

Information Technology Systems Implementation and Processes of Integration and Disintegration

Case Study Evidence from Air Greenland

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Abstract

Purpose

This study analyzes the impact of information technology (IT) system implementation on the integration of data and information between sales and accounting departments, and how data integration affects relations with supplier and customers.

Methodology

The change between three different reservation and distribution systems in an airline company were assessed over 20 years based on qualitative data collected while events unfolded and interviews that traced events retrospectively.

Findings

This study finds that data integration challenges affect the capacity to utilize revenue and sales data for control purposes and integrating with suppliers and customers. The systems either facilitated the ability to integrate sales and accounting data or enabled integration in wider supplier and customer networks. The implementation of different reservation and distribution systems resulted in a trade-off between integration within the firm and into wider customer and supplier networks.

Originality

Extant research suggests that integration challenges when implementing IT systems are caused by differences in information needs between groups with different logics. We illustrate how data integration is also a crucial challenge when implementing IT systems.

Research limitations

Data were mainly obtained from the focal firm, Air Greenland. The protracted study period meant that the data were not as concentrated as they would have been had the analysis been performed over a shorter duration or had the focus been on one implementation process.

Keywords: Data integration, Information integration, Management accounting, Supplier and customer relationships, Distribution systems, Developing economies

Article classification: Research paper

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1. Introduction

Information technology (IT) is a part of most processes in modern organizations (Dechow *et al.*, 2006). The implementation of IT systems, such as enterprise resource planning (ERP) systems, shapes the ability to integrate data between different functions, such as sales, production, and accounting. Besides eliminating numerous costly standalone systems tailored for specific purposes, the integration of data in one system potentially increases the quality of management accounting and organizational control. For example, data integration between sales and accounting helps organizations to cost-effectively store and transfer knowledge as well as develop knowledge for enhanced organizational performance (Dechow *et al.*, 2006; Granlund, 2011).

Challenges in improving management accounting through data integration surface because the shared data cannot be used for all purposes (Booth *et al.*, 2000). Firstly, IT implementation often fails because the system design focuses on technical issues rather than on business needs, which indicates that the demand for data relevant to management accounting is subsumed by IT data standards (Davenport, 1998; Dechow *et al.*, 2006). Secondly, a parallel problem is that different departments (e.g., accounting and logistics) demand different data because they utilize different decision-making logics. As ERP systems are ill-equipped to provide data for multiple decision-making logics, the value of the integrated data for management accounting may be reduced because it has been developed according to another logic (Dechow and Mouritsen, 2005; Drum *et al.*, 2017; Granlund *et al.*, 2013; Hald and Mouritsen, 2013; Heinzelmann, 2017; Kholeif *et al.*, 2007).

IT systems also affect relations with customers and suppliers because increased transparency increases the ability to manage and control relations (Frances and Garnsey, 1996;

Gunasekaran *et al.*, 2006; Hyvönen, 2007; Ruivo *et al.*, 2014). For example, Cuganesan and Lee (2006) found that E-procurement facilitated integration with suppliers and increased control with line personnel. Few studies, though, have analyzed the dynamics between data integration within the firm and how it affects relationships with suppliers and customers.

In light of this, it is interesting to analyze how IT system implementation affects data and information integration simultaneously within and beyond the firm. This focus also responds to the persistent calls for research that analyzes systems implementation over a long duration (Caglio and Ditillo, 2008; Granlund and Malmi, 2002; Hyvönen, 2007). This study will therefore investigate the following research question: *How does IT system implementation affect integration of accounting data and information within the firm and with its suppliers and customers?*

To analyze the research question, the present study draws on data and information integration concepts (Booth *et al.*, 2000; Rom and Rohde, 2007). Data integration is defined as the extent to which the same data can be transported and assessed by many functions or companies through common formats, along with other technical features that expedite the flow of data. On the contrary, information integration is whether the data can be used by organizational units and companies for their specific analytical purposes (Booth *et al.*, 2000). These concepts are useful as they provide an opportunity to make a connection between the IT system and the use of data in the system. Data and information integration is important as it is the basis from which management accounting is performed. Data and information integration issues are also investigated in the ERP literature that has dominated the management accounting research on IT systems (Davenport, 1998; Dechow and Mouritsen, 2005; Granlund *et al.*, 2013; Hald and Mouritsen, 2013). However, we suggest that there is little focus on data integration in this literature.

The relationship between data and information integration is analyzed in a case study of Air Greenland, Greenland's national airline. During a 20-year period, Air Greenland used three IT reservation and distribution systems. We collected qualitative data of processes while they were unfolding and used retrospective interviews to gather data on the first system. We analyzed how the implementation of their reservation and distribution systems affected data and information integration and changed management accounting and relations with customers and suppliers.

Our study contributes to the extant literature in two ways. Firstly, we demonstrate how challenges relating to data integration have implications for information integration. This extends extant research, which suggests that differences in decision-making logics is the primary obstacle to achieving the full benefit of information systems and any subsequent improvement in management accounting (Davenport, 1998; Dechow and Mouritsen, 2005; Granlund *et al.*, 2013). Secondly, few studies have analyzed the impact that data integration across firm boundaries have on relations within the firm (Dekker, 2016; Gunasekaran *et al.*, 2006; Hyvönen, 2007; Ruivo *et al.*, 2014). This study extends this research because it shows how the implementation of multiple IT systems led to a trade-off between integration with suppliers and customers and integration of data and information within the company.

2. Theoretical background

2.1 Information technology and integration within organizations

Data integration and the subsequent integration of information is a key objective when implementing IT systems (Rom and Rohde, 2007). The concepts of data and information in IT and management accounting literature follows the classical definitions of data and information, which states that data are symbols that represent properties of objects, events, and their

environment that are of no use until they are in a useable (i.e., relevant) form, whereas information is inferred from data and put to use with a specific purpose (Rowley, 2007).

Data integration is the extent to which the same data can be assessed by several organizational units or organizations (Booth *et al.*, 2000), which can be achieved if data are stored on one system, rather than on many disconnected systems, or if data flows easily between systems. The standardization of data in one format is central for the integration of data (Bhatt, 2000). Data integration reduces the costs of operating several disconnected systems and facilitates communication between different departments (e.g., sales and production) (Davenport, 1998). If an organization successfully adapts to the software, significant gains in productivity, speed of reaction, streamlined data flows, and direct access to real-time operating data can be achieved (Booth *et al.*, 2000).

Information integration addresses the usability and quality of data for specific purposes and refers to the scope of interchange and use of data generated by internal and external sources (such as functional areas and software applications, Booth *et al.*, 2000). Thus, it concerns whether different departments (i.e., accounting, sales, and logistics) in the organization can use the same data to make decisions. For example, in the airline industry when a customer buys a ticket, data related to the invoice amount, connecting flights etc. are stored. These data may be assessed and integrated with the other airlines selling parts of the ticket. The data stored in the system are also recorded together with all other purchases, cost etc. and other units in the organization may draw on the data. Data are thus integrated. The integrated data may be used to produce information e.g. through integrating information about the combined sales on a route, cost of fuel etc. and compared to other periods sales and cost and thus produce a profitability analysis of the particular route.

Extant literature here studies how information integration problems arise when information systems standardize data flows according to a specific data logic that cannot be used or is not

meaningful for all functions in the organization (Drum *et al.*, 2017; Granlund and Malmi, 2002; Kholeif *et al.*, 2007). Heinzelmann (2017) reported that the implementation of an ERP system, SAP, which contained a German accounting logic, created problems for subsidiaries in the company that did not use that logic. Although the data were integrated globally and practices changed, there were difficulties understanding and accepting the system. Dechow and Mouritsen (2005) showed that different departments in their organization, particularly accounting and logistics, pursued different decision-making logics that were difficult to fulfill using one set of integrated data. As the logistics department's data demands were prioritized, the accounting department's information needs were not fulfilled. Scapens and Jazayeri (2003) similarly showed that integration through a SAP system was difficult to achieve because the accountants were embedded in functionally oriented ways of thinking that impeded the use of information and data across functional boundaries.

The literature on data and information integration also shows that workarounds can be used to manage the tension between data and information integration; however, they can also create data integration problems (Drum *et al.*, 2017; Gasser, 1986). Workarounds are *ad hoc* tactics that are used to solve immediately and pressing local data challenges, and workarounds often conflict with the central ideology of data integration. Drum *et al.* (2017) showed that informal practices in SAP reduced the quality of accounting information, leading to delayed payment of vendors and problems with pricing, tax, auditing, reporting, and expense classification. Workarounds reduced data integration, generating challenges for use of information for business purposes.

The literature on integration through IT systems reviewed above highlights the difficulties with the ability to integrate data and information simultaneously due to different functional logics and workarounds. The literature in general, however, has not paid much attention to the relationship between data and information integration. This focus is interesting because if data

are not integrated, it may be impede the use of data for information integration (i.e., to put them to use for business purposes).

2.2. Control of suppliers and integration with the firm

A small but growing number of studies has examined the dynamics between control within and beyond the firm (Anderson and Lanen, 2002; Carlsson-Wall *et al.*, 2011; Cuganesan and Lee, 2006; Dekker, 2016; Frances and Garnsey, 1996; Meira *et al.*, 2010; Thrane and Hald, 2006), either from the perspective of how the accounting processes of focal firms affect their relations with suppliers or vice-versa.

One body of research suggests that the implementation of IT and control systems for customers and suppliers improves data and information integration. Anderson and Lanen (2002) and Arunachalam (2004) analyzed how the use of electronic data interchange (EDI) helped to standardize data flow with suppliers and customers, lower administration costs and errors, and improve efficiencies. Cuganesan and Lee (2006) demonstrated a positive association between integration between functions and in the supply chain. They analyzed e-procurement and showed that it stabilized and integrated relationships. In addition, the implementation of e-procurement lead to “refinement and greater utilization of accounting controls and new visibilities [into] supplier performance” (Cuganesan and Lee, 2006, p.165). E-procurement also enabled greater control over line personnel and increased control of maverick spending. However, this research focuses on relatively simple EDI and e-procurement systems where the challenge of simultaneously integrating data and information that could otherwise be expected from more advanced IT systems, such as ERP or reservation and distribution systems, is less likely.

The implementation of IT systems also changes buyer-supplier power positions through visibility and the information advantage that they create (Frances and Garnsey, 1996). The

implementation of EDI and point-of-sale scanners in supermarkets was shown to increase the ability to integrate the entire value chain, including various functions, such as sales and accounting (Frances and Garnsey, 1996). These changes led to a reduction in stocks and cost, and customer information was used to develop new offerings. Time series data on customer behavior were used to forecast, plan, monitor, and manage goods from source to checkout. The information advantage gained by supermarkets through system implementation enabled them to dominate suppliers and achieve oligopolistic positions in the market. In this research, there is little mentioning of data integration problems.

Another body of research analyzes in-depth how factors within the firm affect control in the supply chain. Fuchs *et al.* (2018) showed that data capability, defined as the quality of data and functional capability, affected functional IT capabilities (defined as information sharing and process excellence), which, in turn, affected supply chain capabilities. The improvement in supply chain capabilities facilitated joint production planning, inventory management, and distribution, leading to improved relationships with original equipment manufacturers (OEMs). This suggests that data quality and functional capability have implications for value chain integration. Kajüter and Kulmala (2005) showed how problems with providing accurate cost data reduced the ability to perform open-book accounting with suppliers. However, Fuchs *et al.* (2018) and Kajüter and Kulmala (2005) did not relate these discussions directly to the question of data and information integration.

The research indicates that control of the supply chain and management accounting within the firm is interrelated. The literature in general views the relationship between integration within and between firms as mutually supportive (for an exception, see Thrane and Hald, 2006). No study, to our knowledge, assesses the dynamics over an extended period. Research may therefore be extended by evaluating the effects of the implementation of multiple IT systems and by analyzing unintended consequences.

3. Method

The case study method was used to explore the complex relations between data integration with the firm and with its suppliers and customers while implementing IT systems. The case study approach was inspired by prior management accounting research (Ahrens and Chapman, 2006; Jørgensen and Messner, 2010). For example, Jørgensen and Messner (2010) argued that the main task of the researcher is to inquire into a field of practice and make sense of observations using abductive reasoning by moving back and forth between data and theory, where the primary requirement is close proximity to the field. Participant observation was therefore used to develop focus and to direct the researchers to the relevant data and initially to define the problems and search for theories. However, the observation data were not directly used in the analysis directly nor for triangulation.

Participant observation was initiated because one of the researchers was employed in Air Greenland from 2011–2015 as part of the commercial team, while simultaneously conducting a Ph.D. project. The data collection was conducted in two overlapping periods. The overall data collection period was from 2011–2015, whereas 2012–2014, which we call the fieldwork period, was more active. The 24 months of field work, corresponded with the company's departure from one closed system, Navitaire, at the start of 2013 and the implementation, re-adaptation, and use of a new global distribution system (GDS), Amadeus, in 2013. The researcher's job position during the field work period facilitated unrestricted access to the data. During his employment, the researcher's observations were made across different departments within the organization and its subsidiaries. He worked in multiple locations in Denmark and Greenland and interacted with numerous employees and stakeholders.

Observation were performed in the sales, marketing, network revenue management, IT, and distribution departments. Several informal talks were conducted with executives and directors

regarding their perceptions of the shifts between distribution systems. It was evident that the work practices of the employees and external partners were significantly and negatively impacted by the transition from the SAS-controlled distribution system to their own closed system, Navitaire. These observations and the employees' remarks about the then-upcoming change to Amadeus created interest in the three different information systems and their impact on data and information integration.

The primary empirical basis of the paper was 19 interviews with 15 employees and their external partners. One follow-up interview was conducted online in February 2021 that included three respondents that had been employed in the organization during all three periods. The interviews were transcribed verbatim to facilitate the analysis, data about respondents are presented in table 1:

Work titel and organisation	2012		2013		2014	
	Date	Time	Date	Time	Date	Time
Sales Manager - Air Greenland			13-03-13	43:40		
Chief Commercial Officer - Air Greenland					02-04-14	38:00
Network Revenue Controller - Air Greenland					23-08-14	01:10:15
Chief Commercial Controller - Air Greenland			17-04-13	56:43	01-04-14	59:56
e-Business manager - Air Greenland					07-01-14	01:27:44
Post Nominated Holder Operations - Air Greenland					01-04-14	35:42
IT-Manager - Air Greenland					02-04-14	01:07:06

Network Revenue Controller - Air Greenland			11-03-13	41:08:00		
Group leader, Accounting - Air Greenland					03-04-14	01:32:20
Chief Financial Officer - Air Greenland			02-04-13	01:16:06		
CEO Vejle Rejser - Travel Agent			29-04-13	43:44		
Sales Manager - Albatros Travel			21-03-13	36:33		
Manager, Network accounting - Air Greenland			06-07-13	56:12		
Distribution Manager - Air Greenland			09-04-13	34:25	07-04-14	01:36:00
Network Revenue Manager - Air Greenland	22-06-12	01:05:09	05-03-13	01:00:42		
Follow-up interview with Network Revenue Manager, Chief Commercial Controller, Chief Financial Officer all Air Greenland	23-02-2021	41.58				

Tabel 1 Overview of interviews

Table I depicts firm, job positions of the interviewees, and the interview duration.

A retrospective interview method was used to understand the system that preceded the two systems that were studied during the process. Great care is needed when conducting retrospective interviews because the respondents may rationalize events and be affected by performance information (Cox and Hassard, 2007). To discipline interpretations (Ahrens and Chapman, 2006) of past events, the researchers used the approach of “controlling the past,” proposed by Cox and Hassard (2007), because its focus is to ensure maximum accuracy when recalling historical events (see Appendix 1 for the interview guide).

To reduce bias, several methods can be employed. Two were used in this study. Firstly, there was a focus on simple facts and concrete events so that it would be less likely that the respondents' statements would be affected by bias. Secondly, multiple respondents were interviewed to mitigate bias. The findings, particularly those related to differences in operational control in the first (prior to 2007) and second periods (2007–2013), may have been exaggerated by the respondents' knowledge of inadequate performance in the first period. However, the magnitude of the difference was vast between a virtually non-existent accounting and a system that facilitated budgeting, key performance indicators, and pricing. Therefore, bias was unlikely to impact the overall findings. Conscious attempts to lie and influence the findings might have affected the interpretation, but this applies to all interviews. In addition, our general impression was that the use of different IT systems, including the changeover between systems, was without political controversy because external changes made the changes necessary.

The data were initially coded and analyzed in a relatively inductive manner. During the research, the theme of integration emerged, and consequently, the literature was perused. Transcripts were reviewed systematically and carefully using theoretical constructs (i.e., using an iterative data analysis process) (Ahrens and Chapman, 2006; Alvesson and Kärreman, 2011). Thus, the field's issues and problems "exerted a powerful disciplinary force" (Geertz, 1995 in Ahrens and Chapman, 2006, p.820), and we had to revisit the literature to get a better grasp of the problem and locating relevant theories. One of the researchers conducted and subsequently coded the interviews based on the construction of coding categories that focused on system changes. To ensure the quality of the coding, the second and third authors reviewed the coding and analysis. All three authors participated in the abductive reasoning mentioned above.

The decision to include three periods and three IT systems in the evaluation had both advantages and disadvantages. The protracted study period implied that the data were not as concentrated as they would have been had the analysis been performed over a shorter duration or had the focus been on one implementation process. The potential lack of depth to the data for each period was compensated by the advantages of exploring three separate systems. To the best of our knowledge, this is the first study to trace events across three periods concerning three different IT systems.

4. Case study analysis

4.1 Introduction

Greenland is an autonomous region that is part of Denmark. It is the largest island in the world, covering 836,109 square miles, with a population of 55,984 (Naatsorsueqqissaartarfik, 2015). Greenland's geographical composition and climate play a significant role in the infrastructure required to manage the operations because the number of passengers is small and they are scattered over a large geographical area, making them difficult and expensive to reach.

Air Greenland

In 2018, Air Greenland (Greenland's national airline) had 631 employees and its fleet consisted of 27 aircraft and helicopters, ranging from the large Airbus 330-200 to the smaller AS 350 helicopter.[i] Air Greenland has three shareholders: the Danish State (25%), the Government of Greenland (37,5%), and SAS (37,5%).[ii] Besides the airline, Air Greenland comprises several other companies (i.e., hotels, ferries, travel agencies, and tour operators). The study focuses on two types of data integration over three periods and how the data integration affected information integration within the firm. The different types of integration is illustrated in Figure 1:

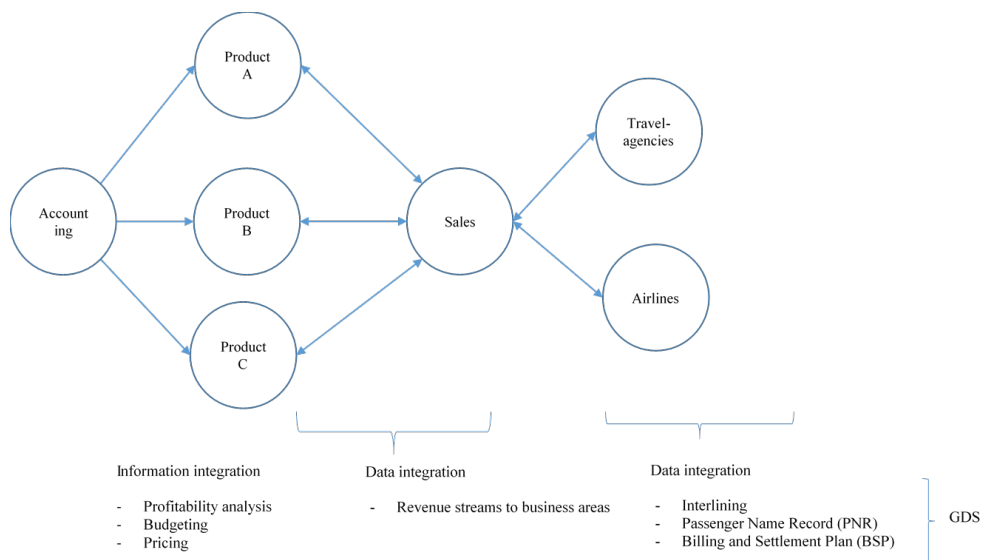


Figure 1. A depiction of data and information integration at Air Greenland

(1) The data integration between Air Greenland and external organizations through GDS, which consists of an interlining agreement, a Passenger Name Record [PNR] and a Billing and Settlement Plan [BSP].ⁱⁱⁱ The integration of data is here a prerequisite for selling travels that include several airlines.

(2) The data integration within Air Greenland. We focus on the separation of the different elements of tickets and allocation to revenue streams, which is done in the billing system. We further analyze the use of the revenue data to management accounting purposes such as profitability analysis, budgeting, pricing.

4.2 Controlled by Scandinavia Airlines System (prior to 2007)

When Air Greenland was established in 1960, SAS was in charge of its reservation and distribution system. From 1987, SAS used Amadeus, a GDS. The setup conferred certain advantages to Air Greenland, but it also created problems concerning its relationship with SAS and use of data for control purposes in Air Greenland.

The integration with SAS's distribution system implied that SAS provided the daily support functions and retained full technical control over all system functions and transactions made using Air Greenland's ticket and PNR numbers. The advantages for Air Greenland were ease of access to the global market through SAS's distribution without being concerned about the technical and practical issues involved in running a GDS.

However, there were according to the distribution manager, certain challenges with having SAS in charge, since Air Greenland had little control over its operations:

'interlining, pricing and all complex assignments of rescheduling was handled by SAS, meaning that we were in a very complex environment, but it was like being in a kindergarten. We had the adults to take care of us, ... the adults would decide what we could do, what we could get access to, and with whom we could play'

SAS controlled the data and managed the reservations and pricing, and Air Greenland had a rather passive role in the daily operations. Changing a price took three weeks, which made it difficult to manage revenues and profits. Air Greenland provided data on available flights and once the tickets were sold, Air Greenland was responsible for moving passengers from A to B.

When the two airlines started to compete on the transatlantic route in 1998, SAS's ability to integrate data from Air Greenland became a problem for Air Greenland. The chief financial officer tells:

'We saw several incidences [sic] where SAS booked cheap classes on our routes through our systems and blocked seats that we then could not sell. They also had the advantage of monitoring our system, which, funnily enough, enabled them to ... match our offers and prices at the last minute'

SAS used their access to Air Greenland's system and blocked the sale of Air Greenland seats. SAS's complete integration of data between Air Greenland and SAS operations was used to coordinate prices and offers. Thus, integration of data enabled SAS to dominate the value chain, similar to Frances and Garnsey's (1996) analysis of UK supermarkets.

4.2.1 First system: Data integration in Air Greenland

There were also problems in terms of using the data from the billing system for management accounting purposes. Even though the distribution system was digital, the billing system was paper-based, and the integration of data was very time-consuming especially when it came to irregularities, which are any incident that resulted in a deviation between the planned and the actual journey. Due to the harsh weather in Greenland, irregularities were a frequent problem in Greenland. According to a controller from revenue accounting, the paper system worked at first sight quite well in handling irregularities as well as rebookings:

'The money followed that paper ticket. It was like sitting with a check in the hand. It was very easy. When you made an invoice, you could only do it when you had a physical ticket. If you had rebookings and IRs [irregularities] ...it was easy to move the physical ticket to another bag. We called them bags.... we could not send an interline bill to another airline company if we did not have a ticket'

Irregularities were easily managed by moving a physical ticket from one "bag" to another but it was very time consuming, which often delayed the delivery of payments. The need to make adjustments owing to irregularities meant that 5–6 people were required to handle the tickets and billing.

The time consuming nature of the billing system meant that revenue data was little used for control in Air Greenland. However, apart from the rather primitive paper system the demand by the company to use the data for control was not very high:

'The lack of management accounting at that time was due to the technological limitations, plus that at that time the company should just break even..(Controller adds) then we received what was missing in the accounts and then the politicians decided how we should fly' (Chief Financial Officer)

The challenges in utilizing revenue data as well as the low interest in control impeded the analysis of the profitability of particular routes. A controller continues:

'It was hard to calculate the ... profitability! In the previous management system, the focus was not on creating control or profit, but more on ensuring successful operations. It was hard to figure out what we earned our money from'

The analysis of the first period illustrates that the integration with the global market via SAS GDS partly inhibited the integration of data between sales and accounting. This logic is illustrated in figure 2.

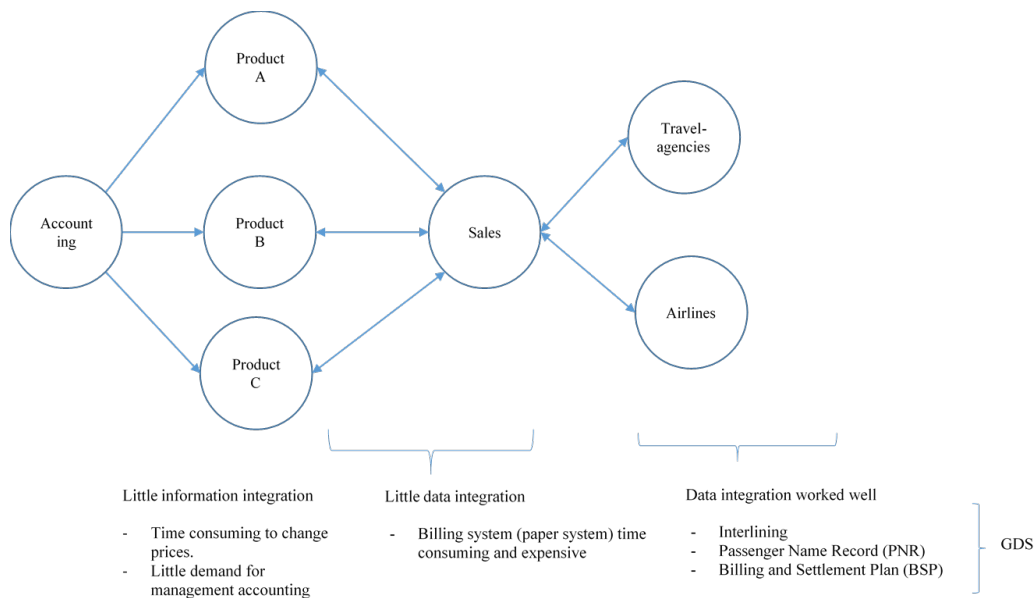


Figure 2. Data and information integration within Air Greenland while under the control of the SAS

The right side of the figure illustrates that SAS was in charge of the data integration with other airlines through interlining arrangements. This made it possible for Air Greenland to sell tickets with other airlines. However, the connection to the global market introduced a trade-off in terms of both data integration and to some extent the ability to conduct management accounting. The middle part of the figure illustrates that the major problem was that the paper based billing system made it time consuming and expensive to trace the revenue streams to specific business areas in Air Greenland. The left side of the figure illustrates problems with information integration – using the revenue data for management accounting – were as such not caused by the presence of different decision-making logics for example between the billing

system and the accounting system, but by the slow process of going through SAS when making changes and the lack of demand for management accounting.

4.3 Second system: Data integration with customers under Navitaire (2007–2013)

The connection to SAS's distribution system and the subsequent lack of control over its own operations became increasingly problematic for Air Greenland in the early 2000s owing to increased competition with SAS and the introduction of digital tickets. Technological developments resulted in demands by the International Air Transport Association (IATA) [iv] that its members utilize digital reservations, bookings, and ticketing to eliminate the use of expensive paper tickets.

The introduction of digital tickets improved cooperation between the airlines. Digital tickets eliminated the need for customers to have paper tickets for travel, thus enabling faster, easier connections between carriers. Customers with digital tickets traveling on a journey with a transfer between two airlines could be checked through to their final destination, thereby eliminating queues and making connections more reliable. In addition, digital tickets simplified rebooking a flight from one airline to another airline; there was no need to obtain a paper ticket first and then have it endorsed by a sales agent. In addition, digital tickets could not be lost or stolen.

Although the transformation to digital tickets made it easier to cooperate with the rest of the travel industry, the use of digital tickets also increased the cost of data integration with competitors and suppliers because the costs of interlining agreements increased. The distribution manager explained this as follows:

'Back in the time of paper tickets, the cost of the interlining agreement was the paper that the agreement was written on. When we went into ... ticketless digital systems, an interlining agreement would cost up to half a million dollars as every interlining agreement ensured that the information systems of each airline could communicate and process data from others airlines within the interline agreement'

Interlining agreements were expensive as they demanded data integration between airlines through the GDS. Furthermore, Air Greenland was not large enough to capture the interest of major GDS suppliers (e.g., Amadeus, Travelport, and Sabre).

Since Air Greenland was unable to gain access to an open GDS, they implemented Navitaire's closed less complex "New Skies" reservation system in October 2007. Navitaire's primary customers were low-cost carriers (e.g., Ryanair) that flew point to point and only distributed tickets through the internet from their webpages. The integration with the rest of the airline industry however was difficult. The distribution manager pointed out that:

'If it was just the matter of ... two airlines that should speak together, then it would not be such a challenge, but when it was 350 airlines, things became much more complicated and devastating for Air Greenland'

Throughout 2006, airlines terminated agreements that were not beneficial to them. This was explained by the manager of the commercial department as follows:

'Many airlines had around 200 interlining agreements, and I think that we had around 50 agreements with different airlines while being ... incorporated in the SAS system. There were none of these agreements, that generated a profit of half a million dollars, so we were effectively excluded'

The process had dire consequences for Air Greenland. At this point, Air Greenland had around 50 interlining agreements, established through the SAS system, and all of them were terminated when the organization was no longer linked to SAS's open system. As a result, Air Greenland could not make sales through interlining or by connecting airline tickets with other airlines.

Navitaire was also problematic for the travel agencies. The CEO from a travel agency argues:

'We eventually figured it out and paid a lot of money and used a substantial amount of time to configure our IT-system to apply Air Greenland's closed system standards and system specification. Moreover, we employed two extra people just to handle this new setup dealing with the Air Greenland distribution system'

Data integration was not easy to establish.

Only a few of the travel agencies were able (or wanted) to make the expensive data integration transition into Air Greenland's Navitaire system. Most travel agencies elected to terminate their business relationship with Air Greenland, except for three out of 12. The distribution manager recalled: "We basically killed the leisure market in Greenland."

4.3.1 Second system: Data and information integration under Navitaire (2007–2013)

The "closed" nature of Navitaire provided Air Greenland with several data integration advantages. In the closed system with no connecting flights, there was no BSP as there was no price of the tickets to split with other airlines. Billing was built around a "book and pay" system, with no time difference between ordering and payment; therefore, revenue streams were much easier to handle under Navitaire than they had been under SAS. According to the commercial controller:

'Navitaire was inexpensive and not nearly as complex as SAS' Amadeus system or any other GDS. I think we saved around \$2.5 million yearly and substantially improved our cash flows... as we had the payment as soon as the ticket was sold'

The billing system reduced many of the problems and errors that made it difficult to use the revenue streams for management accounting in the former system. For example, irregularities, were much easier to handle in Navitaire, according to the chief financial officer:

'When we implemented Navitaire...it did not mean so much [if there was an error] because all the money that was in the system was ours, we should not settle with others. With the situation we have up here with a lot of irregularities and bad weather and rebooking, and then the system told us that if a ticket sold to e.g. 2. April and it was not income recognized the 4. You could balance everything, it was a new world to enter because earlier it was much more difficult' (Chief Financial Officer).

Balancing accounts became much easier in Navitaire.

Air Greenland's chief accountant further explained how the book and pay component of the system improved data integration and thereby the possibility to conduct management accounting:

'[there were] not that many challenges with the new system. We had a documented process that worked fairly well. ... Transactions in Navitaire were subject to finance mapping, and ... every time someone work[ed] in Navitaire, whether in-house or externally, it resulted in ... [a] financial transaction that we could monitor and process. This has made it much easier for us to settle, report... make budgets, setup KPIs'

Data integration facilitated management accounting activities, such as budgeting, performance management, and reporting. The commercial controller adds:

'It was quite nice going from SAS to Navitaire. For the first time, it was us who controlled the complete commercial operation. If we had to change a price in the system, we could do it in five minutes. When we were in the SAS system, it could take up to three weeks. ... we could make changes to our flight schedule without contacting SAS... With the Navitaire system, we only had to operate with a PNR number.[v] Therefore, we could handle all transactions internally. Under Navitaire, we worked under a few integrated internal systems'

Air Greenland's control of data through Navitaire made it possible to adjust management accounting to specific needs:

'Our data was in one place where it was easily available, we could develop our own reports with help from IT, it was not difficult....Now we had a self-developed system that could get us exactly what we wanted' (Network Revenue Controller)

In Navitaire data were stored in one place and Air Greenland was in control of the data. In the former system it for example was time consuming to change prices, in Navitaire they could do it quickly and get the reports they wanted. The improvement of data integration thus also furthered the integration of information.

This analysis illustrates that several contingencies made it necessary for Air Greenland to implement Navitaire. This illustrated in figure 3

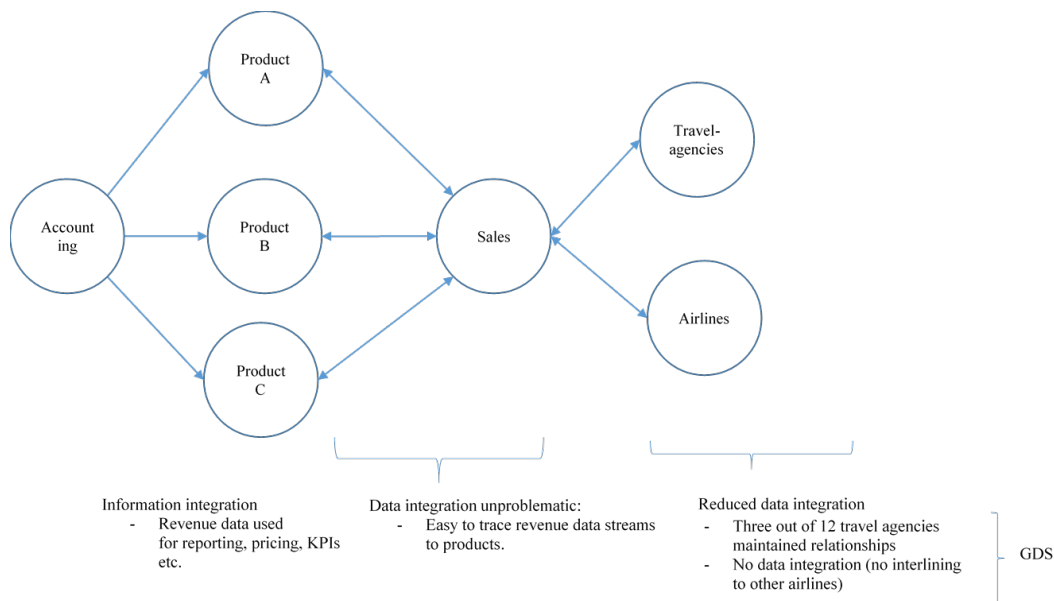


Figure 3. Data and information integration under Navitaire

Figure 3 illustrates that the implementation of Navitaire led to data integration challenges with customers and competitors and Air Greenland was disintegrated (lack of arrow and dotted arrow in figure 3) from large parts of the travel industry and only three of 12 travel agents continued to do business with Air Greenland. The system, however, fostered data integration within Air Greenland compared to the former system because Air Greenland did not have to settle payments with other airlines through the BSP. In the new system sales and payments occurred simultaneously, which is illustrated in the middle of figure 3. In addition, the closed system, with its simple setup, made it easier to resolve irregularities. In general, data integration was seamless as everything was available in one system, and it was much easier and cheaper to conduct management accounting. Information integration, was not a problem under Navitaire, and the use of management accounting developed in the period, which is illustrated in the left side of figure 3.

4.4 Third system: Integration in to the global market under Amadeus (2013 to the present day)

The entrance of new customers forced Air Greenland to connect to the rest of the industry to stay competitive. While some longstanding customers could be managed using the closed Navitaire system, the general opinion was that new customers e.g. from the oil and mining industries would demand access to an open GDS that offered the opportunity to sell tickets with connecting flights. The Chief Financial Officer explains:

'If we look at it from a management accounting perspective Navitaire is by far the easiest to work with, but from a commercial angle it is limited. If you ask our travel agencies they will say that Navitaire was terrible'

Navitaire improved management accounting, but it did not foster integration into the market.

In 2012, Air Greenland signed an agreement with Amadeus IT Group S.A. that enabled access to its GDS system, and allowed Air Greenland to connect to the rest of the travel industry, and all the travel agencies started to deal with Air Greenland again. Furthermore, since the interlining agreements were somewhat cheaper with Amadeus, Air Greenland was once again able to issue tickets with connecting flights. This improved its relations with the rest of the travel industry.

4.4.1 Third system: Data and information integration under Amadeus (2013 to the present day)

The integration in to global markets generated data integration issues, especially billing was a challenging task, because the selling of connected airline tickets lead to a proliferation of products, and an increase of rules and conventions in relation to billing:

'It was complex to go into Amadeus; we were now back to both ticket numbers and reservation numbers, which are two unique system numbers on two independent servers, meaning that ... if you change something in one place, you have to change it in several other places too' (Network accounting manager)

Contrary to Navitaire, Amadeus operated both with ticket (PNR) and reservations number^{vi}, which complicated the billing process.

The data integration problems from having several parallel systems was exacerbated because the selling of air tickets had experienced an increase in number of services:

'It is getting worse and worse. Today we are not only selling tickets, we sell all kinds of additional services, which are on some extra documents. Today it is not only the ticket that needs to follow the PNR, it is also the documents where there is payment for seats, overweight and this and that.' (Chief Commercial Controller)

Due to all these additional services, which included much more flexible tickets, data integration between the airlines became much more demanding. A network manager adds:

'There is rules and conventions for who is going to get the money when. You get a process, where you have your orders that are sold in PNR, and then you have to control, whether it is the right money on the ticket and when there is irregularities and the customers moves then we have to make sure that the money moves along, and then everything has to be settled, so we can see how the revenue is allocated' (Network Revenue Manager)

Air Greenland was now subject to a lot of new rules and regulations regarding billing.

Additional data integration problems surfaced since Air Greenland had to use the MonaLisa-system to handle billing and integrate it with Amadeus' BSP. The head of the revenue accounting department explained the challenges with this new setup:

'I work in MonaLisa, and it is a completely different system from Amadeus. It's an invoicing and settlement system. It has been quite a task starting this system up, and as long as we do not get the correct data, then it will always be a big challenge—put garbage in, and you get garbage out!'

Working with two systems made data integration a challenging task.

According to a revenue accounting controller irregularities were particularly challenging:

'The way we handle irregularities is a major limitation in MonaLisa. Amadeus would be able to handle it, but because we cannot handle it differently in MonaLisa, then it is MonaLisa that dictates how irregularities should be handled in Amadeus. ... All travel agencies can sell everything they want. It is fully open, and it is really irritating to sit in a settlement department and check all the manual errors, and there are so many errors on our tickets'

Data integration between Amadeus and MonaLisa was challenging, and the operational errors that occurred had a significant effect on the ability of the revenue accounting department to settle revenue accounts when adaptations had to be made owing to irregularities.

‘We have some problems getting the revenue streams rights and then the profitability analysis becomes wrong. But it is not a total joke.’ (Chief Commercial Controller)

That ‘getting the revenue streams right’ was not ‘a total joke’ was due to a large effort in terms of handling the errors:

‘Today we have a department, we have a department in Estonia where people check whether the tickets we have sold is aligned with the prices and conditions we have, and when we lift the passengers and thereby recognize them as revenue, they check that the passenger lists are consistent with the ticket set aside as a debt. So where we had nobody doing the billing part (under Navitaire ed.), we now have 5-10 persons doing that job’ (Chief Financial Officer)

As is illustrated in figure 4 the implementation of the GDS Amadeus connected Air Greenland to global market introduced a trade-off. The external data integration increased the cost of data integration with a department in Estonia because of the introduction of reservation numbers, a proliferation of services and the introduction of MonaLisa.

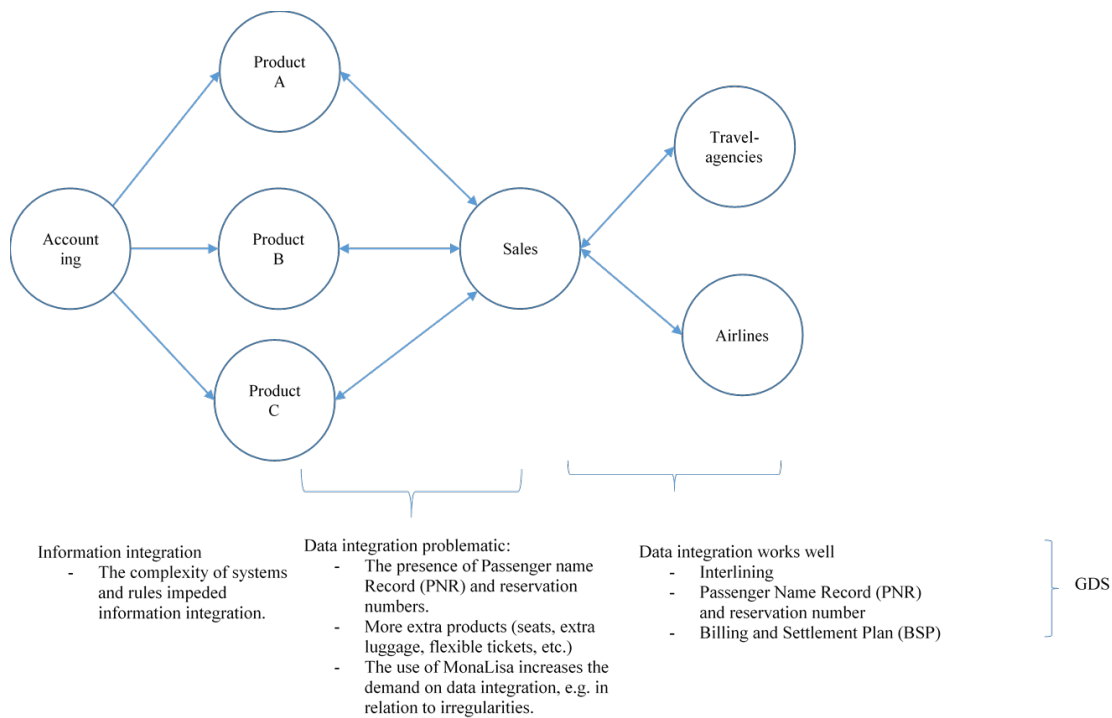


Figure 4 Data and information integration under Amadeus

All of these conditions made it difficult and expensive to trace revenue streams to business areas. This impeded information integration, such as profitability analysis. This is illustrated in figure 4.

5. Discussion

The present case study demonstrated a trade-off between global integration and integration within Air Greenland primarily owing to data integration challenges. An overview of the integration challenges within three different periods using three different systems is depicted in Table II.

Areas that faced integration challenges	Period 1 (hosted by SAS)	Period 2 (Navitaire)	Period 3 (Amadeus)
Integration in the global market	Air Greenland was connected to the global market through SAS: <ul style="list-style-type: none"> - Interlining arrangements 	There was a lack of data integration with other airlines because there were no interlining agreements.	Air Greenland connected to the global market through Amadeus: <ul style="list-style-type: none"> - Interlining arrangements

	<ul style="list-style-type: none"> - Passenger Name Record (PNR) - Billing and settlement <p>SAS integrated information from Air Greenland and dominated Air Greenland.</p> <p>Interlining costs were low.</p>	<p>Only a few travel agencies were data integrated with Air Greenland via Navitaire.</p>	<ul style="list-style-type: none"> - Passenger Name Record (PNR) - Billing and settlement <p>Interlining was affordable and possible.</p>
Internal integration	<ul style="list-style-type: none"> - The paper-based billing system to trace revenue data to business areas (data integration). - Time consuming to change prices (information integration) - Little demand for management accounting 	<ul style="list-style-type: none"> - Revenue streams easy to trace to business areas (data integration). - Revenue data used for profitability analysis prices etc. (information integration) 	<ul style="list-style-type: none"> - The tracing of revenue data to business areas to business areas are difficult due to: <ul style="list-style-type: none"> - The presence of PNR and reservation numbers. - More products (seats, luggage, etc.). - Several systems (e.g. MonaLisa)

Table II: An overview of the data and information integration challenges in three different periods

The findings summarized in the table support the argument that data and information integration can be difficult to achieve when implementing IT systems (Davenport *et al.*, 2004; Rom and Rohde, 2007). In each period, different issues surfaced. In the first period, the manual system precluded the use of sales data for management accounting. In the second period, data were highly integrated, but this occurred at the expense of data integration and collaboration with suppliers and customers. In the third period, the implementation of Amadeus implied that relationships with many of the travel agencies were reinitiated. The complexity of the system,

however, impeded data integration, successively making it difficult to control price setting and complete budgetary control.

These integration issues were to a minor extent caused by differences in decision-making logics between departments (Davenport, 1998; Dechow and Mouritsen, 2005; Scapens and Jazayeri, 2003). Our research does not indicate that information integration challenges due to different decision-making logics is unimportant. We just find that when firms experience challenges with data integration, information integration may be impeded, irrespective of the extent to which the firm experience competing decision-making logics.

Capabilities and informal processes offer competing explanations. Drum *et al.* (2017) find that workarounds impede completeness and accuracy of accounting information. We extend this research through illustrating how features of systems – rather than unintended use – induced issues of data and information integration. The findings of the paper may also be challenged from a capability perspective (Fuchs *et al.*, 2018). While the IT capabilities of Air Greenland surely affected outcomes in so far as Air Greenland is a small national airline and does not have the IT capabilities of larger airlines. However, the findings cannot solely be explained by IT capabilities. In the first period, when paper-based ticketing was used, IT capabilities did not influence information integration within the firm as the processes were manual. In the second period, integration challenges were associated with the inability of suppliers to connect to the system and other airlines' unwillingness to invest in integration in the GDS. In the last period, IT capabilities to a large extent may explain the findings. The last system was evaluated over a short period (i.e., a year), and Air Greenland was in the early phase of its learning curve, which may explain the findings. Future research could further evaluate the extent to which IT capabilities affect integration of accounting data and information.

Internal and supply chain integration entails a trade-off. In each period advances in internal data integration came at the expense of disintegration in the supply chain or vice-versa. This finding adds to the debate of whether IT and control systems oriented towards suppliers and customers or internally reinforce or undermine each other (Anderson and Lanen, 2002; Arunachalam, 2004; Cuganesan and Lee, 2006; Fuchs *et al.*, 2018; Kajüter and Kulmala, 2005) through illustrating that in relation to data and information integration they undermine each other. It supports the finding that unintended effects may result in between internally and externally oriented systems (Thrane and Hald, 2006). It adds to this debate by focusing on data and information integration.

5.1 Limitations

In general, extant research covers the implementation of one system in reference to a previous system. This paper's evaluation of multiple system implementations revealed the material effects of different systems, including the interactions of specific elements within the reservation and distribution systems and data and information integration. As a consequence of analyzing three systems, less detailed microdata was available for each period. The choice of "zooming-out" of discrete interactions around the IT system allowed us to see the changes. Had we scrutinized the micro-interactions around the implementation of one IT system, it is likely that we would have generated a more detailed analysis of the integration problems in that specific period and a more detailed association between data integration issues and the impact on management accounting and relations with suppliers and customers. The use of retrospective interviews was a related problem. A longitudinal study spanning the entire period would have been optimal, but it was impractical.

The findings of the paper must be interpreted considering other limitations. Firstly, the data were collected from one focal organization and its subsidiaries in a relatively specialized

context. Although this allowed us to focus on organizational variables (e.g., systems, integration, and networks), it limits the generalizability of the findings. Secondly, we focused on the role of different airline distribution systems and the complexity of these “types” of systems. This may not apply to other systems (Hyvönen, 2007). Thirdly, we only had data on Amadeus for 12 months after the implementation of the new GDS. Prior research suggests that there is a time lag before organizations fully implement new systems (Dechow *et al.*, 2006; Granlund and Malmi, 2002).

6. Conclusion

The implementation of new, more advanced IT systems generates unintended consequences for integration. IT systems do not solve issues of data and information integration nor do they necessarily increase integration with customers, suppliers, and competitors. In this context, integration involved a trade-off between internal and external integration. Therefore, IT systems do not only facilitate increased control, transparency, and integration but also lead to disintegration and thereby reduce control or hamper the ability to collaborate in wider networks of suppliers, customers, and competitors.

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Appendix 1 Question guide

The question developed over the course of the data collection process. Below is the updated question guide, that was followed up by probing questions and was used in relation to all three systems:

1. How were data integrated?
 - Which systems were used.
 - How is data about customers integrated with other systems?
2. How did you perform management accounting?
 - Probing on specific control elements such as budgeting and profitability analysis.
 - How were data for management accounting retrieved?

[i] www.airgreenland.com/media/1536571/ag_enga-ersberetning17_ny060518.pdf

[ii] Scandinavian Airlines System is the national airline for Denmark, Norway, and Sweden. Until 2002, it competed closely with Air Greenland on the transatlantic route, and it was one of Air Greenland's shareholders.

ⁱⁱⁱ A passenger name record (PNR number, or ticket number, is a standardized piece of data that is a central part of the practical implementation of the interlining agreement. In the airline and travel industries, a PNR is a record in the database of a reservation system that contains the itinerary for a passenger. It was introduced by airlines needing to exchange reservation data in instances when passengers needed to access flights offered by multiple airlines to reach their destination.

A billing and settlement plan (BSP) is an electronic billing system designed to facilitate the flow of data and funds between travel agencies and airlines. BSP supplies a revenue stream to airlines, and integration with the airlines' accounting systems is therefore central. In addition, airlines have to be able to make changes and inform other airline systems that the passenger has been "lifted," so that whoever transported the passenger (i.e., the operating airline) can bill the airline that issued the ticket (i.e., the ticketing airline or travel agency) and obtain the financial share owed from the passenger who was lifted through the BSP.

[iv] IATA is the trade association for airlines globally. It represents approximately 240 airlines and accounts for 84% of total air traffic.

[v] The closed distribution system only operated on PNR numbers and excluded ticket numbers that were used in GDS systems.

^{vi} A reservation number may contain several people, but each person needs their own ticket number.