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A SYSTEMATIC REVIEW OF THE ROLE OF REGIONAL AVIATION IN THE AIRFREIGHT INDUSTRY

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The purpose of this article is to explore the themes and challenges for regional aviation regarding the provision of airfreight services. The systematic review highlights three major challenges affecting the regional airfreight sector including: integration; infrastructure; and service reliability. There is a considerable dearth of academic literature available in this area. Thus, this paper aims to assist in highlighting these gaps and illustrating the potential for future research opportunities. It is hoped that this work will assist policy-makers, supply chain and air transport industry representatives as they seek to overcome the challenges hindering the development of regional aviation.

Keywords: regional aviation, airfreight, supply chain, perishable, air cargo, logistics, airline, integration, infrastructure, service reliability.

Метою даної статті є вивчення тематики і проблем регіональної авіації в частині виконання авіаційних вантажних перевезень. Систематичний огляд дозволяє виділити три основні проблеми, що впливають на сектор регіональних авіаційних вантажних перевезень, — це інтеграція, інфраструктура і експлуатаційна надійність. У цій галузі існує значна недостатня кількість навчальної літератури. Таким чином, стаття покликана допомогти у виявленні таких прогалин і показати потенційні можливості для майбутніх досліджень. Сподіваємося, що ця робота буде корисна вищим посадовим особам, постачальникам і представникам повітряного транспорту, оскільки вони прагнуть подолати труднощі, що перешкоджають розвитку регіональної авіації.

Ключові слова: регіональна авіація, авіаційні вантажні перевезення, ланцюг постачання, швидкопсувний вантаж, логістика, авіакомпанія, інтеграція, інфраструктура, експлуатаційна надійність.

Introduction

Over the past two decades, the air cargo industry has demonstrated significant growth (Yuan et al., 2010). At 2006, International Air Transport Association (2008) statistics indicated that airfreight accounted for approximately 35 percent of global merchandise trade by value. Three reasons may explain this dramatic growth in airfreight. Firstly, there appears to be an industry trend towards the production of high value light-weight goods (Ari-Pekka and Hintsa, 2009). One of these is the new economy associated with the transport of fresh, perishable, high value produce intensified by the emerging 'farm to table' movement (Sim et al., 2007). This is supported by statistics indicating that the transport of perishable food accounts for 14 per cent by volume of the total global airfreight (Bridger, 2008). Secondly, shippers and producers are recognizing that the apparent higher costs of airfreight can be offset by the costs savings associated with storage, and packaging (Tseng et al., 2005; Yuan et al., 2010). Finally, the air service costs have experienced a significant reduction as a result of the entry of large numbers of wide body freighters (Gardiner et al., 2005). Ultimately, the overall effect is that airfreight is becoming the norm in the distribution systems of many companies (Murphy et al., 1989).

This research is set in the context of the emergence of new forms of growth and development in the agricultural commodities markets (Renting et al., 2003) bolstered by a transition from a 'productivist' to a 'postproductivist' regime (Ilbery and Bowler, 1998; Schucksmith, 1993)

Through new rural development patterns, research in this area now seeks to understand the growth of 'new' or 'alternative' food supply chains. In line with the 'farm to table' movement and the preferences of consumers, food markets are being driven by and differentiated on the basis of food quality criteria of social construction (Marsden, 1998). It is this paradigm shift that has given birth to the new high quality niche agricultural food market. With that background, understanding the food chain in an effort to understand rural development patterns then became the focus of research in the field (Renting et al., 2003).

As such, sea, road, rail and air transport of freight in the food production cycle from the farm gate to the consumer plate has been under heavy scrutiny (Saunders and Hayes, 2007). The scrutiny has been applied in an attempt to understand the supply chain and networks associated with rural development, and to understand the impact of transport as a cost to the environment and society. Regional aviation forms a significant part of the transport of perishable food from the farm gate.

While there is a wealth of literature and research into international, domestic air cargo utilizing the belly of wide body passenger jets or dedicated aircraft freighters, there is a dearth of literature on a the increasingly critical part of the perishable cargo supply chain (i.e. regional aviation).

For the purposes of this paper, regional aviation is defined as regular scheduled air services operating to or from non-metropolitan (regional) areas. Generally, a metropolitan area is described as a capital city or a major urban centre. Thus, all other areas are considered non-metropolitan areas. The definition of regional aviation then considers regular scheduled air services between metropolitan and regional areas, or between regional areas. This is consistent with the definition of regional air services used in Bureau of Infrastructure Transport and Regional Economics (BITRE) (2003).

This leads to the two research question being set for this paper:

RQ1. What themes have been studied in the relevant literature related to supply chains, especially concerning airfreight?

RQ2. What are the main challenges, identified in previous research, in the provision of regional airfreight services?

This paper aims to contribute to the existing literature on supply chain management, and support the literary gap associated with regional airfreight. The following sections describe the method of investigation applied. The paper then provides the synthesis of identified themes and challenges, of which the research propositions are drawn. Concluding remarks including the limitations of the research completes the paper.

1. Material and methods

This paper provides a systematic literature review including a content analysis and synthesis of relevant literature. It offers an interpretation and synthesis of the chosen literature (Rousseau, 2008) as it aims to provide an understanding of the themes and challenges found in the applicable literature. While there have been a number of recent studies which include literature reviews on air cargo supply chains (Bowen & Thomas, 2004; Yuan et al., 2010), many of the reviews focus on international airfreight utilizing large wide body aircraft. This research provides an important contribution representing the role of regional air transport in the freight industry. It also offers propositions for further research in the themes and challenges highlighted from the scope of the literature considered.

As previously highlighted, there is a significant gap in academic literature that focuses on the role of regional aviation in the airfreight industry. To the best of our knowledge, no paper has yet addressed the combination of these research areas. This paper looks at the themes and challenges of regional airfreight for both policy-makers and actors in the supply chain.

1.1. Literature review

The article was prefaced with a narrative literature review (Baumeister, 1997). The literature was sourced from a range of secondary sources (e.g., the internet and theses) and documents (predominantly industry journals, trade publications, public submissions, government reports and mass media items). This activity offered the authors the opportunity to become familiar with: (1) the current understandings of the research area (airfreight transport and the sectors impact on the logistics industry); (2) significant concepts, theoretical findings and emergent themes of this area; and finally, (3) significant debates and industry questions yet to be researched and/or answered.

As a result, the initial literature review provided the foundation for the development of this research. Using the content analysis method, the investigation was then focused on the identified research questions.

1.2. Content analysis

A content analysis provides researchers with the tools to scientifically investigate communicative documents with the aim of identifying key ideas and themes contained within them (Cullinane and Toy, 2000). Content analysis can be both qualitative and quantitative (Bryman and Bell, 2007). However, this area of research aims to investigate the communications of academic literary sources. Kerlinger (1964) offers that content analysis is more than a method of analysis. It is a method of observation. Instead of observing the behavior of people directly, or interviewing them, the researcher takes already published and produced communications and asks questions of these communications. Qualitative content analysis may be used to develop an understanding of the meaning of communication or highlight key processes (Elo, 2008). Ultimately, this method of analysis is concerned with meanings, intentions, consequences and context (Downe-Wambolt, 1992). Content analysis (particularly when used in an inductive way), is generally guided by some pre-determined categories (Abbasi, 2012). Qualitative content analysis offers the researcher greater flexibility in the interaction between conceptualization, data collection, analysis and interpretation than with quantitative content analysis (Bryman and Bell, 2007). Considering the limitations of the literature sources, the complexity of the issues presented by the industry, professional and trade communication

sources, the content analysis for this paper is based on a qualitative investigation. The following subsections describe the major steps of the content analysis.

1.3. Research questions

Based on the outcomes of the initial literature review and following numerous discussions with industry representatives working in airfreight, (and the freighting of perishable produce), the research question was set (Denyer, 2009).

Three overarching items challenged the definition and scope of the research. Firstly, there are many definitions concerning "regional aviation" which emphasized the difficulties associated with literature or thematic comparisons. Secondly, complexity associated with current airfreight provision (i.e., the use of dedicated airfreight aircraft compared to the use of available cargo holds in dedicated passenger aircraft) gave rise to the fundamental questions associated with airfreight service. Finally, the various factors that impact on the integration of airfreight services in the overall logistics industry, (e.g., airports, freight forwarders, shippers, suppliers, governments), highlighted the abundance of approaches and perspectives affecting the sector.

While the focus of the paper had been set on regional air transport, with special emphasis on airfreight issues in supply chains, the study of the various definitions, factors and perspectives was necessary to distil the challenges affecting regional airfreight services.

Accordingly, the research questions were constructed with the goal of understanding the characteristics of a small, yet growing part of the logistics industry within an overall consumer generated supply chain.

1.4. Selection of a sample

Bryman and Bell (2007) suggest that an appropriate and valid sample of literature and/or documents must be selected in an effort to answer the identified research question. Convenience and non-probability sampling techniques were used in this paper. Firstly, the Griffith University Library Catalogue (GULC) was selected as a search database of journals. GULC is an online database at the library of Griffith University in Australia.

This database holds a range of sources including electronic journals, electronic archives, and a range of scholarly databases (including Proquest, Ebscohost and JSTOR databases).

Sampling of three types of journals was needed in an effort to address the research question: those relevant to supply chain management (Type one); those relevant to air transport (Type two); and those relevant to freight (Type three).

Journals were limited with the selection and application of relevant keywords selected. Journals of type one were restricted to those that contain one or some of the following keywords: "supply chain", "perishable", "airfreight" and "air cargo".

Although the terms "air freight" and "airfreight" appear to be used interchangeably within the literature, the use of "air freight" generally highlighted many terms, which included "air" and "airfreight".

Keywords selected for type two journals were: "freight", "cargo", "logistics" and "regional aviation". Keywords selected for type three journals were: "air cargo" and "regional aviation/airline".

Table I

Population of journals types one and two

Journal types	Searching keyword	Number of journals at GULC	Total
Journal type one	Supply chain	20	28
	Perishable	2	
	Air freight	3	
	Air cargo	3	
Journal type two	Freight	2	7
	Cargo	2	
	Logistics	3	
	Regional aviation	0	
Journal type three	Air cargo	2	4
	Regional aviation/airline	2	

Table I presents the total number of journals found of all three types.

Following this, the authors selected a sample from the number of journals of all three types. A ranking process was employed to assist in the selection. Journals were ranked according to highest citations and impact factors.

The website www.journal-ranking.com assisted in the criterion associated with citation numbers. However, the website www.isiwebofknowledge.com assisted with the criterion associated with impact factor. Consequently, five journals of type one, three journal of type two and two journal of type three were selected (see Table II).

Table II

Journals selected

Journal types	Journals selected	Total
Journal type one	International Journal of Physical Distribution and Logistics Management	5
	Journal of Business Logistics	
	International Journal of Logistics Management	
	Supply Chain Management: An International Journal	
	Transport Reviews	
Journal type two	Journal of Air Transport Management	3
	Journal of Air Transportation	
	Journal of Transport Planning and Technology	
Journal type three	Transportation Research: Part A, Policy & Practice	2
	Transportation Research: Part D, Transport & Environment	

Delimiting boundaries were developed as more literature was collected.

While criteria associated with citation and impact factors was necessary, additional delimiting conditions were also given as follows:

1. Papers published only in peer-reviewed journals were considered;
2. Papers were collected for a period of 20 years (1990–2010);
3. Papers addressing the search key terms were considered; and
4. Papers addressing regional aviation freight transport issues were considered.

Considering the limited breadth of sources that included reference to all of the search key terms, the search for scholarly sources continued. A cross referencing technique was applied to papers collected under the above delimiting conditions combined with further academic research database interrogation using all search key terms (i.e., Emerald — www.-emeral-dinsight.-com, Elsevier — www.-sciencdirect.-com, Springer — www.-springerlink.com, Wiley — www.wiley.com). As a result, additional journal articles and books were discovered. While these sources assisted in providing substance to some of the identified key issues, those that did not meet the above delimiting boundaries were not considered.

1.5. Unit of analysis

In the process of content analysis, the researcher nominates the units of analysis called "recording units" (Chelimsky, 1989). In this step, the aim of the recording unit is to set limits on the portion of written material that is to be examined for categories of words or statements. Thus, a recording unit is the specific segment of the context unit in the written material that is placed in a category. A recording unit may be a word, a group of words, a sentence or a paragraph (Chelimsky, 1989). "Applicable article" was the designated unit of analysis in this research. The rationale for this choice was to analyze how those articles selected deal with regional air transport in the context of perishable cargo supply chains. Corresponding articles were selected according to the following procedures:

1. In the initial stages of the literature review, notional ideas related to the area of research were used to establish appropriate and suitable articles in all three journal types. Articles in type one journals selected were refined and registered in a database. These articles had to include one or more of the following words anywhere in the article: "supply chain", "perishable", "air freight", "air cargo". For type two journals "freight", "cargo", "logistics" and "regional aviation" were the keywords chosen for the search. For type three journals "air cargo", "regional aviation" and "regional airline" were the keywords chosen for the search. The sample included scholarly journal articles published between 1990 and 2010.

2. The filtered articles were analyzed and ranked by the primary author who was responsible for reading the abstract and ranking the appropriateness of the article to the research questions. A colour

coding technique was applied where green was used for appropriate articles, yellow was used for semi-appropriate articles, and red was used for articles deemed to be inappropriate to the research question.

3. Further academic research databases (listed above) were interrogated combined with a cross-referencing technique applied to those articles deemed to be appropriate and semi-appropriate. Keywords chosen for the search included "perishable", "air freight" and "regional aviation". The articles were published in a range of peer reviewed academic journals and were selected for appropriateness to the research question and on condition of meeting the delimiting criteria. These articles provided important evidence in the synthesis of the research area.

4. The outcomes of the analysis are found in Tables III-VI.

In total, the review resulted in 83 appropriate articles out of the total sample of 712, i.e, 11.6 per cent.

Table III

Total number of relevant articles and total number of those selected – Journals and articles of type one

Journals selected type one (181(38))	Number of suitable articles (total number of those selected)			
	Supply chain	Perishable	Air freight	Air Cargo
International Journal of Physical Distribution and Logistics Management	31(5)	41(5)	13(2)	17(2)
Journal of Business Logistics	12(3)	13(3)	4(1)	0(0)
International Journal of Logistics Management	15(5)	10(2)	0(0)	0(0)
Supply Chain Management: An International Journal	11(4)	23(6)	0(0)	0(0)
Transport Reviews	1(0)	0(0)	0(0)	0(0)

Table IV

Total number of relevant articles and total number of those selected – Journals and articles of type two

Journals selected type two (468(27))	Number of suitable articles (total number of those selected)			
	Freight	Cargo	Logistics	Regional aviation
Journal of Air Transport Management	3(3)	1(1)	0(0)	0(0)
Journal of Air Transportation	9(5)	20(5)	7(2)	31(5)
Journal of Transport Planning and Technology	212(2)	96(2)	86(0)	3(2)

Table V

Total number of relevant articles and total number of those selected – Journals and articles of type three

Journals selected type three (36(8))	Number of suitable articles (total number of those selected)			
	Air cargo	Regional aviation	Regional airline	
Transportation Research: Part A, Policy & Practice	21(4)	1(0)	13(3)	
Transportation Research: Part D, Transport & Environment	0(0)	1(1)	0(0)	

Table VI

Total number of relevant articles and total number of those selected – Journals and articles of further academic research database interrogation (other)

Journals selected type other (27(10))	Number of suitable articles (total number of those selected)	
	Either: Perishable, Air freight, and/or Regional aviation	
Journal examples: "Transportation Journal", "Journal of the Transportation Research Forum", "Transportation Research Part E: Logistics and Transportation Review"	27(10)	

1.6. Coding

"Content analysis stands or falls by its categories. Particular studies have been productive to the extent that the categories were clearly formulated and well adapted to the problem and to the content." (Berelson, 1952, p. 147). Coding categories provide the structure for grouping and classifying textual content and formulating these categories is crucial to the process of content analysis (Abbasi, 2012; Berelson, 1952; Chelimsky, 1989).

According to Krippendorff (1980) categories can be conceptualized in a variety of ways. For example, groups, scales or matrices may be used. However, it is structured category formats that increase the efficiency of the coding (Chelimsky, 1989). The coding manual, specifying the categories used to classify the text, is both inductive and deductive.

At first, two categories were introduced: Supply chain discourse, and exploration of airfreight (see Table VII).

Table VII

Coding schedule and manual

Category	Features to be considered (deductively)	Emergent features (inductively)
Supply chain discourse	• Supply chain – focus on perishable, agri-produce, just-in-time • Logistics processes and associated activities • Focus of transport (air)	What themes, challenges and opportunities have been discussed?
Exploration of airfreight	• Air freight/air cargo themes • Focus on regional air transport as opposed to global or international air transport	How have the themes, challenges and opportunities been discussed?

In the qualitative investigation of concepts and themes the sub-categories were culminated by inductive reasoning and were propelled by the question of which themes and challenges have been presented and how have these been considered (Table VII). Thus, in this analysis, articles were assembled together based on themes found, e.g., "technology integration" or "emerging role of freight forwarders". The test for a theme was that it should either be presented similarly in a number of articles, or it may have a thematic character, e.g. "service reliability" or "nodes (airport) and geographic impacts". Although the themes could be distilled and connected to distinct articles, the challenges and opportunities identified were inextricably bound to a number of themes and were of a more homogenous nature. That is, the issue of the cost of airfreight was raised directly or indirectly in a majority of articles. Consequently, rather than analytically deconstructing the challenges, the authors have presented the challenges for the regional airfreight sector through a synthesis of all the selected articles.

To do this, the authors applied the qualitative research method suggested by Glaser and Strauss (1967). Essentially, this technique involved the primary author reading all the articles and then discussing the initial coding and analysis with the remaining authors. These workshops allowed fresh perspectives and new insights to the data being analyzed which assists in the evolution of meaning and the validity of results (Corbin and Strauss, 2008). The first stage of coding involved those challenges that were plainly stated in the articles. Many of these challenges were related to the question or area of study in each article, e.g., highlighting the growth in the international airfreight task, or explaining the emerging consumer demand for farm fresh perishable produce. The second stage of coding focused on the conclusions, discussions, research limitations and research opportunities. From here, challenges were deduced and compared with similarly mentioned articles. In the third stage, the authors concentrated on the method in which the identified issues had been addressed and discussed. Consequently, a vast number of associated challenges and issues were identified. The final synthesizing stage culminated in three challenges affecting the regional airfreight sector.

1.7. Evaluation of quality of content analysis

Chelimsky (1989) suggests that a content analysis requires rigorous reliability and validity checks if its results are to overcome critical scrutiny. This is supported by Bryman and Bell (2007) who offer objectivity and systematic rigour as qualities of content analysis. Objectivity is drawn from positivism in that as far as possible, researchers should apply impartiality to their study and allow transparency in the methods and process in which

the research is being conducted. The quality of being systematic further discourages bias with the concern for rigorous and methodological approach to the techniques and process being used. The authors of this research have tried to present the selection of journals and research methodology in a transparent manner. Additionally, a number of authors have been used to improve the validity of the research (Guthrie et al., 2004). The authors have tried to ensure that the coding categories developed are independent, exhaustive and mutually exclusive (Chelimsky, 1989; Cullinane and Toy, 2000). However, there are some limitations to this research that need to be specified. The quantitative aspects of the content analysis are clearly delineated, the synthesis, qualitative and inductive analysis of the 83 articles reviewed is more complex to describe. Although categories and coding schedules and manuals aim to eliminate the subjectivity in our research, the analysis still lends to our previous experience and knowledge levels.

In an effort to diminish this issue, the emergent findings have been presented at international peer reviewed conferences involving transport, logistics, economic and government policy experts.

It should also be noted that our choice of journals impacts on the findings and the representation of the issues.

2. Results

Identifying the number of articles that qualify to fit within each category of the coding manual formed the deductive aspect of the content analysis. The results found in Table VIII highlight the supply chain discourse (supply chain with a focus of perishable or agri-produce, logistics processes and associated activities, and air transport focused) as well as the exploration of airfreight (air freight and air cargo themes and focus of regional air transport). In Table VIII, the first number in each field indicates the number of articles of type one journals. The second number represents the articles of type two and the third number represents the articles of type three journals. As the numbers highlight, there are a sound number of articles in type one, two and three with an airfreight, or air cargo focus. However, articles with a focus on regional air transport, particularly with respect to supply chain and logistics are significantly lacking. Suggested reasons for this will be explored later as the challenges of this sector are discussed.

Table VII

Number of articles in each category of coding manual (type one + type two + three)

Category	Supply chain	Logistics	Air transport
Air freight/air cargo (38 + 17 + 4)	29 + 0 + 0	7 + 5 + 2	2 + 12 + 2
Regional air transport (0 + 7 + 7)	0 + 0 + 0	0 + 0 + 2	0 + 7 + 5

2.2. Themes of articles

In the subsequent stages of research, an inductive content analysis was applied to identify and explore themes presented by the literature. Systematically reviewing the literature with respect to the identified themes, allowed the authors the opportunity to further collate those themes that could be grouped together, e.g. those with a collaboration/coordination focus (supply chain integration, technology implementation), etc. A theme was designated where it was considered in several articles in a similar way, e.g. “coordination based on consumer preference”, or a theme may be of a thematic character, e.g., “Decision making frameworks”. As a result, three major themes emerged: Coordination/collaboration in food industry supply chains; drivers of growth in airfreight task; and finally decision making frameworks.

2.2.1. Coordination/collaboration in food industry supply chains

A number of articles have placed a focus on collaboration in the food industry supply chain. While the airfreight transport industry is just one important sector of the overall logistics industry (Yuan et al., 2010), for the purposes of this research, it was investigated as part of a supply chain that delivers fresh perishable consumer driven produce from ‘farm to table’. Matopoulos et al. (2007) emphasizes that the concept of supply chain collaboration is of particular importance to the agri-food industry. By applying a case study research approach, the paper provides empirical evidence supporting the coordination at the grower-processor interface.

Other articles highlight the important collaboration between different parts of the supply chain (i.e. that required between the airfreight forwarders and the airlines). Lillie and Sparks (1993) interrogate the buying behaviour of airfreight forwarders in Scotland and determine that while price is a consideration in buying behviour, it is the total product offering that is crucial for long term relationship building, promoting more stable relationships and greater reliability for the customer in this part of the supply chain. Burghouwt and Veldhuis (2006) provides an international transport focus to the supply chain integration argument,

highlighting that positive relationships between merger and feeder airlines and airports which focus on appropriate route networks and connectivity, can positively impact on airport performance. Understanding that integration between food industry companies in a supply chain is related to positive company performance, Gimenez (2006) contributes to the literature by exploring the sequence of integration stages between companies. Although strong integration can be achieved between companies, managers need to be aware of appropriate collaborations and relationship management techniques in an effort to maintain these levels of integration (Fugate et al., 2009). In the air cargo supply chain, integration and coordination with different levels of the supply chain remains imperative. Issues of integration in this sector is not limited to the management of relationships or strategic alliances (Kalligiannis et al., 2006), but also on the connectivity of IT systems (Forster, 2001) and logistics processes (Ramachandran and Tiwari, 2001).

2.2.2. Drivers of growth in the airfreight task

The emergence of the 'farm to table' movement has indirectly impacted on the airfreight task. Concerns for sustainable practices in agriculture and food processes arose as consumers became aware of various unintended side effects associate with these processes that placed a burden on the environment and human health (Conway and Pretty, 1991; Lang and Heasman, 2012; Pretty, 2002). Thus society's heightened awareness of sustainable practices and processes has driven consumers to seek food that has been produced on the 'farm' and delivered to the 'table' safely and sustainably, yet maintains high quality. In line with the 'farm to table' movement and the preferences of consumers, food markets are being driven by and differentiated on the basis of food quality criteria of social construction (Marsden, 1998). It is this paradigm shift that has given birth to the new high quality niche agricultural food market (Kille et al., 2013a). Hence, many papers within this review have tried to address the issue of supply chain flexibility response to consumer preferences. Mowat and Collins (2000) provide empirical evidence of the emerging fresh fruit industry in Australia and New Zealand to demonstrate how adopting a supply chain orientation can assist in linking product quality to consumer behaviour. Kurnia and Johnston (2003) emphasize the benefits of adopting e-commerce strategies to efficiently manage consumer requirements in the grocery industry including direct store delivery of perishable items.

Ari-Pekka and Hintsa (2009) conducted a global study in an effort to document the drivers of change and the implications they will have on international supply chain management over the next two decades. The study reveals that airfreight in the future will be driven by consumer needs associated with high value products. While airfreight represents only a small fragment of the global freight volumes, it accounts for nearly one third of the total value (Ari-Pekka and Hintsa, 2009). Other papers are more enabling in their investigations, highlighting the important impact that airports, facilities (storage, cold room) and opportunity for networked intermodal changes has on the demand for airfreight.

For example Ashford and Fathers (1989) investigate the design needs of airfreight terminals compared to passenger terminals in determining the ability to enhance the flow characteristics for small express parcels. Blauwens and Voorde (1985) provide empirical evidence conducting a cost benefit analysis of public investment in an airfreight terminal at Brussels National Airport. The findings suggest that investment in such a facility would have a high rate of return. Givoni and Banister (2007) present a public policy perspective on the benefits of intermodal collaboration where rail and air services integrate for the benefit of passenger movement. While the concepts in the paper are not specifically related to cargo, it highlights an important area of research where prospective infrastructure developments are examined to allow intermodal transfers of freight and/or passengers.

Additionally, Ari-Pekka and Hintsa (2009) suggest that innovative breakthroughs in energy technology and/or aircraft technologies may completely alter the situation in favour of more airfreight, over the long term. However, Berghof (2005) posits that introduction of new aircraft technology (particularly in energy and emissions reduction technology) must take a measured approach as dramatic introduction may have the effect of reducing the profitability of the aviation industry.

2.2.3. Decision making frameworks

Decision-making at a range of levels on the supply chain are considered in the selected papers. The choice of transportation modes is a primary focus of Ahumada and Villalobos (2011) who study the production and distribution of packaged agri-fresh produce. Akkerman et al. (2010) considers the selection of transportation modes by reviewing literature on three levels: strategic network design, tactical network planning, and operational transportation planning.

While Hsiao et al. (2010) consider the reasons behind decision making associated with the outsourcing of logistics activities in the food supply chain networks.

Some authors of the supply studies purposely chose to exclude airfreight as a mode of choice due to complexity, a lack of use, or the assumption that this mode is only used on very rare occasions (Coley, 2011; Ortmann, van Vuuren and van Dyk, 2006).

However, from a grower perspective (particularly those harvesting high value, perishable produce), the work of Akkerman et al. (2010) and Ahumada and Villalobos (2011) highlight an important paradigm shift in decision behavior.

At the farm gate, decisions of transport logistics are not based on cost alone, but on reliability, network services and certainty that produce will be delivered to the 'table' maintaining high quality standards (demanded by the high paying consumer) (Batt and Morooka, 2003)

Finally, Fugate et al. (2009) provides a more integrated and holistic review of decision-making.

The research develops a theory of how supply chain relationships facilitate a company's decisions regarding the allocation, sharing and management of resources on an operational level in an effort to improve a company's overall performance.

3. Discussion

Access to the market can be a challenge for regional communities supporting agriculture and food production, particularly those in island states. With increasing consumer demand for high-quality, niche food production, the 'farm to table' movement requires efficient and effective transport of perishable items. For time sensitive, perishable produce, access to market means access to airports and suitable air transport services with the ability to transport goods efficiently and effectively from 'farm to table' (Tseng et al., 2005). Thus, regional aviation (or air transport in remote regions) is a significant factor in the development of regional and remote communities (Kille et al., 2013 b). For many of these communities, the local airport represents success. It provides agricultural communities with critical access to markets and may lead to further development of business within the region (Reynolds-Feighan, 1995). From our systematic review and content analysis, a number of challenges for the regional air transport sector of the perishable food supply chain emerged. The synthesis resulted in three main categories of regional air transport challenges as depicted in Fig. 1

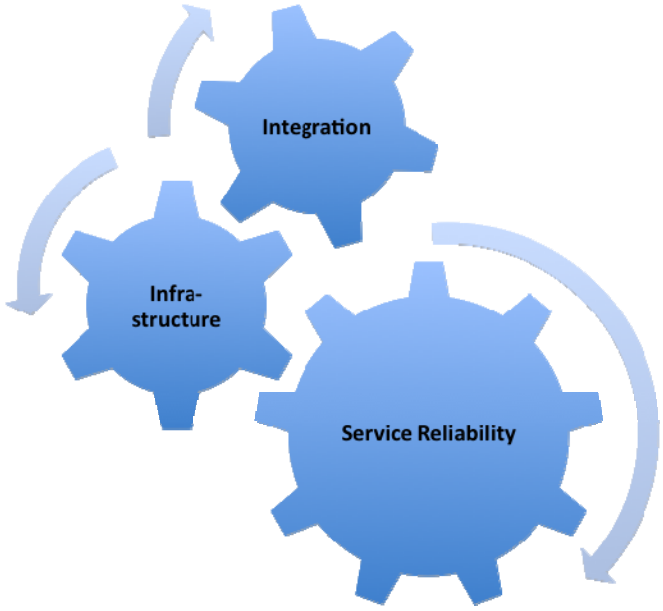

Fig. 1. The three main areas of challenges facing regional airfreight services

3.2. Integration

The future of the global air cargo logistics industry will be one dominated by key players with an international network, high performance capabilities and strong performance reliability. To achieve this, these key players need to possess process reengineering skills practically applying procedures that are shared throughout the network (Ramachandran and Tiwari, 2001). In an increasing consumer driven model of supply chain management, regional aviation plays a small but crucial role in the transport and logistic movement of fresh, perishable often high value products. As the need for transport of perishable food products and time-sensitive deliveries grows (Bridger, 2008), access to air services, for the rural communities providing the produce, becomes incredibly important.

The challenge for the regional aviation sector is to correlate and implement the research outcomes

demonstrating the positive benefits of integration (Lillie and Sparks, 1993; Matopoulos et al., 2007).

Often the rural communities have limited access to services and feeder services. For example, the lack of freight forwarding companies may leave a grower confused or unaware of the availability of certain air transport logistic providers. Some constraints applicable to agricultural exporters stem from the passenger demand and scheduling policies of domestic airlines (Rundle, 1998). Hanaoka and Phoosanabhongs (2010) confirm this suggesting that the use of the belly capacity of an aircraft to accommodate cargo and baggage creates problems for shippers in terms of reliability. When the airline experiences issues associated with weight and balance, it is not the passengers to be offloaded or transferred but the freight or cargo.

However, regional communities do not always afford the luxury of dedicated air freighter and the regular airline schedule (if any) is the only method of airfreight. For producers of high value perishable items, the issue of cost is not the only determining factor in deciding on the mode of transport (Batt and Morooka, 2003). Reliability, strong network and ensuring the quality of the produce at delivery are the focus of shipper requirements. It is these decision factors, with integration requirements that must be addressed by regional airfreight carriers in order to enhance service delivery. Given the potential revenue from air transportation of high value produce, Popescu et al. (2006) argue that airlines must manage cargo capacity effectively. Overbooking passenger services as a technique may be appropriate for capacity management and it is certainly a technique applied my many regional operators. However, the techniques used for passenger capacity management are different for those of cargo capacity management. Ultimately, Popescu et al. (2006) argue that air carriers dealing with cargo should employ a cargo capacity forecasting model in an effort to improve the utilization of cargo capacity. For a regional airline with thin margins, these kinds of techniques can assist in business success.

Much of the literature highlights a resulting competition between modes of transport as a result of deregulation (Crowley, 1998; Hanna et al., 2005; Helms and Dileepan, 2005; Pita et al., 2013). In Australia, the deregulation of the airline industry and associated infrastructure such as airports, has effected the transport industry in the same way. However, some authors contend that the key to overcoming these challenges is to consider the importance of logistics integration with other modes, i.e. rail, road and sea (Sankaran, 2000). For research and practice, the first proposition is made:

***P1*:** If regional airfreight as a sector is to survive, management approaches and infrastructure challenges will need to be addressed. Empirical research is needed which considers the importance of integration with other modes of transport and provides researched guidelines supporting the regional aviation sector in subsequent integration processes.

Airfreight can be carried from airport to airport. In the case of the 'farm to table' movement where prompt, reliable and quality transport services are required, it is imperative for air services to collaborate with other modes of freight transport.

The benefits of integration in food industry supply chains are further discussed by (Stank et al., 1999) who support that the implementation of interfirm coordination processes, i.e., communications, information technology, partnering, and performance monitoring, will result in overall improvements to critical logistics performance areas. The challenge for regional airfreight carriers will be the collaboration and sharing of vital business processes and operations with other modes of freight transport.

A final important factor highlighted by the review of literature associated with the "integration" themes indicates the emergence of the role of airfreight forwarders (Bowen & Thomas, 2004; Helms and Dileepan, 2005; Lillie and Sparks, 1993; Tseng et al., 2005). In the case of a high value perishable product shipper, i.e., associated with the 'farm to table' movement, costs is a factor in transport modal choice, but the total product offering is equally as important (Lillie and Sparks, 1993). According to Helms and Dileepan (2005), speed-to-market delivery, and supply chain management are generating a greater demand for intermodal transportation services and a transport infrastructure that is multi-modal. In order to meet these challengers, mergers in the transport industry are the norm as companies aim to effectively and efficiently manage complex supply chains, adding value and technology. In some cases, the mergers create a network that includes freight-forwarding allowing customers to transport freight by air, road, rail or sea and a combination of these (Helms and Dileepan, 2005). In the case of many rural communities, speed to market delivery requires the utilization of air services in the first instance where available. However, the ability to book entire services door to door through a one stop platform is high on the shipper wish list (Tseng et al., 2005). The challenge for regional airfreight carriers will be the realistic application of this concept. Integration, thus, in the case of freight-forwarding will need to come from key regional players able to communicate with and

understand the range of freight services available at one time.

Overcoming this challenge with the application of management processes that consider the entire supply chain, carefully manage cargo capacity, monitor and manage to success long term cooperative partner relationships and integration with other modes of transport will ensure the viability and reliability of airfreight provision for regional and rural communities.

3.3. Infrastructure

The importance of infrastructure, particularly with regards to entire supply chain and relative to this area of study is another challenge identified from the systematic review (Gardiner et al., 2005).

It is evident that the challenges facing agricultural infrastructure in Australia are heavily affected by the value of the Australian dollar (Australian Government, 2012; West, 2013). Certainly this is the case for Australia's ability to compete on a global platform in agricultural production, and also in Australia's ability to tempt international investors. Macro-economic reform does little to stimulate these abilities unless there are well-advised and strategic incentives provided to attract Australian and foreign investment. Incentives come at a cost to some aspect of the Australian economy.

Deregulation in Australia provided the necessary infrastructure developments to support the development of air transport infrastructure. For example, the privatisation of Australia's airports allowed foreign and domestic private investment to develop airports in areas of significant investment potential. The government also claims deregulation success due to its relatively unusual foreign investment policy associated with domestic airline ownership (Australian Government, 2009). However, regional aviation associations claim the policy hindered the sectors ability to grow and compete (Kille et al., 2013 b). The policy attracted heavy investment in domestic air carrier start-ups, providing lower fares and greater options to domestic travellers. However, over the last decade, these domestic carriers have started to impinge on the regional passenger market previously the domain of regional carriers. Older aeroplanes, high operating costs and incomparable financial backing has left many regional carriers unable to compete.

In the case of the regional airfreight scenario, there are two aspects to the challenge of infrastructure. The first is the requirement for private investment, technology and innovation in the areas of growing and processing (at the producer level). This can only be achieved by appropriate financial incentives to attract foreign investment. Many niche products are highly successful in terms of quality due to the conditions of growing at specific locations. In many cases, this geographic limitation and specific growing climate is what makes the produce valuable. Time sensitive and perishable produce also does not have the luxury of distance to process as the travel to process time adds valuable time to the entire transport time. Additional incentives need to come from federal, state and local governmental support into research in this area. This leads to the second proposition:

***P2*:** Research in the area of airport networks and nodes is required. While it is understood that airports have become powerful nodes in the perishable supply chain, further research is required which aims to optimize the airports functionality, from the perspective of the grower, the freight forwarder and the air operator.

Access to scientific, transport and social research will further encourage private investment. This investment may result in development of infrastructure such as processing centers, innovative growing technologies, sustainable growing practices and improved job opportunities in regional Australia. If production of food continues to contribute significantly to the Australian economy, the cost of labour is an important consideration in global competition. Strategies to address production, processing, and labour cost need to be applied combined with significant investment in innovation and development of sustainable practices. This has the potential to provide the economy with the ability to sustain global competition.

The second requirement for private investment, technology and innovation is in the area of air transport access to regional communities. In the case of the 'farm to table' movement, air transport holds many benefits over road, rail and sea freight networks. Rail requires considerable infrastructure, long term planning with limited flexibility in the case of market fluctuations or changes to the regional requirements around the rail stations being constructed. Limited sea ports are also a challenge for growers seeking to distribute their goods from the farm to the table efficiently. However, access to other regional agricultural areas is limited with additional means (such as rail or road) necessary to transport goods to the closest sea port. Additionally, travel time imposed by road, rail and sea is not viable for the transport of fresh, perishable and time sensitive produce.

Aerodromes are found in great numbers across Australia. However, adequate transport research is needed to determine the most appropriate airport sites. This research will provide suitable forecasts as to development potential and the cumulative

economic benefits to the effected regional communities. Relevant research has the potential to spur private investment into airport infrastructure development. In the case of high-quality, niche products and premium produce applicable to the 'farm to table' movement, agriculture and food production industries will benefit from resulting improved access to markets

Similar to passenger services, air cargo services are initiated in order to meet the demand for the carriage of goods from point a to point b. Thus, Gardiner et al. (2005) suggests that the geographic location of the airport is critical. While the body of literature supporting the importance of airports in airfreight logistics is not specific to regional air services, many of the concepts can be correlated to regional contexts. Zhang (2003) investigated Hong Kong as an international cargo gateway and found that airports close to the shippers and have lower total costs and lower delivery times are strong candidates for a regional air cargo hub. What this means for the case of the regional airfreight sector, while often challenged by competing modes of transport (i.e, sea, road and rail), is that attention to key airport criteria may enhance competition positively towards airfreight. Tseng et al. (2005) comment on the competition between the modes, further emphasizing the importance of necessary airport infrastructure. Airfreight might be more expensive than road transport, but the storage costs may be less. In this way, airfreight might be the most reasonable transport mode for a particular transport purpose.

However, infrastructure requirements for the regional airfreight sector go beyond simple locality issues. For freight operations, (Zhang and Zhang, 2002) customs efficiency was a critical feature, highlighting that efficient customs clearance processes provide an additional competitive advantage to airports seeking to lure air cargo operators to service. Amplifying the theme of integration, Gardiner et al. (2005) further emphasizes the infrastructure requirement of access to freight forwarders. An air cargo operators choice of airport to service is influenced by access to freight forwarders, and airport management processes that demonstrate a thorough knowledge of the air cargo industry combined with an understanding of the way airlines do business (Gardiner et al., 2005).

For regional airfreight operators, additional infrastructure challenges come in the form of government or council imposed environmental restrictions (such as noise limitations and curfews on night operations (Shaw, 1993). In the case of providing an attractive airport service to a potential airfreight operator in an effort to enhance the economy of regional communities, it is logical that airports, communities and councils work together to consider those infrastructure restrictions. By working together, the community may determine that the benefits associated with removing such economic restrictions outweigh the environmental concerns (specifically in the case of noise).

The final infrastructure challenge to regional airfreight operations in the movement of perishable products is that of tangential facilities. For example, adequate access to cold storage facilities at airports, may enhance the overall service quality, and reliability of freight services. In a study of cold chains, Hafliðason et al. (2012) determined that a lack of temperature control caused by frequent interruption of the cold chain during loading and unloading between different transport modes (e.g., land, air) is more severe for airfreight transport of fresh fish products, compared to shipping. While the temperature monitoring system proposed by Hafliðason et al. (2012) may not be applicable to cold chain scenarios in the regional airfreight sector, enhancing airport infrastructure to include cold storage facilities may go a long way to improve the performance of airfreight in this respect (Yuan et al., 2010).

3.4. Service reliability

Service reliability, another integrated theme is identified as a challenge by a compact body of literature (Gardiner et al., 2005; Ramachandran and Tiwari, 2001; Vokurka and Lummus, 2000; Yuan et al., 2010). Service reliability is defined by Park et al. (2009) to have features of accuracy, punctuality, dependability, and safety.

This challenge appears inextricably bound to the two challenges discussed above, in that service reliability demands appropriate service integration and appropriate facility and infrastructure requirements. Park et al. (2009) posits that the speed and reliability demands of contemporary supply chain management has encouraged airfreight (in general) and express air cargo, one of the most rapid growth areas in the dynamic cargo sector.

Foster and Strasser (1990) investigated the key factors of shippers and carriers in carrier/ modal selection. The research revealed that "schedule reliability" was highly ranked as a selection variable for shippers. Murphy and Hall (1995) investigated the relative importance of cost and service variables before and after deregulation. The study revealed that shippers in the United States generally value service more highly than cost in the freight transportation choice.

With that in mind and considering that the competition variables of regional airfreight (i.e. cost, locality, frequency) are similar to those listed in the

international studies, we can draw comparative conclusions for the regional airfreight sector. The third proposition reads:

***P3*:** For regional airfreight providers to improve service delivery, further research is required into the needs of shippers. Surveys of shippers in a rural or agricultural setting are likely to highlight additional requirements for regional air services. These are unlikely to be the same as those of the international and capital city shippers that dominate the current literature in the field.

The challenge for the regional airfreight sector will be responding to the demands of shippers (growers and producers) seeking seamless door-to-door service rather than just airport-to-airport (Park et al., 2009). The features of integration and infrastructure are beneficial but not necessary to overcome the challenge of service reliability from a regional carrier perspective. Understanding that accuracy and promptness are considered the most influential service factors (Park et al., 2009), regional air carriers should address these characteristics as a first step.

Conclusion

This paper has sought to systematically review the selected literature with regards to the role of regional air transport in the airfreight industry. The investigation of the current state of literature highlighted the dearth of research and academic literature associated with regional aviation specifically relating to the perishable cargo supply chain. Of the 83 articles examined, three themes (coordination/collaboration in food industry supply chains, drivers of growth in airfreight task and decision making frameworks) were distilled from the literature. A limitation of the study is the number of journals included in the review. The selection process was applied in an effort to balance feasibility and rigour. While more journals may have increased the number of appropriate articles found, theoretically this may have improved the review. However, practically, this process would have exceeded the amount of articles we could review within a reasonable time frame. A sample or a smaller size, however, might lead to a failure to identify all of the important issues. Thus, we encourage further research, which reviews a broader sample of journals. Never-the-less, the synthesis gave light to the three emerging areas of challenge for the regional aviation sector with regards to the provision of airfreight services. These challenges are associated with integration, infrastructure and service delivery. Suggestions to assist the sector in overcoming these challenges have been provided. However, these challenges have highlighted the areas in dire need of research. It is hoped that this paper will assist the advancement of research by supporting industry and policy makers in future efforts towards the development of supply chain management and the regional aviation sector.

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