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ENHANCING PRODUCTIVITY WITH e-FREIGHT@SINGAPORE

A Collaboration Between

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Georgia Institute of Technology

The Logistics Institute – Asia Pacific

A THINK Executive Whitepaper

EXECUTIVE SUMMARY

Intensifying global competition and scarce resources are compelling enterprises and industries to re-examine traditional business practices, and seek innovative and productive alternatives.

This paper presents a process re-engineering approach to enhancing productivity and customer experience in the air freight supply chain by harnessing technology and digital information. Initiated and steered by the International Air Transport Association (IATA), *e-freight* aims to take paper out of the airfreight supply chain by replacing paper documents with electronic messages. *e-freight@Singapore* leverages on IATA e-freight messages and proposes to capture "data at source" (*data@source)* and transmit it electronically throughout the supply chain (through *data reuse*). It attempts to minimize data re-entry, entry errors, reduce processing time and improve the overall productivity of the air freight supply chain in Singapore.

Our analysis suggests that the shippers and other stakeholders in the air cargo export supply chain can save up to 1.7 million man-hours annually by adopting *e-freight@Singapore*. The time taken to process each document can be reduced by at least 40 per cent for House Air WayBills (HAWB) and more than 50 per cent for the remaining 5 key documents (Packing List, Certificate of Origin (COO), Master Air WayBill (MAWB), Consol Manifest and Flight Manifest). Thus, *e-freight@Singapore* can facilitate the smooth and fast exchange of data between different members of the air cargo community across the world as well as enhance productivity.

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1. INTRODUCTION

Businesses are increasingly being confronted with the implications of unproductive and outdated processes in the face of global competition and diminishing resources. In a manufacturing process, productivity can be defined as the effective transformation of input resources into market demanded outputs [1]. Similarly, service productivity is defined as the use of inputs for providing services with quality matching the expectations of customers [2]. In services, however, measuring productivity is not as straightforward due to the participation of customers who act as co-producers and since services are 'open systems' with no 'single unit of service' [3]. In economic terms, productivity measures the amount of work done in a given time. As compared to the developed countries such as US and Japan, productivity in services in Singapore stood at 58 (on a scale of 1 to 100, 100 being the most productive) and productivity growth averaged about 1 per cent over the past decade [4]. Productivity can be enhanced through initiatives which include automating processes and improving the skillset of the existing workforce. Pushing the productivity imperative adds value for the service provider, enhances the customer experience, and results in wealth creation especially for service-based economies.

Organizations that actively partake in measures to enhance productivity not only help their bottom-line but also have much to gain through one or more of the following ways: (i) increasing the efficiency of the supply chain leading to a reduction in operating costs, (ii) decreasing the number of man-hours worked resulting in an improvement in employee satisfaction, and (iii) involving the consumer in the process to attain productivity gains in service operations [5].

It has been recognized that one of the main culprits for the low profitability in the transport and logistics sector, an increasingly important pillar in the global supply chain, is low in productivity. The rapid growth of the air transport industry estimated at 5-6 per cent [6], both domestically and internationally in recent years has led to an increase in cost without a significant increase in profitability [7], making it an ideal candidate for the study of productivity initiatives (Figure 1). As such, there is now a recognition and renewed effort by governments, regulators and other stakeholders to encourage higher productivity of aircraft and their operations, through better use of information technology, and better management practices.

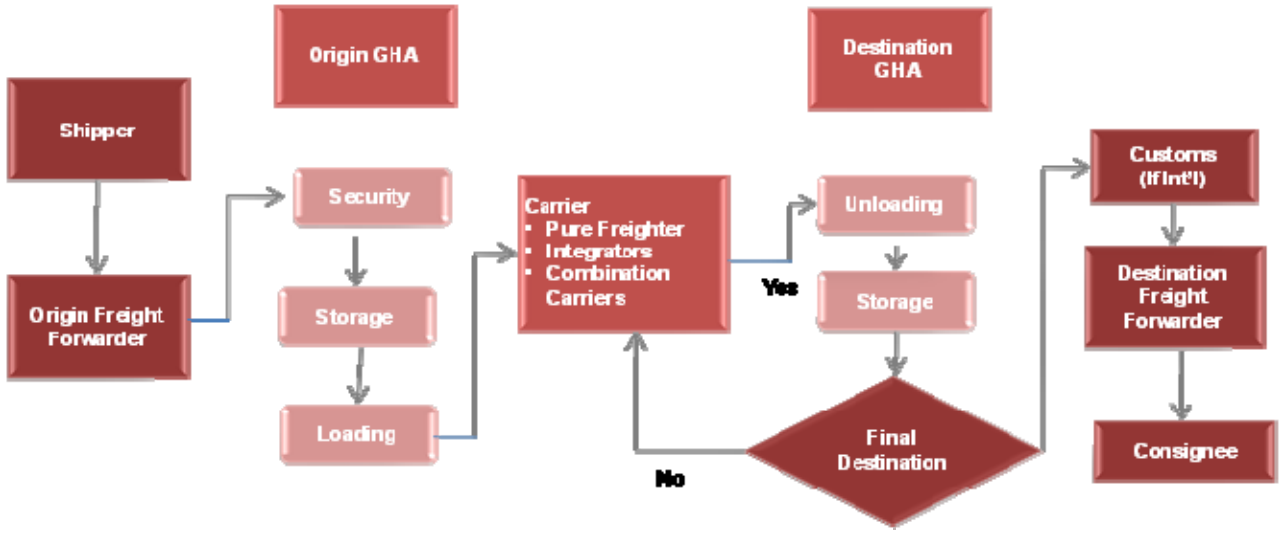

Figure 1: Schematic diagram of the air cargo supply chain

Source: Adapted from [8]

e-freight, an IATA initiative, launched in 2004, aims to increase productivity and reduce the amount of paper documents in the typical air freight supply chain by moving to a paper-free, efficient electronic environment [9]. IATA has estimated that automating and standardizing business systems by leveraging on its e-freight messaging standards can yield annual savings of up to US$ 4.9 billion in cost throughout the international supply chain. This saving is equivalent to eliminating 64 percent of the paper consumed in the global air freight business.

Currently, an average air freight shipment generates up to 30 different paper documents (Figure 2), including the 20 essential documents such as the Air WayBills [9]. Indeed, by replacing paper documents with electronic messages in the supply chain, key stakeholders in the industry can benefit from cost reduction, reduced paper trail, shortened processing time [10], increased data accuracy, and reduce any overlapping functions. e-freight involves the diverse players in the air cargo community namely the shippers, freight forwarders, Ground Handling Agents (GHAs), airlines, the airport authorities, and customs. In 2010, IATA further appealed to members involved in the air freight cargo value chain to support the IATA e-freight initiative as it is productive as well as environmentally friendly.

e-freight@Singapore, a Business Process Re-engineering (BPR) initiative to integrate the air cargo supply chain through the adoption of paperless air freight documentation is one such effort. *e-freight@Singapore* will enhance industry capabilities, improve data accuracy by reducing repeated manual data entry, and raise the overall productivity. Its key concepts of data at source ("*data@source*") and *data re-use* leverage defined electronic messaging standards (excluding scanned documents), to capture the data created in the source document and to re-use that data as needed throughout the supply chain.

Figure 2: Documents in trade flow

Source: Accessed from [11]

In this paper, we apply BPR on the international air freight documentation flow through Changi Airport in Singapore. There is good reason for doing so. Changi Airport is the seventh busiest cargo airport globally in terms of international air freight, handling about 1.8 million tonnes of cargo in 2010 [12]. In freight documentation terms, this amounts to at least 4 million page documents annually. Reducing paper documentation will therefore improve the overall efficiency and reduce wasteful paper consumption. This paper therefore examines the existing air cargo export process in Singapore, provides an analysis of the weaknesses and improvement potential in the existing process and describes the productivity gains that can be accrued by leveraging on the concepts of *e-freight@Singapore*.

2. METHODOLOGY

Six focus group discussions focusing on four industry verticals (i) Automotive and Aerospace, (ii) Electronics, (iii) Chemicals and Pharmaceuticals, and (iv) Perishables, IT vendors, and freight forwarders were organized from August to October, 2010. We mapped the "as-is" process for the air cargo export and validated it with industry. The Small and Medium Enterprises (SME)[1] and Multinational Corporation (MNC) freight forwarders, airlines, and IT service providers were each involved in a 1.5 hour long interview. A "to-be" process was developed based on the concepts of *data@source* and *data reuse* as well as inputs from the focus groups. The "to-be" process was validated with all stakeholders, namely, shippers, forwarders, GHAs, and airlines. A Cost-Benefit Analysis (CBA) model was also developed to demonstrate the costs, benefits and savings of adopting the "to-be" process.

[1] Small and Medium Enterprises are identified either as enterprises with net fixed assets investment of at most S$ 15 million or as non-manufacturing enterprises with fewer than 200 employees (www.spring.gov.sg).

3. "AS-IS" PROCESS

We now report the findings on the differences between the export processes of the MNC and SME freight forwarders, which may have a bearing on adoption of *e-freight@Singapore* primarily due to the difficulty in harmonizing all of these differences. The specifics are described in Figure 3.

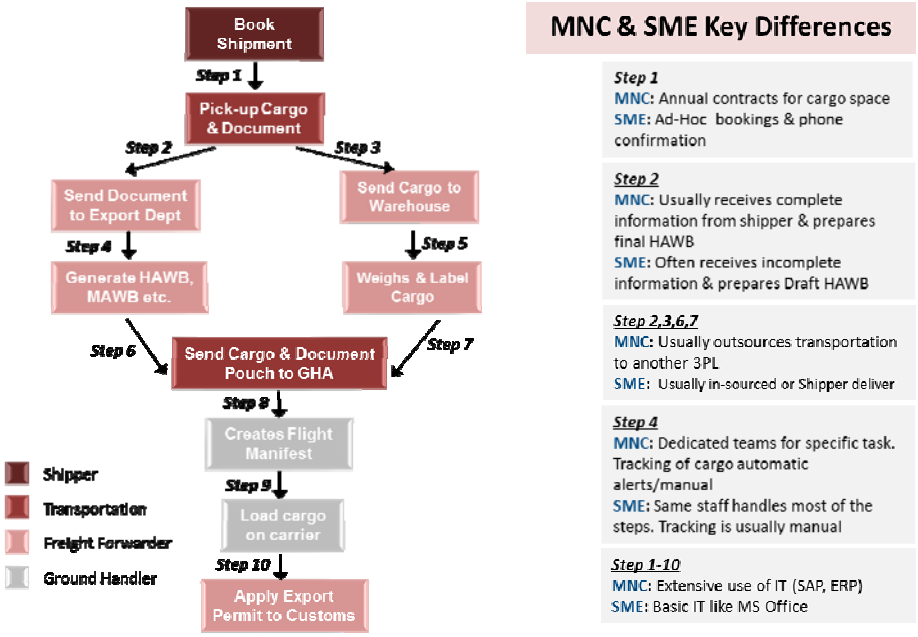

Figure 3: Graphical representation of differences in SME and MNC air cargo export process

Source: Inputs from Industry

Next, when profiling the differences in the export process, the additional documentation and special handling procedures for the four industry sectors studied, were observed to present a challenge for the *e-freight@Singapore* initiative. Table 1 highlights some of the sector specific differences.

Table 1: Sector specific differences for air freight export process

Activity	Sector			
	Chemical & Pharmaceutical	Automotive & Aerospace	Ornamental Fish & Plants	Electronics
Shipment booking	Obtain Dangerous Goods (DG) permit. Attach Material Safety Data Sheet (MSDS). Special packaging and labeling. Volume restriction for gels, liquids, pastes.	Batteries and seat belts are DG goods.	Fish health certification where required. Phytosanitary certificate required for ornamental plants from AVA. Fish packed and labeled by shipper.	Often engage integrators to avoid split shipment problem.
Booking of space	Specify type of goods in the case of DG cargo. Differential rates for DG cargo.	Difficult to confirm booking for bulky, odd-shaped engine parts.		
Place all documents in a consol pouch			Apply for COO where required. Packing list to be endorsed by AVA.	
Deliver consol pouch and cargo to GHA	Designated storage area at the GHA premises.			
Freight forwarder tracks cargo via GHA/ Airlines website			In cases where cargo is off-loaded, GHA informs freight forwarder by phone.	
Permit application			Cargo clearance permit applied before shipment.	Certain products do not have clear HS codes.

Source: Inputs from Industry

Third, through the site visits, interviews and focus group discussion sessions, some of the industry concerns about the acceptance of e-freight in the current air cargo export process emerged:

1. Most freight forwarders indicate that there is substantial data entry involved in the current air cargo export documentation and the probability of data entry errors are high. Similar information is entered into different type of documents as there is no centralized database used by the companies involved in the air cargo export supply chain. Further, hard copies of documents are normally required at many stages of the air cargo export process, especially when exporting to developing countries.

2. There is a substantial amount of printing, scanning and sending of physical documents involved, as observed during the site visits to the freight forwarders' offices. The same set of information is sent to the other parties in hardcopy via courier, email, and Electronic Data Interchange (EDI).

3. Players in the air export process do not perceive any tangible benefits related to e-freight adoption and some feel that e-freight has limited benefits. Even MNC freight forwarders are not keen to replace their legacy systems with the new initiative.

4. Shippers, especially those with low transaction volumes, are reluctant to implement electronic data transmission. They feel that adopting e-freight (Table 2) will result in additional cost, re-training of staff, and involves cumbersome processes e.g. tweaking their in-house processes to suit the new system that is required for e-freight.

Table 2: Summary of weaknesses and improvement potential

	Weakness	Improvement Potential
Data/Document	Shippers reluctant to transfer data electronically	Adoption of *data@source* & electronic data transfer by stakeholders
	Hard copy document requirement by Destination Freight Forwarder	Adoption of e-freight with specific countries & freight forwarders
	Hard copy document requirement for IRAS and GST refunds	e-archival of documents as part of *e-freight@Singapore*
	Hard copy requirements by controlling agencies	Reduce hard copy documents
Costs	Costs of electronic messaging, IT upgrades and re-training of manpower	Mass adoption of *e-freight@Singapore* can lower costs of messaging
	Need for tangible cost benefits for various stakeholders	Potential cost and time savings
	Inaccuracy & incompleteness of electronic messages	Explore *data reuse* to improve accuracy of electronic messages
Manpower	Lack of IT training & e-freight awareness	Upgrading the IT skills of existing staff

Source: Inputs from Industry

4. "TO-BE" PROCESS

The design of the new process is based on the concept of *data@source* and *data reuse*. The first step of *data@source* and *data reuse* is to capture the determinant data from the source documents. The captured data is then reused in subsequent documents along the supply chain without having the need to re-enter similar data. Through *data@source* and *data reuse*, stakeholders can minimize data re-entry and avoid duplication of work. This will, in turn, streamline the cargo documentation process, leading to shorter industry cycle times and higher data accuracy.

5. DUPLICATION OF DATA SEGMENTS

In all, 7 key and most relevant documents for air export were studied. The format of each document may differ across companies. For standardization purpose, all documents used in this study (Invoice, Packing List, COO, HAWB, MAWB, Consol Manifest and Flight Manifest) are extracted from the IATA list of e-freight documents. The list of documents as well as the stakeholder responsible for generating them is shown in Table 3.

The data fields found in each document are categorized under several data segments. Each data segment is analyzed for duplication in the other documents. Table 3 shows the number of occurrences of each data segment across the 7 documents. Of the 21 data segments listed, approximately 60 per cent of them are duplicated in more than 3 documents.

Table 3: Number of documents with duplicate data segments

	Shipper			Freight Forwarder			GHA	
Document / Data field	Invoice	Packing List	COO	HAWB	MAWB	Consol Manifest	Flight Manifest	No. of Occurrences
Quantity of goods	x	x	x	x	x			5
Number of packages		x		x	x	x	x	5
Dimension and weight		x		x	x	x	x	5
Shipper's details	x	x	x	x				4
Consignee details	x	x	x	x				4
ETA and ETD	x	x			x		x	4
Transport details	x	x	x					3
Description of goods	x	x	x					3
Origin airport				x	x		x	3
Destination airport				x	x		x	3
HAWB number				x	x	x		3
MAWB number					x	x	x	3
Incoterms	x			x				2
Carrier					x		x	2
Flight details					x		x	2
Handling instructions		x		x				2
Payment details	x							1
Value of goods	x							1
Classification of Goods							x	1
COO of Goods			x					1

Table 4 shows the number of data fields that are found in each of the 7 documents as well as the proportion of data being reused when comparing source and new documents.

Table 4: Percentage of *data reuse*

Source document* (No. of fields)	New document (No. of fields)	Number of data fields for reuse	% of data for reuse
Invoice (267)	Packing List (178)	174	97
Invoice (267)	COO (159)	98	62
Invoice (267)	HAWB (208)	76	37
Packing List (178)	HAWB (208)	76	37
COO (159)	HAWB (208)	75	36
HAWB (208)	MAWB (218)	195	89
MAWB (218)	Consol Manifest (36)	24	67
MAWB (218)	Flight Manifest (84)	53	63

*Data extracted from www.iata.org

For example, there are 208 data fields found in the HAWB. When we compare the data fields in the invoice with the data fields in the HAWB, almost 40 per cent of the data fields found in the HAWB co-exist in the invoice. Hence, by applying the concept of *data@source* and *data reuse*, stakeholders need not re-enter the duplicate data in the other downstream documents in the air freight process. In addition to saving time and resources, any data entry error will also be minimized.

6. PRODUCTIVITY GAINS

A Cost - Benefit Analysis (CBA) was done to measure the productivity gains when adopting *e-freight@Singapore*. Through *data@source* and *data reuse*, the time taken to process export documents was found to be reduced by at least 40 per cent (Table 5).

Table 5: Time saved through *data@source*

	No. of characters (manually entered)		Time taken per document (min.)		Time saved	
Document*	**Without *data@source***	**With *data@source***	**Without *data@source***	**With *data@source***	**(min.)**	**(%)**
SHIPPER						
Invoice	5,160	-	22	-	-	-
Packing List	3,500	70	15	1	14	93
COO	3,100	1,200	13	5	8	62
FREIGHT FORWARDER						
HAWB	3,800	2,300	17	10	7	41
MAWB	4,200	500	18	3	15	83
Consol Manifest	1,100	400	5	2	3	60
GHA						
Flight Manifest	1,500	600	7	3	4	57

*Data extracted from www.iata.org

The time taken to process each document with and without the use of *data@source* was computed with the following assumptions:

- **Definition of 'without *data@source*':** All data fields found in the document were assumed to be manually entered. No Enterprise Resource Planning (ERP) system is used in the calculations.
- **Definition of 'with *data@source*':** Similar data fields that are found in the source documents are automatically transferred to the reuse

documents. The remaining data fields are manually entered.

- Data field length for type *Alphanumeric*, *Number* and *Date* is set at 20, 10 and 8 characters respectively.
- Data entry speed is set at 30 words per minute or 230 characters per minute.
- Total number of working hours per employee is set at 8 hours per day.

Table 6 indicates the reduction in the number of man-hours needed to process the same number of documents per month.

Table 6: Number of documents generated with and without *data@source*

	Without *data@source*		**With *data@source***	
Document*	**Time taken (min. per doc)**	**No. of documents generated (per employee)**	**Time taken (min. per doc)**	**No. of documents generated (per employee)**
SHIPPER				
Packing List	15	32	1	480
COO	**13**	**37**	**5**	**96**
FREIGHT FORWARDER				
HAWB	**17**	**28**	**10**	**48**
MAWB	18	27	3	160
Consol Manifest	**5**	**96**	**2**	**240**
GHA				
Flight Manifest	**7**	**69**	**3**	**160**

*Data extracted from www.iata.org

Table 7 summarizes the productivity gain for each stakeholder when adopting e-freight.[2] Hence, by utilizing *data@source* and *data reuse*, the shipper and other stakeholders will save a significant amount of man-hours involved in document processing. In this analysis, productivity gain is measured by the number of man-hours saved in processing air cargo documentation, when comparing the "as-is" and "to-be" processes.

Table 7: Productivity gained (based on 40,000 MAWB per month)

Productivity Gain ('000 Hours/Month)	SHIPPER	FREIGHT FORWARDER	GHA	AIRLINE
"as-is"	251	77	2	10
"to-be"	155	38	1	7
Savings	96	39	1	3
Savings ('000 hrs. / year & % between "as-is" and "to-be")	1,152 (38%)	468 (51%)	12 (50%)	36 (30%)

[2] To compute the productivity gains, we assumed that the average number of MAWBs for the industry is 40,000 per month (estimated from major airlines). The implementation method is assumed to be Host-to-Host integration. The document relationship (as verified by the stakeholders) is as follows: 1 shipment booking results in 1 HAWB, 1 Flight Manifest comprises 30 HAWB. 1 MAWB accommodates 5 HAWB, and requires 1 Export Control Form and 1 Cargo Manifest. 1 HAWB is generated from 2 invoices. For each invoice, 1 Packing List is generated. It is also assumed that COO is required for 5% of the total shipments.

7. IMPLEMENTATION CONSIDERATIONS

The main difference between the two potential solutions lies in the implementation method and technology used. A web portal approach requires low initial investment and allows flexibility of payments while a host-to-host approach via a data mapper allows for high transaction volume which justifies the high initial investment (Table 8). However, both methods leverage on standard IATA e-freight XML messaging standard for transmission of data between the stakeholders.

Table 8: Comparison of Data Mapper and Web Portal

	Host-to-Host	Web Portal
Description	• Convert data in one format (e.g. EDI, excel, pdf etc.) to another format (e.g. XML, EDI format)	• Anything that involves delivering hosted services over the Internet. Also known as SAAS (Software-as-a-Service) • Third party IT vendor supplies the hardware infrastructure, the software product and interacts with the user through a front-end portal. • End user is able to use the service at anytime and anywhere.
Cost involved	• Data mapping cost (charged based on number of messages to map) • System upgrade/ integration cost	• Monthly subscription with unlimited number of message transmission allowed (rate is dependent on the number of users)
Advantages	• Security of data i.e. confidential data are not shared with other parties	• Save on hardware cost • Ease of maintenance and management due to less server required
Disadvantages	• System, Software and Hardware upgrade cost can be substantial • Need to assign personnel with IT knowledge to maintain the system	• Require stable internet connection • Security and confidentiality of data and information is dependent on third-party

Table 9 lists the differences between the “as-is” and “to-be” processes. One main difference between the “as-is” and “to-be” processes lies in the flow of documents. In contrast to the “as-is” process where hard copies of documents ‘move’ along with the cargo, cargo in the “to-be” process moves independently without any accompanying document pouch. It is important to note that cargo flow between the “as-is” and “to-be” process does not vary. Cargo, in most instances will be picked-up by the assigned freight forwarder from the shipper, and then consolidated and palletized. Consolidated cargo will be sent to the GHA. Finally, cargo will be loaded onto the carrier.

Table 9: Differences between “as-is” and “to-be” processes

“as-is” process	“to-be” process	Benefits of “to-be” process
Manual data entry	XML messages	● Reduce data error ● Increase productivity ● Comply with regulatory requirements (e.g. Advance Export Declaration and EU 24 hour rule)
Documents flow together with cargo	Documents and cargo flow independently	● Minimize the need of having to wait for palletized cargo before documents can be sent to the downstream stakeholder
Storage of physical paper	e-archival of documents	● Reduce the need for physical storage ● Documents can be retrieved easily whenever it is required

8. CONCLUDING REMARKS

Our analysis suggests that by adopting the concepts of *data@Source* and *data reuse*, the annual productivity gain in terms of the total number of hours saved by the industry when processing the same number of documents in the "as-is" and "to-be" processes is estimated to be 1.7 million hours or 630 headcounts. This clearly indicates that *e-freight@Singapore* can play an important role in increasing the productivity in the air cargo export process as well as ensuring the fast and accurate transfer of data.

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9. REFERENCES

1. Gronroos, C. and K. Ojasalob, *Service productivity Towards a conceptualization of the transformation of inputs into economic results in services.* Journal of Business Research, 2004. **57**: p. 414– 423.
2. Järvinen, R., U. Lehtinen, and I. Vuorinen, *The change process of industrialization, electronising service channels and redesigning organization in the financial sector from the productivity viewpoint*, in *Second International Research Workshop on Service Productivity*. 1996: Madrid.
3. Nachum, L., *The productivity of intangible factors of production: some measurement issues applied to Swedish consulting firms.* Journal of Service Research, 1999. **2**(2): p. 123 - 37.
4. Accessed from *http://www.straitstimes.com/STI/STIMEDIA/pdf/20100201/020110productivity02.pdf* on 23/8/2011.
5. Fitzsimmons, J.A., *Consumer Participation and Productivity in Service Operations.* Interfaces, 1985. **15**(May/June 3): p. 60-67.
6. Accessed from *http://www.boeing.com/commercial/cmo/* on 14/7/2011 .
7. Accessed from *http://www.iata.org/pressroom/speeches/Pages/2011-06-06-01.aspx* on 18/7/2011.
8. Petersen, J., *Air Freight Industry - White Paper*. The Supply Chain and Logistics Institute: H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, 2007.
9. Accessed from *http://www.iata.org/pressroom/facts_figures/traffic_results/pages/2010-06-29-01.aspx* on 15/7/2011.
10. Smith, S. and M. Moosberger, *IATA e-Freight: Taking the Paper Out of Air Cargo*, in *The Global Enabling Trade Report 2009*, R.Z. Lawerence, M.D. Hanouz, and J. Moavenzadeh, Editors. 2009.
11. Accessed from *http://www.iata.org/whatwedo/cargo/efreight/Pages/index.aspx* on 05/01/2011.
12. Accessed from *http://www.changiairportgroup.com/cag/html/the-group/airfreight_movement.html* on 2/1/2011.

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