Mapping Expert Perspectives of the Aviation Sector

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ABSTRACT

Aviation globally is characterised by significant change and consequently the future of the sector has always been difficult to predict. This study adopts a systemic approach based on findings from exploratory interviews with UK aviation academics to: determine the roles of stakeholders in the air transport system; report the current issues facing the sector; explore how these issues interact and impact on the stakeholders in the system; and speculate on the future implications. Six core stakeholders are identified: airlines, airports, consumers, manufacturers, governing institutions and interest groups. Nine core issues are reported, namely: local environment, climate change, peak oil, the state of the economy, social norms, demographics, disruptive events, national (or international) regulations and capacity. A matrix of interactions and their impacts and implications for managing the aviation system is then presented.

Keywords: aviation issues; air transport; future scenarios; stakeholders; expert perspectives; soft systems methodology (SSM); airlines; airports; exploratory interviews

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1 INTRODUCTION

In recent decades the aviation sector across the world has undergone a period of significant change and seems at times according to some to be facing a more uncertain future McKelvey (2002). The sector has always been engaged in attempts to model its own trajectory in terms of overall growth both in the short and medium term. Some (e.g. Kivits et al (2010) and Sgourdis et al (2010)) suggest that currently the entire sector is 'locked-in' to a deep aviation paradigm which relies heavily on a space and time rich landscape due to the requirements of the highly complex technological regime in which aviation craft, manufacturers and airports function. This paper argues that due to high investments in research and development that long periods of time are required to reach profitability. These slow processes of 'product lifetimes' ranging from 30-40 years require long times for change. Airports similarly require large spaces to operate to disperse not only craft (on the ground and in airspace) but to also reduce negative externalities such as noise, visual intrusion and local air quality issues.

However, informative though they are, such studies have not attempted to investigate the contemporary aviation system as a whole in a holistic way. Consequently the aims of this paper are to identify the roles of stakeholders in the air transport system; report the current issues facing the aviation sector; explore how these issues interact; investigate the effects of these issues on the stakeholders in the system; and speculate to a lesser extent on the implications of these findings. In particular the findings are framed in terms of understanding how the aviation system is managed with respect to the environmental consequences and the understanding of environmental technology and its impacts.

The structure of the paper is as follows: section 2 provides a brief review of previous work, while the method is described in section 3. Section 4 sets out the findings from the interviews, section 5 provides a discussion and section 6 concludes.

2. PREVIOUS WORK

From the literature there are a number of ways of describing the actors or stakeholders involved in the aviation community. Thus, Thomas and Lever (2003) list ten actors, namely the government, airport, employees, service partners (include airlines), local authorities, travelling public, local community, Non Governmental Organisations, providers of other transport services in the area and airport suppliers. Taking a different perspective, Graham and Guyer (1999) suggest airlines, wider society, airline customers, regulators and airport operators as being the relevant stakeholders. Aggregating these groupings, Pastowski (2003) categorises the stakeholders in the aviation sector into:

- Government (Governmental bodies (at various levels), international organisations);
- Industry (aircraft industry, airlines, airports, air traffic control);
- Consumer groupings (travellers, tourism industry and shippers);
- Non Governmental Organisations.

From this, it would appear that the literature examining the role of stakeholders in the aviation sector is relatively limited (see Amaeshi and Crane, 2006).

Meanwhile some of the work identifying the major challenges facing the aviation sector (and the way they interact) is reported below.

Thus, global warming is one area that dominates the literature as a challenge facing aviation. For example, Sgourdis et al (2010) reports that the key challenge facing aviation is to reduce greenhouse gas emissions whilst sustaining current passenger and freight mobility in developed economies and meeting future demand for aviation in less developed countries. It continues that a portfolio of mitigation measures incorporating technological and operational improvements, use of biofuels, demand shift and carbon pricing will be required to balance economic pressures for increased mobility with environmental constraints. Similarly, Miyoshi and Mason (2009) reports on how carbon emissions can influence airline strategies relating to aircraft type used, load factors and seat configurations.

Upham et al (2004) focuses on looking at the issue of local environmental constraints restricting airport capacity (and hence the capacity of the aviation system as a whole). Upham et al (2003) categorises these as being aircraft noise, air quality, third party risk, biodiversity, and community opposition to growth. Hamzawi (1992) outlines a taxonomy of measures aimed at addressing the capacity implications imposed by these constraints.

Fuel related issues too, are noted. Typical of the genre is Nygren et al (2009), which finds that the impact of future (reduced) levels of crude oil production means that big efficiency savings will be needed to maintain current rates of air traffic growth (~5% per year) while the possibility of bio jet fuel replacing oil remains only a possible long term solution meaning that the aviation industry needs to rethink its position on its future development. Another is Rao (1999), which highlights the volatility of jet fuel prices and the sensitivity of the aviation industry to fuel price risk.

Economic and demographic factors obviously influence how aviation has developed and will develop in the future (e.g. see Vedantham and Oppenheimer, 1998), as do social norms. One paper that pulls these three influences together is a based on evidence from Germany. Böhler et al (2006) looks at sustainable holiday travel and finds that income level, the specific household situation (e.g families with children prefer mid-distant journeys, whereas long-haul journeys are more interesting for persons without children, and values (especially ‘openness to change’) are a driving force for the choice of overseas travel. And Graham (2006) finds that while demand for air transport has become much less certain and stable in recent years, in the long term “it is likely that traditional drivers of demand such as income, cost and time will continue to play an important role in influencing demand” (pp.20).

A large body of evidence refers to impacts relating to institutional issues on aviation, such as competition, liberalisation and consolidation (e.g. Mayor and Tol (2009), Oum et al (2006) Button (2009) and Dennis (2005)); tradable permits for carbon (e.g. Anger (2010)); and issues specific to individual stakeholders such as determining the ‘optimal structure’ of an airline (e.g. Mason and Alamdari, 2007) or airport (Carney and Mew, 2003). Meanwhile Raguramen (1997) links these institutional issues with cultural/political factors, by noting the importance of flag carrier airlines as a form of national marketing.

Next, a few papers seek to determine the effects of what could be termed ‘disruptive events’. For example, Zeng et al (2005) reflects on the impact of the SARS virus while Ito and Lee (2005) and Nolan et al (2004) evaluate the repercussions of the 9/11 terrorist atrocity on US airline demand. Meanwhile, ash cloud (from volcanoes) also presents specific issues for

airspace closure and disruption (see Budd et al, 2011 and associated papers in this special issue of *Mobilities*).

Finally, one report that sums up several of the issues is Eurocontrol (2008), which adopted a very much operations perspective to identify the five main challenges facing aviation as being airport capacity, environmental impact, increased vulnerability to perturbations due to increased congestion, institutional and social change [within the air traffic control system], and climate change.

Interestingly, as noted above while work has considered future scenarios for aviation from the perspectives of particular stakeholders (especially airlines and airports), and in relation to specific issues (e.g. global warming, peak oil, disruptive events), it would appear that a broader view of the aviation sector as a whole has not recently been taken that seeks to discuss how these elements may interact with each other, and particularly not from a systemic aspect. It is this apparent omission that this paper attempts to address.

3. METHODOLOGY

Morris and Martin (2009) define a system as being "a collection of entities… that are seen by someone… as interacting together… to do something" (pp.160). They note that the systems approach is "as much about problem finding and problem exploring as it is about problem solving", and contend that one "cannot deal with wicked problems… without thinking and acting systemically" (pp.157). Interestingly, Bieger and Wittmar (2006) have previously used a 'soft systems methodology' (SSM) to look at the aviation sector, although this took a tourism/business perspective more than an aviation activity perspective as adopted here. Further guidance on this type of method is available from Checkland (1999) and also Hawkins (2011). As already noted, often the previous work has tended either to be geographically specific and/or founded on one specific aspect of the sector (e.g. airline management, passenger responses to pricing behaviour, etc). Consequently, for this study it was decided that a systems theoretical framework which is focused specifically on providing a fully holistic approach to complex and multi-faceted subject areas was appropriate.

Face-to-face in-depth interviews were undertaken with eleven UK academics with significant research expertise of the aviation sector. The interviewees were selected based on careful study of the literature in the area and on the author's knowledge of the aviation sector. All eleven interviewees have doctorates; all have published widely in the field and have been involved in researching the aviation sector for at least five years (most substantially longer). Three of the interviewees have worked for airlines, two for airports, two for aviation consultants and two for government/international institutions. In this paper the experts are identified as simply A, B, C, etc., and their words are either paraphrased or quoted (shown in italics).

A set of structured questions were asked to explore issues within the aviation sector. These included questions that established the backgrounds of the interviewees, before moving onto stakeholders and their roles. Next, the likely future trends in the aviation sector worldwide were discussed, followed by the key issues and challenges, threats and opportunities, and possible solutions. Finally, the interviewees were asked to relay their opinions on how the aviation sector was likely to develop in the future.

The interviews were recorded digitally and then transcribed into documents. Next, these files were used as basis for further analysis, such as coding, regrouping and condensing. The

interviews were then analysed using thematic analysis. This technique is widely used to analyse qualitative data as it provides "theoretical freedom" and "provides a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data" (Braun and Clarke, 2006, pp.78).

4. RESULTS

The interview findings are reported in three sub sections. The first identifies the stakeholders in the air transport system, the second reports the issues in aviation and the third looks at how these issues influence one another.

4.1 Stakeholders and the Air Transport System

The stakeholders in the air transport system that emerged from the interviewees can be divided into primary actors (airports and airlines) and secondary actors (institutional bodies, interest groups, manufacturers and consumers). More specifically:

- Airports: e.g. international, national, regional, local.
- Airlines: e.g. full cost carriers/flag carriers, and low cost carriers.
- Institutional bodies: e.g. international governmental agencies (IATA, ICAO), national government agencies (US Federal Aviation Administration, UK National Air Transport Service).
- Interest groups/lobbies: e.g. labour unions, tourism interests, environmental groups, business groups.
- Manufacturers: airframe, engine, components.
- Consumers: passengers (business and leisure) and freight.

This taxonomy neatly overlays the Thomas and Lever (2003), Graham and Guyer (1999) and Pastowski (2003) categories, though it disaggregates the 'industry' grouping and introduces a form of hierarchy that is not presented before.

4.2 Issues in Aviation

In terms of issues from the interviews, nine external to the industry were identified, and these were subsequently categorised as being environmental, economic, social, political, legal and technological. In some cases the category is arbitrary as systems thinking would emphasize the interconnectedness of each of the issues. For example one can argue equally that oil supply (particularly relating to peak oil issues) could be technological, economic, or even social. Nevertheless for ease of layout the nine issues have been placed in the four over-arching headings with technological, legal, and political combined into one heading. Other headings are environmental, economic and social (see Table 1 for further explanation).

TABLE 1 – Issues in aviation characterised and explained

Issue	Description	
	Category	**Comments**
Local environment	Environmental	Issues include air quality and noise.

Climate change		Broadly includes any issue related to the increased generation of greenhouse gases due to human activity.
Oil supply		This refers to issues related to the dependence of the aviation sector on oil and its derivatives, both from short and longer term perspectives.
The economy	Economic	Economic factors might include changes in economic activity levels from the personal to the global level.
Social norms	Social	Social norms reflect the prevailing cultural influences on operator and traveller behaviour.
Demographics		Age, gender and wealth characteristics of particular population segments.
Disruptive events	Political, Legal	Unusual occurrences that disturb planned operations.
Regulation	and Technological	This refers to the influence of institutional, regulatory and planning regimes.
Capacity		Pertains to issues limiting the supply of aviation activity.

Issues ***not*** included directly within the systems analysis include the following drivers in aviation: the push for further liberalization, aviation fuel substitutes (e.g. biofuels was mentioned frequently), virtual travel (e.g. teleworking, telepresence), level of passenger taxes, airport management and strategy, aero-engine efficiencies, general and rising costs of aviation fuels, and finally the presence and importance of specific flag carriers in some countries. These are all undoubtedly very important issues and all of them have linkages with our analysis but the frequency of these terms was less and in some cases the experts couched these issues in different ways. For example costs of aviation fuel were predicted to rise with the advent of peak oil, or even the perception of peak oil.

4.2.1 Environmental Issues

The issues are discussed with respect to the overall activity pattern using the previous order of issues shown. Within the environmental domain, local environmental impacts (such as noise and local air quality conditions near airports) as well as climate change were considered.

Interviewee H is of the opinion that *"we are not going to prevent the 2 degree rise as we thought we could. We have lost control and we'll have to adapt to it. When the Kyoto protocol was signed, international aviation was excluded because it was seen as a special case. Only domestic aviation was included because it was easier to apportion the level of emission within one country. It was difficult to decide which portion of emission was to be accounted for at departure and arrivals. But now international aviation is not a special case any more"*. He went on to say that now because of the open sky, you may have ten aircraft flying to the same destinations instead of five. *"Eco-efficiency is decreasing and emissions are increasing. A jumbo jet carries 5 tons of catering. Half a ton of fuel has to be carried for this. We now need different business practice. Duty free items don't have to be carried on onboard. Unsustainable! Unsustainable!."* And moreover: *"If the industry is sensible and sensitive to the issues of environment, it will look at all this, which is not the case now,"* adding that *"low cost airlines' are more eco-efficient because of no frills. But then the cheaper the flights the more people travel."* This looks more like a vicious circle and a no-win situation and was a clear identification of some of the feedback loops existing within the aviation activity system. There were strong links between both climate change and the topic of peak oil.

The issue of oil supply was raised by Kivits et al (2010), who states that both carbon trading emission schemes as well as the 'imminent reality of peak oil production, with its consequent

impact on oil price' play dominating role. The panel experts agreed, with Interviewee A noting that "*oil prices continue to be [...] almost an obsession for most airlines*" International economics will dictate some levels of fluctuations as well, but some stability may arise depending on the international economic situation. For Interviewee E, oil prices will continue to rise and those who hedge on fuel prices will continue to lose money. Almost all of the interviewees feel that alternative sources of energy for aircraft will not be found in the next 25 years although they may release pressure on other traditional users of crude oil like the electricity suppliers. Many of them acknowledged that technological fixes such as biofuels, nuclear or hydrogen fuels would not be 'easy answers'. For example: According to (D*) "the airline industry will probably be one of the last users of kerosene as it is still a more attractive source of energy in terms of price. If other alternative sources of energy become attractive may be then the price of fuel will be more interesting for airlines".* Interviewee C is rather positive in thinking that within 25 years, there will be more production of energy through alternative sources outside the air transport industry. There will sure[ly] be more investment in the development of fuels. But Interviewee A thinks that *"biofuel is not a solution as some people tend to think. There is still a risk that the fuel freezes at very high altitude."* Interviewee H stated:*"bio-fuels and artificial fuels will only prove a short term solution. Because of the quantity required, these will never be a viable solution. Hydrogen fuel will also be costly and you'll have to have a hydrogen fuel station at each airport. Nuclear energy will be politically unacceptable. People living around the airport will not agree to it. It is a decision for society to use alternative sources of energy for domestic and industrial purpose and leave the carbon fuel to aviation".* Thus there was a consensus towards saving high energy density fuels for this sector if possible, but the experts also acknowledged that oil and the economy are strongly linked both in terms of national economies but also for aviation activity.

4.2.2 Economic Issues

Most of the interviewees tend to think that the industry is now facing the greatest challenge of its existence with recession now impacting on the global economy, resulting in a fall in demand, a lack of finance for investment and continued pressure from all sectors – political, social, and environmental. The industry will have to fight many battles on several fronts if it wants to survive. One of these battles will be to regain the faith of investors. The state of the economy will also have strong interactions with the core of aviation activity as well as with the users of aviation. The social norms of these users may well change under prolonged economic recession with a reduction in some low-cost carrier activity for example. Finance is an important requirement for the simple reason that the industry is investment-intensive and the credit crunch is imposing serious limitations to credit availability as Interviewee D points out: *"Banks are now reluctant to lend and they are also lending at premium rates."* Moreover, the industry is very vulnerable to oil price fluctuations, emphasizing the link between the oil resources and the economy.

One of the main issues for the airline business has for many years been that of sustainable business operations. Air transport is cost intensive: equipment, capital and labour intensive. High operational costs in a situation of almost perfect competition do not guarantee viability and profitability, especially if airlines working at marginal profitability. For Interviewee B, to achieve an acceptable level of viability and profitability, *"the structure should change. No remarkable profitability will be seen unless there are some structural changes"*. Experts in general agree that there will be consolidation in some format. Also experts noted that there

was potential change in social norms to have less of an appetite for travel depending on circumstances.

4.2.3 Social Issues

Austerity (and its subsequent influence) has been touched upon earlier and supported by some of our interviewees that in spite of the international economic downturn, people will still travel for business, conferences, visiting friends and relatives but perhaps less for holidays. The way that social norms map onto various business models and markets will be of critical importance for the aviation core, and technology will affect this as well. For example some stated that it is not clear yet which type of future aircraft will best serve the user's needs, in the large versus smaller debate. It was also not clear which of these was more environmentally friendly and that it would take considerable operation time (up to 20 years) until it was really known what the optimum aero-frame might be. Interestingly, the idea that flying may be increasingly viewed as being anti-social due to environmental pressures thus leading to a decline in demand was not specifically raised by any of the interviewees, though this would seem to be a possible outcome.

4.2.4 Political, Technological and Legal Issues

There was general agreement that deregulation and liberalization are both here stay for many more years to come and this is seen now an irreversible situation. This is a process which all future development will have to cope with and creates a situation where the fittest will continue to survive. Operators will venture to change threats into opportunities and weaknesses in to strengths. The developing countries will continue to lag behind and if they cannot beat the situation, they will continue to pool resources with the mega carriers. Mergers and acquisitions will continue with some airlines moving out to make way for new entrants with new technology and new management methods. However, as government is one of the most important stakeholders, the bigger challenge is often for politicians and policy makers. *"Governments will obviously have to continue to meet the expectations of operators and consumers alike and because of the essential nature of the service, governments, especially those maintaining the flag carrier concept, [they] will continue to fork out subsidies to keep the services going."* (Interviewee E).

Other interesting technological dominated futures considered *'pilotless aircraft'* (Interviewee F) and Interviewee D is also of the opinion that it will be possible to fly planes without pilots but then asks the question*: "How many passengers will agree to travel in an aircraft without pilots?"*. None of the experts though had discussed how airlines might realise, or work with this type of innovation. Yet growth was still a key theme and for Interviewee D, *"there will be some growth and in both passenger and freight traffic"*. Interviewee H foresees that "the regulation regarding climate change and the rising prices of oil will drive up the cost of air travel."

For Interviewee G, there will be a remarkable technological advancement *but "technology comes with a price. Technology will be used as a competitive weapon. Those who can afford will use this consciously to dominate the market and to drive out competitors; particularly in long haul journeys of over three/four hour flights and longer where you will see the real benefits of technology"*.

4.3 Aviation issues and their interactions

The issues derived from the interviews were grouped into a large single matrix (9X9) which is shown in Table 2. The table is read horizontally with each issue shown in a row from the left, along with main issues repeated at the top of each column. The purpose of the grid is to illustrate the interconnections between the issues derived from the interviews.

INSERT TABLE 2 – A matrix of example interactions for the issues identified

Within the environmental denomination the experts generally agreed that local environmental issues and impacts were important both in countries where aviation is expected to grow more in the future as well as in lower growth rates found in the markets of US and Europe. Some discussed the potential issues that India and China will face in terms of air quality whilst other concentrated on ways that European aviation activity can become more 'environmental friendly.' One example of this follows: *"it is a recognized fact that with global warming for which the aviation industry is also partly responsible, damage to the environment will continue to be a threat to the planet. The aviation sector will be under pressure to review its ways of operation. Most Airlines will be subject to tough laws and the EU has already set the scene with its regulations regarding the level of emissions, decibels at airports and the age and conditions of aircraft."* For three interviewees at least notably Interviewee A, B and E environment may be the biggest challenge for the industry. The big questions according to Interviewee B will be:*" To what extent they can expand and grow without damaging the environment and increasing global warming, and to what extent also the industry will have to pay its way especially regarding the environmental costs"*. According to Interviewee D, communities living around airports will be a cause for concern because of noise pollution. This is also the concern of Interviewee E who thinks that the industry will be further constrained. He gave the example *of "the third runway at Heathrow which will [de facto] be constraining."* For Interviewee H, *"water will also be a serious problem, added to this you have peak oil, climate change, environmental and capacity constraints at airports; aircraft noise, local residents, local air quality"*. H went on to say *"that airports will have smaller capacity than their actual infrastructure..."*. This implies a contraction for some aviation systems.

In terms of systems analysis the next step was to construct a multiple cause diagram (Morris and Martin, 2009), with the identified issues interacting with aviation activity as completely as possible. This is depicted in Figure 1.

INSERT FIGURE 1 – Multiple Cause Diagram of the issues linked to aviation activity

Figure 1 places aviation activity at the core of the diagram and attempts to show how all the other issues affect it and in some cases how the aviation sector (and its activity) can affect issues such as the local environment through levels of noise pollution. The two way interconnections are depicted by lines with arrows at each end and for clarity the lines linked to aviation activity have been drawn as dashed lines; this is not an indication of interaction strength as dashed lines are conventionally used to show weak relationships.

The authors have also used their prerogative to re-label certain issues, such as peak oil to oil supply, even though in the majority of cases the experts used the phrase peak oil to describe a variety of oil-related issues. Similarly the frequent use of both "global recession" and "the economy" has been termed the state of the economy to reflect a more neutral, non-prejudiced statement. In some cases the term is deliberately vague such as capacity which can refer to a

whole variety of capacity related issues including airport capacity, airline capacity, specific route/flight capacity as well as infrastructural (national) capabilities and capacities. In some cases for clarity some influences have been omitted – for example one would expect that changing demographics at a national level would have an effect on the national economy, and vice-versa, through immigration, and related policy that might influence migrant workforces. This was felt to be only an inadvertent effect. Likewise the connection between the state of the economy and disruption is also not shown partly as this is thought to be a weak effect. A test for this would be to consider how disruptive events influence the state of the economy. An example such as extended air space being closed due to volcanic ash which Budd et al (2011) estimated to be worth US $1.7 billion in lost revenue to the airlines, thus indirectly feeding into the overall state of the economy. Therefore in Figure 2, one should read this as disruptive events influencing (decreasing the number of flights available) aviation activity which in turn influences economy (reduced revenue to airline industry). One thing not highlighted by our influence diagram is the additional revenue that might be generated by the non-aviation sector (e.g. retail, ground-based transport, etc) which could be considered an additional good for some aviation passengers.

Following the 'full' multiple cause diagram, with approximately 32 two-way interconnections (also summarised in Table 3), further processing then (in Table 4) illustrates the reduced map emphasising the links deemed by the interviewees to be the most critical which is linked to Figure 2. In this reduced figure the majority of interaction is considered to be one-way; most arrows represent a cause and effect in one direction. About six weak interactions have been removed. Examples included oil supply on capacity [this acts only through aviation activity], and climate change influencing disruption [protestors against aviation have disrupted activity in the past on runways].

INSERT FIGURE 2 – Systems map showing reduced number of interactions based on the major issues concerning aviation

This diagram can be manipulated in many ways to illustrate specific various feedback loops but only the most relevant interactions are discussed in this study.

5 DISCUSSION

From the analysis above, this discussion aims to focus on two areas in particular, namely how the aviation issues relate to the air transport system stakeholders and then on how the same issues may affect the development of aviation in the future. Interestingly, the data did not expose any significantly divergent views as to the stakeholders, issues or future trends beyond those noted in the narrative. In other words, there was quite a strong degree of agreement between the interviewees (and indeed in the literature) as to the issues that are important.

5.1 Aviation issues and the links with stakeholders

Table 3 summarises how the aviation issues might map onto the stakeholders in the air transport system using a linear cause and effect pathway.

TABLE 3 – Aviation issues and how they relate to the stakeholders in the air transport system

Issue	Stakeholders	
	Directly impacted	**Indirectly impacted**
Local environment	Interest groups (local residents,	Government, then airports, airlines, manufacturers

	environmentalists).	and users.
Climate change	Interest groups (environmentalists).	Government, then airports, airlines, manufacturers and users.
Oil supply	Airlines.	Manufacturers and then users.
The economy	Users	Airlines and then airports.
Social norms	Users	Airlines and then airports.
Demographics	Government	Users, then airlines, airports and manufacturers.
Disruptive events	Government	Airlines, then airports and users.
Regulation	Airlines.	Government.
Capacity	Airports.	Airlines and then users.

Table 3 reveals a number of interesting outcomes. Thus, for both global and local environmental issues it appears that lobby groups apply pressure on Government to regulate aviation activity which then impacts the airlines, airports, manufacturers and users (depending on the regulatory mechanism). Such a categorisation tallies with the literature. Upham et al (2004) reports stakeholders as being airlines, airports, air navigation service providers, regulators and NGOs, whilst Lawrence (2009) looks at stakeholders involved in addressing aircraft emissions, and lists oil companies, aircraft suppliers, aircraft users, aircraft controllers, aircraft regulators and Government lobby groups as being important actors in the sector.

In exploring the interactions between these groups, it would seem that the state of the economy and social norms seem to impact users first, who in turn then affect the airlines and airports. Government typically responds first to demographic effects and disruptive events, whilst the primary actors influenced by oil supply, regulation and capacity issues would seem to be airlines and airports. At this point it should be noted that it is of course an oversimplification of how each issue might impact on the various stakeholders. In particular, one would expect a range of feedback loops to be evident in any detailed analysis. However, instead Table 3 is intended to provide almost a series of hypotheses that may be explored more fully in any future work.

Looking to the issues highlighted in more detail, the underlying conflict about two issues – local environment and climate change. These conflicts lie mostly between interest groups on the one hand and the aviation industry on the other. Government acts as the arbiter as to where the line (or boundary) should be drawn in relation to the other issues namely regulation and capacity. The issues relating to oil supply, the state of the economy, social norms, demographics, and disruptive events are essentially beyond the control of the stakeholders in the sector and so it is less useful to consider this aspect in the same way as the other issues.

It is also useful to examine the geographic scope and timescale aspects relating to each of the issues. The local environment tends to refer to immediate impacts near an airport, whilst climate change is a global effect, although there is no consensus as to the timescale for impact with respect to rising temperatures. Similarly peak oil is a global issue with an uncertainty in the timeframe. Next, the state of the economy can be thought of as being a national level issue overlaid on the global scale, while the impacts are probably short to medium term. Social norms tend to be highly variable with some being highly personal and some more national or culturally based. Generally change is gradual over time although in some cases ‘trigger’ events can significantly alter values. By contrast demographic trends are fairly predictable over the medium to long term across the world. Disruptive events tend to be immediate/short term, and either predictable (e.g. strikes, weather disruptions) or unpredictable (e.g. terrorism events), while impacts can range in scale from being highly localised to global. Regulation in aviation generally impacts from the global to the national

level with a medium to long term time horizon, whilst lastly capacity issues are most closely related to the local and national context over the short to medium term.

5.2 Aviation issues and their potential impact on air transport activity

Table 4 illustrates how the identified issues may affect the development of aviation in the future, and their degree of impact ranked according to a basic content analysis-informed exercise. Specifically, it sets out how the multiple causes can contribute to increased or decreased aviation activity; how certain positive and negative feedback loops occur; and how these then might impinge on the stakeholders in the aviation system.

TABLE 4 – Aviation issues and their influence on aviation activity

Degree of Impact	Issue	Implications for aviation activity
High	Oil supply	Increased aviation activity leads to high demand for oil, which leads to an increased demand for oil, and then possibly to economic decline and thence to a decrease in aviation activity. Decreased aviation activity leads to lower demand for oil, to a reduction in demand and price of oil, leads to increased economic activity and increase in aviation activity. Airlines, and then manufacturers and users are most directly affected.
	Regulation	Regulations directly influence aviation activity. Regulations are influenced by issues such as Climate Change, oil supply, the state of the economy and social norms. They are applied by Government, usually on airlines, airports, manufacturers and then users.
	Climate change	Increased aviation activity increases threat of Climate Change causing interest groups to persuade Governments to regulate, thus limiting activity (e.g. European Trading System) and impacting on airports, airlines, manufacturers and users.
Medium	Disruptive events	Disruptive events (e.g. terrorism, war, volcanic ash clouds) can directly influence aviation activity. Here Government is often the stakeholder that responds and then influences airlines, airports, users and manufacturers.
	Demographics	Changing user demographics (e.g. population increases, rising incomes) directly influence aviation activity through Government, airline, airport and then manufacturer responses.
	The economy	Increased aviation activity by users leads to increased economic growth, leads to increased aviation activity, and vice versa. Airlines and airports are also impacted.
	Social norms	The social norms of users relating to aviation activity are directly influenced by attitudes to Climate Change, 'Peak Oil', disruptive events, local environmental impacts, the state of the economy and to changing demographics. Airlines and airports are also affected.
Low	Local environment	Increased aviation activity damages local environment (noise, air pollution, land take etc) changing social norms through interest group activity which then persuades Governments to regulate aviation system, limiting activity (e.g. London Heathrow, Stockholm Arlanda), and influencing airline, airport and aircraft manufacturer strategies.
	Capacity	Aviation activity influences, and is influenced by, available capacity in the system. Disruptive events and perhaps changing demographics also affect capacity, which are most affected by Government, airports, airlines, and then users and manufacturers.

As previously noted, such issues also emerged from the literature, though there are differences in emphasis. Thus, while global warming/climate change (Gössling et al 2007; Bows et al, 2005; Sgourdis et al 2010; Miyoshi and Mason, 2009) and institutional issues relating to competition, liberalisation, and consolidation (e.g. Mayor and Tol, 2009; Oum et

al, 2006; Dennis, 2005) are clearly important to the interviewees, both have been studied extensively and dominate the aviation literature. By contrast, previous work reporting on the influence on the demographics, social norms and capacity seems less developed, though apparently of equal interest to the experts interviewed.

6. CONCLUSIONS

The aims of this paper were to report the current issues facing the aviation sector; explore how these issues interact; investigate the effects of these issues on the stakeholders in the system; and speculate the implications of these findings on the future of aviation. It is very difficult to speculate on the future of aviation and there are many other studies which have attempted to do that. This study takes a different approach and attempts to characterize the mostly likely interactions between the current issues raised by an expert panel.

The paper reports that the stakeholders comprise of a core system of airlines and airports and a wider network of manufacturers, consumers, interest groups and governing institutions.

Next, nine major issues for aviation are identified and categorised into four groups. These are environmental (local environment and climate change); economic (oil supply and the economy); social (social norms and demographics); and political/legal/technological (disruptive events, regulation and capacity).

As the paper illustrates, there are a huge number of interactions in terms of how these issues interact. In the event, three particularly interesting loops emerged. First, as economic growth occurs (state of the economy), then higher earnings lead to people expecting to fly more (social norms) and aviation activity increases as a result, thus leading to more economic growth. This is a ‘virtuous circle’ style feedback loop. Second, as aviation activity increases then local environmental impacts worsen causing social norms to push the political mood towards increased regulation thereby limiting aviation activity. In this case, the feedback loop is self regulating. Finally, a cyclical loop can arise relating to oil supply, the state of the economy and aviation activity whereby a growth circle switches to a circle of decline and then back again. Thus, increased aviation activity leads to high demand for oil, which leads to an increased demand for oil, and then possibly to economic decline and thence to a decrease in aviation activity. Decreased aviation activity leads to lower demand for oil, to a reduction in demand and price of oil, leads to economic boom and increase in aviation activity.

Such issues affect the stakeholders of the system in a variety of ways. Thus, for both global and local environmental issues it appears that lobby groups apply pressure on Government to regulate aviation activity which then impacts the airlines, airports, manufacturers and users (depending on the regulatory mechanism). Meanwhile the state of the economy and social norms seem to impact users first, who in turn then affect the airlines and airports. Government typically responds first to demographic effects and disruptive events, whilst the primary actors influenced by oil supply, regulation and capacity issues would seem to be airlines and airports.

From this, the implications for the aviation system are that this highly complex and interconnected sector are that the future is becoming increasingly uncertain. In particular, current scenarios for the future whereby even ‘doomsday’ style situations result in positive levels of growth in air passengers and freight would seem to be over optimistic and suggests that applying a more systemic approach to looking to the future would be a beneficial activity.

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Focusing on the environmental consequences due to the levels of increasing air travel it is widely acknowledged that aviation is the fastest growing source of CO_2, and that the local impacts (of air and noise pollution) of such aircraft taking off and landing can be significant. Moreover, capacity is already stretched at key points requiring major investments along with disruption and destruction of local habitats. Technological solutions in aviation look to be a long way off and so managing the demand through prices regulation must be a key strategy. It is probably the only means of mitigation environmental impact in the short/medium term and yet currently there is little appetite for restrictions so progress has been slow in addressing demand. Ultimately government has to act, but will only act if the time is ripe for change (in terms of public opinion), and if the case is made by interest groups, and outweighs the concerns of the aviation industry. For the moment though, there is little sign that these changes are likely to happen.

Ultimately, the core questions that emerge are:

- Given that the global aviation system is likely to come under increasing pressures, under what conditions might it collapse, and what are the most likely mechanisms whereby this could occur?

- Alternatively, what would need to happen for the aviation system to re-model itself to become more robust and economically, environmentally and socially sustainable in the medium to long term?

In other words, the key challenge facing aviation industry stakeholders and policy makers more broadly, is to ensure that the second and not the first scenario takes place.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

Amaeshi, K. M. and Crane, A. (2006) Stakeholder engagement: A mechanism for sustainable aviation, *Corporate Social Responsibility and Environmental Management*, **13**, 245-260.

Anger, A. (2010) Including aviation in the European emissions trading scheme: Impacts on the industry, CO2 emissions and macroeconomic activity in the EU, *Journal of Air Transport Management*, **16**, 100-105.

Bieger T and Wittmer A (2006) Air transport and tourism – perspectives and challenges for destinations, airlines and governments, *Journal of Air Transport Management* **12**, 40-46.

Böhler, S., Grischkat, S., Haustein, S. and Hunecke, M. (2006) Encouraging environmentally sustainable holiday travel, *Transportation Research Part A*, **40**, 652–670.

Bows A, Upham P and Anderson K (2005) Grooth Scenarios for the EU and UK Aviation: contradictions with climate policy (Tyndall Centre for Climate Change, North and Friends of the Earth) 16 April 2005, 91pp. Accessed 20 Sept. 2011. http://www.foe.co.uk/resource/reports/aviation_tyndall_research.pdf

Mootien, Namasoondrum P.; Warren, James P.; Morris, Dick and Enoch, Marcus P. (2013). Mapping expert perspectives of the aviation sector. International Journal of Environmental Technology and Management, 16(3) pp. 179–202.

Braun V and Clarke V (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, **3**, 77-101.

Budd L, Griggs S, Howarth D, and Ison S (2011) A Fiasco of Volcanic Proportions? Eyjafjallajökull and the closure of European Airspace *Mobilities* 6:1, 31-40

Button K (2009) The impact of US-EU "Open Skies" agreement on airline market structures and airline networks, *Journal of Air Transport Management* **15**, 59-71.

Carney, M. and Mew, K. (2003) Airport governance reform: A strategic management perspective, *Journal of Air Transport Management*, **9**, 221-232.

Checkland P (1999) Systems Thinking, Systems Practice, John Wiley & Sons, Chichester, England.

Dennis N (2005) Industry consolidation and future airline network structures in Europe, *Journal of Air Transport Management* **11**, 175-183.

EUROCONTROL (2008) Challenges of Growth 2008, Summary Report, European Organisation for the Safety of Air Navigation, Brussels, November. Visit http://www.eurocontrol.int/statfor. Last accessed 19 November 2010.

Graham, A. (2006) Have the major forces driving leisure airline traffic changed? *Journal of Air Transport Management*, **12**, 14-20.

Graham, B. and Guyer, C. (1999) Environmental sustainability, airport capacity and European air transport liberalisation: Irreconcilable goals? *Journal of Transport Geography*, **7**, 165-180.

Gössling S, Broderick J, Upham P, Ceron J-P, Dubois G, Peeters P and Strasdas W (2007) Voluntary Carbon Offsetting Schemes for Aviation: Efficiency, Credibility and Sustainable Tourism, *Journal of Sustainable Tourism*, 15:3, 223-248

Hamzawi, S. (1992) Lack of airport capacity: Exploration of alternative solutions, *Transportation Research A*, **26A**, 47-58.

Hawkins, R. (2011) Systems Thinking and Links to Systems pages, International Centre for development oriented Research in Agriculture http://www.icra-edu.org/page.cfm?pageid=anglolearnsyslinks Accessed 20 Sept 2011.

Ito, H. and Lee, D. (2005) Assessing the impact of the September 11 terrorist attacks on US airline demand, *Journal of Economics and Business*, **57**, 75-95.

Kivits R, Charles M B and Ryan N (2010) A post-carbon aviation future: airports and the transition to a cleaner aviation sector, *Futures* **42**, 199-211.

Lawrence, P. (2009) Meeting the challenge of aviation emissions: An aircraft industry perspective, *Technology Anslysis and Strategic Management*, **21**, 79-92.

Mason K J and Alamdari (2007) EU networks carriers, low cost carriers and consumer behaviour: a Delphi study of future trends, *Journal of Air Transport Management* **13**, 299-310.

Mayor, K. and Tol, R.S.J. (2009) Aviation and the environment in the context of the EU-US Open Skies agreement, *Journal of Air Transport Management*, **15**, 90-95.

McKelvey, F. X. (2002) Perspective on our national air transportation system – past, present and future, *Transportation Research Record* **1788**, Paper no. 02-6166, 5-10.

Miyoshi, C. and Mason, K.J. (2009) The carbon emissions of selected airlines and aircraft types in three geographic markets, *Journal of Air Transport Management*, **15**, 138-147.

Mobilities (2011) Special Section - Stranded: An Eruption of Disruption, Volume 6, No.1. February, pp.1-102. (10 articles) ISSN 1745-0101.

Morris D and Martin S (2009) Complexity, Systems Thinking and Practice; skills and techniques for managing complex decisions. In: Stibbe, A.(Ed) 2009. *The handbook of sustainability literacy*. Dartington, UK, Green Books

Nolan, J.F., Ritchie, P. and Rowcroft, J. (2004) September 11 and the world airline financial crisis, *Transport Reviews*, **24**, 239-255.

Nygren, E., Aleklett, K. and Hook, M. (2009) Aviation fuel and future oil production scenarios, *Energy Policy*, **37**, 4003–4010.

Oum, T.H., Adler, N. and Yu, C. (2006) Privatization, corporatisation, ownership forms and their effects on the performance of the world's major airports, *Journal of Air Transport Management*, **12**, 109-121.

Pastowski, A. (2003) Climate policy for civil aviation: actors, policy instruments and the potential for emissions reductions (in eds. Upham, P., Maughan, J., Raper, D. and Thomas, C.) *Towards sustainable aviation*, London, Earthscan, 179-198.

Raguramen, K. (1997) Airlines as instruments for nation building and national identity: Case study of Malaysia and Singapore, *Journal of Transport Geography*, 5, 239-256.

Rao, V.K. (1999) Fuel price risk management using futures, *Journal of Air Transport Management*, 5, 39-44.

Sigourdis, S., Bonnefoy, P.A. and Hansman, R.J. (2010) Air transportation in a carbon constrained world:Long-term dynamics of policies and strategies for mitigating the carbon footprint of commercial aviation, *Transportation Research A*, in press.

Thomas, C and Lever, M. (2003) Aircraft noise, community relations and stakeholder involvement (in eds. Upham, P., Maughan, J., Raper, D. and Thomas, C.) *Towards sustainable aviation*, London, Earthscan, 97-114.

Upham, P., Raper, D., Thomas, C., McLellen, M., Lever, M. and Lieuwen, A. (2004) Environmental capacity and European air transport: Stakeholder opinion and implications for modelling, *Journal of Air Transport Management*, **10**, 199-205.

Upham P, Thomas C, Gillingwater D and Raper D (2003) Environmental capacity and airport operations: current issues and future prospects, *Journal of Air Transport Management* **9**, 145-151.

Vedantham, A. and Oppenheimer, M. (1998) Long-term scenarios for aviation: Demand and emissions of CO2 and Nox, *Energy Policy*, **26**, 625-641.

Zeng, B., Carter, R.W. and De Lacy, T. (2005) Short-term pertubations and tourism effects: The case of SARS in China, *Current Issues in Tourism*, **8**, 306-322.

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FIGURE 1 Systems map of many interactions

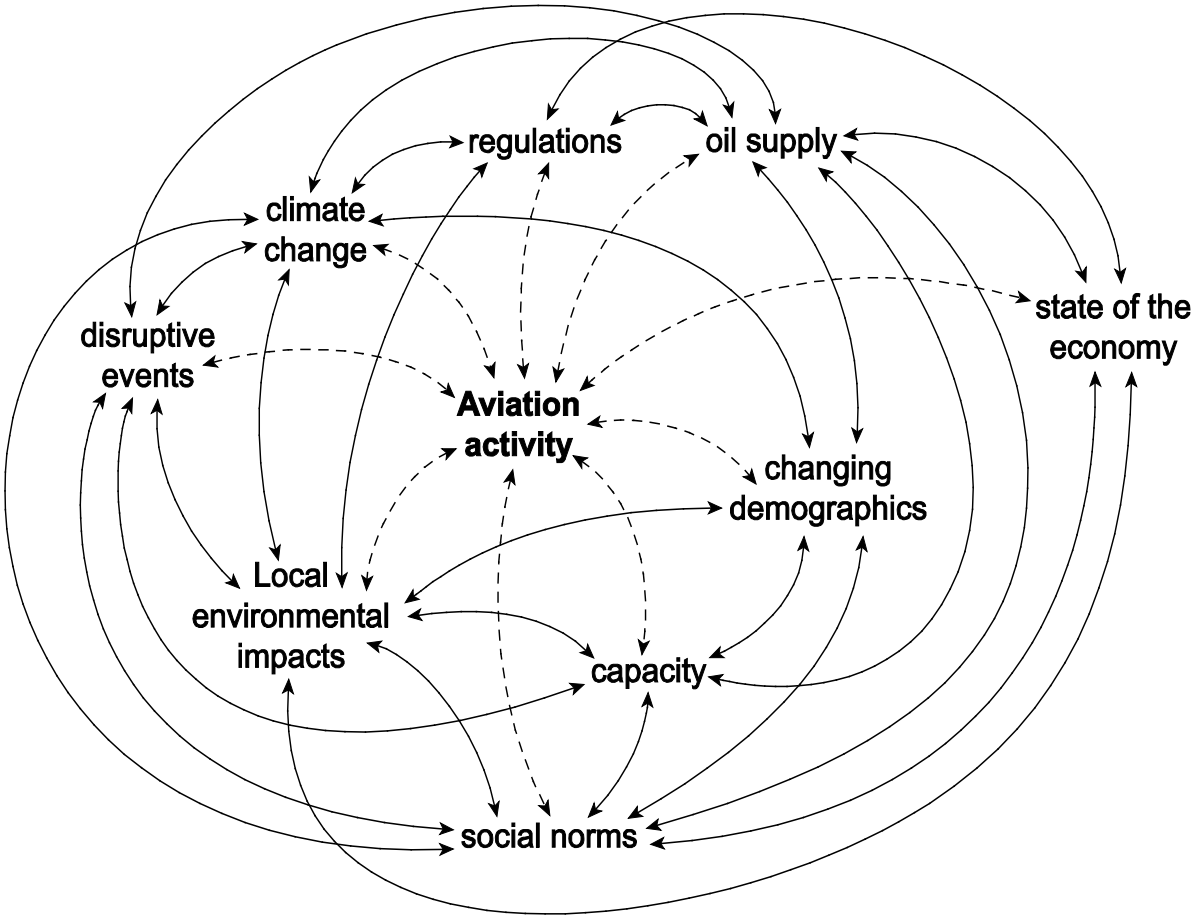

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TABLE 2 Example interactions for the main issues identified from interview transcripts.

	Environment	Climate	Oil	Economy
Local Environ-mental Impacts		*What happens if we do not achieve [what] we expected. Climate change will continue to be a major challenge.*		*The recession will subside eventually and the aviation industry will be among the first sectors to recover. So any improvements might be temporary....?*
Climate change			Peak oil will be a concern and in [some] way will force airlines to have recourse to alternative sources of energy which may be a positive step towards climate change.	The recession will further make it difficult to invest in research that will make it difficult to find new sources of clean energy. This will obviously worsen the effects of climate change.
Oil Supply		Airlines and manufacturers seek to increase fuel economy and look to alternative energy sources.		Peak oil has been one […] of the drawbacks for profitable airline businesses but also for countries' economies in general. Will further add to the negative effects of the recession unless new and cheaper sources of energy are used.
The Economy	Global recession will be a 'blessing' in the sense that consumption of resources will decrease and may improve local environmental conditions.			
Social norms	[Rising consciousness] of civil societies regarding the importance of local environmental conditions and ecology. Sustainable development will be a growing & global concern.	Global warning and climate change will force society to adopt new ways of life and new methods of production and consumption.	Prices of oil have already had severe impacts on peoples' lives and there will continue to be greatere awareness on new sources of energy and the demand for the replacement of fossil fuel.	
Demo-graphics		*Movement of population and migration [as a result of climate change] will have no major effects; although [increases in] population density may have an effect especially in the cases of Brazil, China and India.*	Demography normally has considerable effects on oil consumption. More people consume more energy. This pattern will continue.	*Recession hits harder the countries with larger and denser populations. This will continue to hold true and as a result one cannot foresee major growth in the aviation sector in general.*
Disruptive events	Disruptive events like wars and other such crises will only worsen environmental issues. Nonetheless, pressure groups will be more vociferous in their demands.	As a result of wars and increased armaments climate change will probably worsen.	*Disruptive events will require further resources and more investment in such resources, oil being one of them.*	Negative economic growth as a result of world calamities or natural disasters. Consequences of diseases on the tourism industry of countries ...dependent on the industry.
Regulation	Local air quality will improve because of tough international laws and regulations	*Some governments will continue to pay lip service to changes in policies but most governments and nations have understood the threats that climate change represents and the need to have more compatible regulations, thus there is still no overall agreement.*	Although oil prices will cause serious economic problems for developing countries, it will be difficult for them to amend laws in order to cut down on consumption	The recession has already shown that some countries can easily adapt whereas others will have to be assisted. It will be necessary for vulnerable countries to review their policies.
Capacity	Greater load factors when achieved [may] mean less journeys with half full aircraft and this can only improve the quality of air and reduce aircraft noise at landing and takeoffs. [Capacity in this context means per flight].	*Global warming and climate change will be less of an issue if flights are rationalised and consolidated [but total capacity and flight capacity both need to be considered].*		

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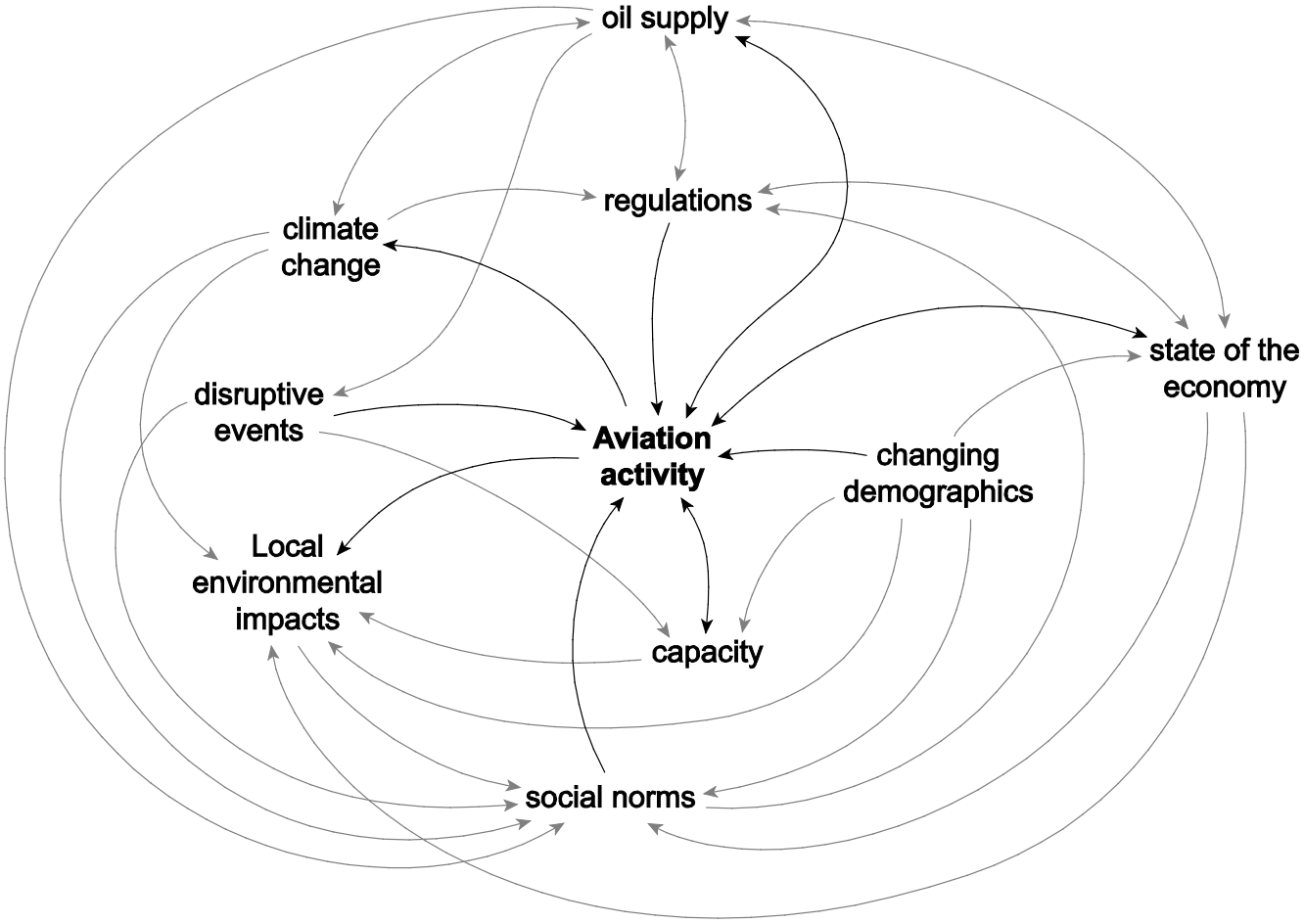
TABLE 2 (cont'd)

	Social norms	Demography	Disruption	Regulations	Capacity
Local Environ-mental Impacts	*Patterns of travel will change as people have a higher purchasing power. Countries like India and China will generate more business and this will impact some countries local areas more than others.*			Contradictory [application of] laws from different organisations or countries may lead to different local noise and air pollution.	
Climate change	Civil society has taken cognisance of the threats of climate change and will be more demanding from airline operators.	*Climatic conditions, erosion, desertification will prompt people to migrate. Countries like Malta and other small islands will have to consider major movements of their populations.*		Some countries will continue to pay lip service to climate change control and effects. The local regulations will not make a change whereas international laws may change things.	
Oil Supply	*May lead to increase in virtual travel. Travel will be more of a luxury and may only be devoted to more business and less leisure travel. So peak oil may be delayed?*	Fuel prices will continue to be a major concern for densely populated countries especially the import bills will force governments to adopt drastic policies. This in turn may cause social and political unrest.	Increased uncertainty over cost of fuel. OPEC cartel may dictate prices or control supply.	*Although oil prices will cause serious economic problems for developing countries, it will be difficult for them to amend laws in order to cut down on consumption.*	Capacity will be further rationalised to make economic sense [to cope with peak oil].
The Economy	Leisure users likely to reduce frequency of weekend trips abroad. Annual holiday stays sacred. Recession will be a blessing in disguise to force nations to have a new look at production and consumption. As a result of recession, travel as a luxury will shrink and more and more people will travel for work and business but not for leisure.	Recessions cause people to migrate to places which are economically strong. This also applies to investment in human resources and the migration of other resources, e.g movement of capital.		Taxation treaties, bilateral and multilateral agreements will have to be reviewed. New and more sensible agreements will have to be ratified by respective countries.	As a result of recessions, airlines will reduce capacity for operations to make economic sense. This will make travelling more expensive.
Social norms		[Acceptability of] Population policies will have to be reviewed in countries where population control has not been successful. Demographic indicators will be determinant in policy making.	Ecological sustainability will be on top of the list [of peoples' concerns] especially in cases of industrial disasters such as Chernobyl, Bhopal and Exxon oil spills.	Political correctness will continue to dictate the wrong policies of some governments.	*Could we ever imagine a future where users wanted less aviation? Market might be saturated in the UK? There is a timid consensus already for cutting down on air travel for ecological reasons.*
Demo-Graphics			Because of poor living conditions in developing countries and the struggle for survival it will be difficult for countries to ensure political stability. We can foresee some major political upheavals.	Some [countries] will have to toughen laws and policies like China & India (one child policy); other under-populated and ageing societies will have to reconsider immigration laws.	*Future growth mostly in Asia, but not enough airports to cope with potential demand. Countries with large populations will find it more difficult and costly to travel.*
Disruptive events		*Events will cause migration of population which will eventually have effects on travel patterns. Wars in Africa and the Middle East will further exacerbate movements.*			When disruptive events require countries to disinvest or divert investments, capacity [may be temporarily] constrained.
Regulation	It will be difficult for countries to legislate as far as peoples' ways of living are concerned ... will be a big challenge for governments. People are not ready to impose self-sacrifice and will be more demanding from their governments.	*Overpopulated countries will have to review their policies and laws. Under populated countries with and ageing population will encourage immigration and this will obviously dictate air transport policies.*			[Despite] of capacity constraints, incompatible laws will continue to be applies wherever this suits vested interests, [for example] some governments will still maintain the concept of national flag carriers and fly to unprofitable destinations for political reasons.

Capacity	*Capacity will be an issue but not so much as consolidated travel comes in. Airlines will be more in to flight rationalisation in order to increase load factors. Travellers will themselves demand such changes. Constrained capacity will force society to find alternative modes of transport.*				

FIGURE 2 Systems map showing reduced number of interactions



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