therefore felt that a Stated Preference survey of the willingness-to-pay for frequency and timetable improvements would be the most appropriate method. The disadvantage with this method is that the value obtained cannot be split into its constituent parts. For example, it may be hypothesised that values of frequency (and headway) in addition to including the willingness-to-pay to improve the scheduling of activities may also include some level of expected wait time and also some level of expected risk of missing the public transport service. Additionally, with this method it is not possible to disaggregate scheduling costs between the costs associated with re-arranging activities to fit around the timetable and the cost associated with not undertaking an activity at the desired time (schedule delay). The valuation that will be derived is therefore similar to Bråthen and Hervik's concept of inconvenience cost.

3. CASE STUDY – AIR SERVICES IN THE HIGHLANDS & ISLANDS: VALUING SCHEDULE DELAY

3.1. Expanding the air services network in the Highlands and Islands

HITRANS, the regional transport partnership for the Highlands and Islands, commissioned a number of studies exploring the possibility of expanding the existing air services network in the Highlands and Islands. A set of options was defined (A&TC, 2003), which were then subjected to an appraisal (Steer Davies Gleave, 2004), which was submitted to the Scottish Executive in July 2004.

The proposals for improving the air services network were developed with regional priorities in mind - to reduce air fares and to increase frequencies, where possible allowing a day return trip in either direction between the islands and the mainland. The proposals comprised:

- An average fare reduction of 30% across the network;
- Improved schedules which offer longer times at destinations;
- Additional frequencies; and

- New airports and new routes.

As part of the economic appraisal primary research with businesses and residents was undertaken, which included a Stated Preference survey (Kroes, 2004). This element of the project in particular allowed benefits relating to frequency and reliability to be measured and monetised.

3.2 Stated Preference valuations

The Stated Preference exercise referred to above was undertaken to determine the value in money terms that individuals would be willing to pay for increased reliability, frequency of flights and the possibility of undertaking a day return trip.

People travelling to or from a Scottish island by air were intercepted in the airport lounges at Aberdeen, Glasgow, Inverness and Edinburgh. A total of 300 people were interviewed, travelling on business, health or non-work purposes.

3.2 Survey design

The interview involved asking each respondent about their current trip. This was followed by a Stated Preference exercise, which focussed on choices between alternative air services for the journey they were making and which included four attributes:

- Cost of travel;
- Number of return flights per day;
- Whether or not a day trip is possible at destination; and
- Reliability of flights in very bad weather conditions.

Choices were offered as Service A or Service B: Service B was always offered at the same price as respondents had paid for their current ticket along with some improvement to the service. Service A presented a more basic service with a discounted ticket cost. Attributes and their levels are shown below.

- Return flights per day:
  - One (A) vs Two (B)
  - Two (A) vs Two (B)
  - Two (A) vs Three (B)
  - Two (A) vs Four (B)
- Day trip possible at destination:
  - No (A) vs. Yes, at least 4 hours available, excluding check-in (B)
  - No (A) vs. Yes, at least 8 hours available, excluding check-in (B)

    - Yes, at least 4 hours available, excluding check-in (A) vs Yes, at least 4 hours available, excluding check-in (B)
    - Yes, at least 8 hours available, excluding check-in (A) vs. Yes, at least 4 hours available, excluding check-in (B)
- Flight reliability:
    - Flights subject to cancellation in very bad weather conditions
    - Virtually no flights cancelled in very bad weather conditions
- Cost of travel:
    - Service A: 50% less than today (half price)
    - Service A: 33% less than today (a third off)
    - Service A: 20% less than today (a fifth off)
    - Service A: 10% less than today (a tenth off)

Figure 1 presents an example of a showcard used in the survey.

Figure 1: Stated Preference Showcard Example

CARD 1

Service A	**Service B**
TWO outward and return flights per day	THREE outward and return flights per day
Day trip possible at destination, at least 8 hours, excluding check-in	Day trip possible at destination, at least 4 hours, excluding check-in
Flights subject to cancellation in very bad weather conditions	Virtually no cancellations in very bad weather conditions
Return fare 10% less than today (one tenth off)	Return fare the same as today

Which of these two services do you prefer?

Service A **Cannot choose** **Service B**

3.2. Stated Preference response analysis

An analysis of respondents' choice patterns was undertaken followed by an estimation of discrete choice models.

Two thirds of respondents traded with non-traders present on both sides – that is, some people would always choose the cheaper option while other would always choose the improved but more expensive option.

Those travelling on business were more likely to choose the better more expensive service while those making non-work trips were more likely to choose the cheaper more basic service.

The next step in the analysis was to ascertain what proportion of people chose air service B, the improved service at the reported fare for each level of attribute offered. Analysis of choice pattern demonstrates that respondents reacted consistently to changes in attribute - increasing the cost of travelling and improving flight reliability significantly impacted upon the respondents' choices. The ability of making a day trip has a significant impact while the effect of increasing the number of flights per day is small.

The discrete choice analysis consisted of fitting logit models to the choice data. Two types of utility equations were specified, in which the cost was treated in different ways. Calibrations of the first type used cost differences inferred from the data set on the basis of the reported cost of travelling and the discount offered. In these cases respondents who failed to provide a cost of travelling were excluded from further analysis. Calibrations of the second type used the proportional difference in cost, as used on the SP cards. This produced willingness to pay information expressed in terms of % changes in fare, which can be converted to monetary values on the basis of the average reported cost of travel. The latter method generally produced better models and is used to produce recommended monetary values for the use in the appraisal process. All parameters were of the expected sign and except for parameter a_1 (flights per day), were statistically significant. When absolute cost increments were used in the utility specification, 3 out of the 5 parameters were not statistically significant.

Next a refinement of the utility specification was tested. Parameter a_1 (flights per day) was dropped in favour of a dummy variable estimating the effect of offering 1, 3 or 4 return flights per day (relative to a basic service offering 2 return flights per day) separately. This indicated that there was no statistically significant effect when the number of flights was increased beyond 2 per day. The analysis demonstrates that a reduction to 1 return flight per day was disliked by respondents and there was little perceived value in having more than 2 return flights per day.

The final utility specification used is printed below.

$$V_i = a_1 \cdot \text{One Flight Per Day} + a_4 \cdot \text{Day Trip 4 Hours} + a_5 \cdot \text{Day Trip 8Hours} + a_6 \cdot \text{Improved Reliability} + a_7 \cdot \text{\% Change in Cost} + b_7 \cdot \text{\% Change in Cost Business} + b_4 \cdot \text{Day Trip 4 Hours Business} + b_5 \cdot \text{Day Trip 8 Hours Business} + m_6 \cdot \text{Improved Reliability Medical Day} + b_6 \cdot \text{Reliability Business Day}$$

Parameters b_4, b_5, b_6, b_7, and m_6 in the above equation are “adjustment parameters”. Parameters b_4 and b_5 represent the additional utility associated with the ability to make a day trip offering 4 or 8 hours for respondents making business trips. Parameters b_6 and m_6 represent the additional utility of improved reliability for respondents making a business day trip or a medical day trip. Parameter b_7 represents the additional utility associated with changes in the cost of travelling for those making business trips. Table 3 shows the results from the final model calibration.

TABLE 3 LOGIT RESULTS - RECOMMENDED MODEL

Parameter	Estimate	T-Statistic
One Return Flight per Day (Relative to Two) – a_1	-0.5307	-5.4
Improved Reliability – a_6	0.2197	2.6
Day Trip Four Hours – a_4	0.1980	1.3
Day Trip Eight Hours – a_5	0.4137	3.3
% Cost of Return Ticket – a_7	-3.1325	-9.0
% Cost of Return Ticket Business – b_7	1.4749	3.5
Day Trip Four Hours Business – b_4	0.4420	2.2
Day Trip Eight Hours Business – b_5	0.2270	1.4
Improved Reliability Business Day – b_6	0.6824	3.3
Improved Reliability Medical Day – m_6	0.7471	2.3

From Table 3 it can be seen that parameter a_4 (day trip 4 hours) is not statistically significant at the 95% confidence level, but that parameter b_4 is. In other words respondents making business trips value the ability to make a 4-hour day trip, but those travelling on non-work trips appear not to. The reverse is true regarding the ability to make an 8-hour day trip Parameters a_4 and b_5 were retained on the basis that they were not sufficiently weak to justify dropping them.

Parameter b_7 is significant and positive, indicating respondents making business trips are less sensitive to changes in the cost of travel. Finally parameters b_6 and m_6 are significant indicating additional benefit of improved reliability for respondents making a business or medical day trip.

The results from Table 3 were used to re-calculate parameter estimates for five segments: Business Day Trips, Business Non Day Trips, Non Business Trips, Medical Day Trips and Medical Non Day Trips. For example the parameter estimate on cost for all business trips is obtained by summing parameters a_7 and b_7. The results are shown in Table 4.

TABLE 4 RECOMMENDED MODEL – PARAMETERS BY SEGMENT

	Business		Non Business	Medical / Personal	
Parameter	**Day**	**Non Day**	**All**	**Day**	**Non Day**
1 Return Flight	-0.5307	-0.5307	-0.5307	-0.5307	-0.5307
Improved Reliability	0.9668	0.2197	0.2197	0.9021	0.2197
Day Trip 4 Hours	0.6400	0.6400	0.1980	0.1980	0.1980
Day Trip 8 Hours	0.6407	0.6407	0.4137	0.4137	0.4137
% Cost	-1.6576	-1.6576	-3.1325	-3.1325	-3.1325

The implied benefits of the improvements included in the SP exercise can now be calculated by expressing the improvements or changes in the attribute levels in terms of equivalent proportional changes in the fare and applying average fares to work out the monetary benefits. For example the benefit of the ability to make a 4-hour day trip for respondents making a business trip is obtained by taking the ratio of parameters b_4 and b_7, and is equivalent to 27% (0.6400 / 1.6576) of the average fare. The average reported fare for business trips was £215, giving a benefit of £83.

The results are shown in Table 5 using average fares for the sample segmented by journey purpose. Note: all benefits are expressed in terms of the cost of a return ticket.

TABLE 5: BENEFITS (£ / RETURN FLIGHT)

Benefit	Business		Non Work	Medical / Personal	
	Day	Non Day	All	Day	Non Day
1 → 2 Return Flights Per Day	£69	£69	£23	£38	£38
2 → 3 Return Flights Per Day	--	--	--	--	--
2 → 4 Return Flights Per Day	--	--	--	--	--
Flights subject to cancellation in very bad weather → Virtually no flights cancelled in very bad weather	£126	£29	£10	£64	£16
No Day Trip Possible at Destination → Day Trip Possible at least 4 hours	£83	£83	£9	£14	£14
No Day Trip Possible at Destination → Day Trip Possible at least 8 hours	£83	£83	£18	£29	£29
Average Cost of Return Ticket	£215	£215	£138	£222	£222

Note: 2003 Behavioural prices and values.

Those making business trips have the highest willingness-to-pay for improvements, with reliability being valued highly, particularly by those making day trips. This can be expected, as those travelling on business tend not to pay for travel costs themselves.

Those making non-work trips do not value the possibility of a 4-hour day trip though do place a value on increased frequency (1 to 2 flights per day) and the potential for making an 8-hour day trip.

4. DISCUSSION

4.1 Comparison with evidence in the literature

The SP results presented above are in 2003 behavioural prices and values. For the purposes of the economic appraisal and for comparison against those values concluded in other studies, it is necessary to convert these figures into 1998 market prices and values.

TABLE 6: BENEFITS (£ / RETURN FLIGHT)

Benefit	Business		Non Work	Medical / Personal	
	Day	Non Day	All	Day	Non Day
1 → 2 Return Flights Per Day	£67	£67	£22	£37	£37
2 → 3 Return Flights Per Day	--	--	--	--	--
2 → 4 Return Flights Per Day	--	--	--	--	--
Flights subject to cancellation in very bad weather → Virtually no flights cancelled in very bad weather	£122	£28	£10	£62	£14
No Day Trip Possible at Destination → Day Trip Possible at least 4 hours	£81	£81	£9	£17	£17
No Day Trip Possible at Destination → Day Trip Possible at least 8 hours	£81	£81	£17	£28	£28

Note: 1998 Market prices and values. Assumptions used in converting unit of account: Growth in Value of Time between 1998 and 2003 – 1.118; indirect tax correction factor: 1.209; and inflation correction factor for 2003 to 1998 prices: 0.8985.

The literature review highlighted a number of studies where scheduling costs have been valued *indirectly* and do not focus on the costs or benefits of activity rescheduling or altering the time or duration of an event undertaken. The range of values determined varies considerably for different levels of headway reduction between studies. In comparison to the range in the literature, the case study suggests that benefits of the same order of magnitude but exceed the upper bounds of the range, particularly for those travelling on business. This is felt to occur as a consequence of the fact that the values determined from the literature were extrapolated from surveys of relatively high frequency services, whilst this study has specifically focussed on low frequency services and the creation of day trip opportunities. It would be expected that the change in scheduling costs associated with a change in frequency will be greater at lower frequencies than at higher frequencies.

TABLE 7: COMPARATIVE SCHEDULE DELAY VALUATIONS

Change in service	Non work		Work	
	HITRANS Air services	Literature range	HITRANS Air services	Literature range
1 → 2 Return Flights Per Day	£22	£2.79 - £20.94	£67	£9.77 - £40.48
No Day Trip Possible → Day Trip Possible 8 hours	£17	No data	£81	No data

4.2 Valuations of scheduling costs as part of the economic appraisal

A full economic appraisal was undertaken for the proposal to expand the air services network in the Highlands and Islands. The project included some infrastructure enhancements, including new airports at Oban and Skye, plus increased frequencies to all ten Highlands and Islands airports and fares reduced on average by a third across the region. The monetary values derived in the Stated Preference work were included in the appraisal and account for just over a third of the user benefits (34%).

While the SP work highlighted that the ability to make a day return trip was valued most, particularly by those travelling on business, the appraisal results reveal that more benefit was accrued through frequency improvements. This is due to the fact that those routes with greater patronage already allow day return trips (i.e. Sumburgh to Aberdeen). Frequency improvements for business users accounted for just over a quarter of all business user benefits, while the ability to make day trips accounts for ten percent of business user benefits.

TABLE 8: ECONOMIC APPRAISAL SUMMARY

Appraisal elements	Including SP Valuations	Excluding SP Valuations
Consumer user benefits		
Travel time	31.844	31.844
Frequency improvements	39.041	
Creation of day trip opportunities	10.800	
Vehicle operating costs	0.000	0.000
Reliability	2.593	2.593
User charges	93.228	93.228
During construction and maintenance	0.000	0.000
	177.506	95.821
Business User benefits		
Travel time	201.966	201.966
Frequency improvements	150.719	
Creation of day trip opportunities	59.872	
Vehicle operating costs	0.000	0.000
Reliability	1.081	1.081
User charges	175.866	175.866
During construction and maintenance	0.000	0.000
Total	589.504	176.947
Net Present Value	400.603	140.171
Cost Benefit Ratio	**1.66**	**1.23**
Government Cost to Benefit Ratio	**2.73**	**1.61**

5. CONCLUSION

Reductions in scheduling costs, that is reductions in the inconvenience of organising activities around transport schedules, are real benefits associated with improvements to lifeline transport services. Through a case study of air services in the Highlands and Islands this paper has demonstrated valuations of scheduling costs are significant and have a significant impact on the value for money of the proposal – thereby strengthening the case for funding improvements to these lifeline services.

The innovative approach applied to measuring the economic benefits of the proposals clearly demonstrate, within the economic appraisal, the value that remote and rural communities place on frequent lifeline services. It is recommended that further research is undertaken in this area and for other lifeline services (such as ferries). Furthermore consideration should be given to including scheduling costs as standard in the appraisal of lifeline services, in the same way that time savings are.

NOTES

1. Small's model does not include unanticipated congestion (but can be extended to include this), so actual arrival time = planned arrival time.

2. SPASM is the Department for Transport's passenger allocation model (Scott Wilson Kirkpatrick, 2004). It forecasts the number of passengers and air traffic movements (ATMs) at UK mainland airports on an annual basis from 1998 to 2030. SPASM is a demand side model allocating air passengers to airports based on the relative generalised cost of surface access routes to the airports, flight frequency and interchange costs.

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