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# Evolution of ICT in Airline Distribution – Perspectives on Co-creation with IATA NDC and One Order



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**Summary:** The IATA distribution standard NDC and the fulfilment standard One Order could help airlines to facilitate co-creation in the airline industry. This paper sheds light on the pitfalls and hurdles that accompany this process making it an interesting learning case of technology disruption and technology adaption for all industries. Even though an open API structure is urgently needed to realize distributed and decentralized co-creation, a main challenge remains the need to organize the cutover from older systems to the next generation.



**Keywords:** Airline Distribution, IATA, NDC, One Order, Co-Creation, ICT, Tourism

**Entwicklung von Informations- und Kommunikationstechnologien in der Airline Distribution – Perspektiven auf Co-Creation mit IATA NDC und One Order**

**Zusammenfassung des Beitrags:** Der IATA-Distributionstandard NDC und der damit verbundene IATA-Fulfilment-Standard One Order eröffnen neue Möglichkeiten im Bereich der Co-Creation von Dienstleistungen innerhalb der Airlinebranche. Dieser Beitrag beleuchtet die Herausforderungen und Schwierigkeiten im Rahmen der Praxisimplementierung und liefert interessante Einblicke in ein konkretes Lernbeispiel für die Einführung einer disruptiven Technologie auch über die Airlinebranche hinaus. Um zu einer offenen, dezentralisierten API-Struktur zu gelangen, die dringend gebraucht wird, verbleibt als Kernherausforderung die Parallelität im Betrieb von althergebrachten Systemen.

**Stichwörter:** Airline Distribution, IATA, NDC, One Order, Co-Creation, IKT, Tourismus

## 1. Introduction

Because tourism is an industry that sells experiences, co-creation is key in this industry (Buhalis/O'Connor 2005; Kim 2010). In order to achieve a well-managed value co-creation process in the tourism industry, co-creation and sharing processes need to be accompanied by an appropriate application of Information and Communication Technology (ICT).

Information and Communication Technologies have been a major backbone of the airline industry ever since the introduction of the first Airline Reservation System (ARS) in the 1960s by American Airlines and IBM (Bingemer 2018; Buhalis 2004). Computerized

Reservation Systems (CRS) and Global Distribution Systems (GDS) have evolved out of the initial ARS. Different participants in the travel supply chain, such as Airlines, Hotels, Rental Car Companies, Tour Operators and Travel Agencies, nowadays use CRS and GDS to connect sellers with buyers.

For tourism, first ARS, then CRS and GDS did represent sort of an industry-specific extranet long before the internet itself became powerful enough to serve as a commercial platform. Therefore, the GDS was the unrivaled single point of truth in bringing tourism demand and offers together for a long period of time.

With Airline Reservation Systems being the cradle of the GDS, it is no surprise that the GDS's performance is structured around schedule, price and availability. Despite their importance to airlines (O'Connell/Warnock-Smith 2013), ancillary services against a fee were only added later to the process. This addition happened in a complicated fashion by adding extra documents (i.e. eMCOs and EMDs). The GDS architecture was created as a stable and reliable replacement for the former paper ticket process. As the system intended to resolve a seller's process problem, it was inherently not designed to match the modern understanding of value co-creation that is designed around the customer perspective. Moreover, this "struggle-by-design" persists until today.

The first disruption hit the airline and distribution ICT with the emergence of the internet. A decade after the birth of the public internet in 1990, the internet has evolved into a new sales channel for different products and services, including air traffic (Bingemer 2018). With the emergence of the internet, GDS finally lost its role as a single point of truth. Airlines built their own websites in order to market and sell directly to their customers. Moreover, the advent of Low-Cost Carriers in Europe and worldwide was supported by the fact that the internet enabled them to sell tickets without using the expensive GDS infrastructures (Diaconu 2012).

The latest evolvement in airline distribution is the emergence of the airline distribution standard IATA NDC (New Distribution Capabilities) and the related fulfillment standard IATA One Order. In conjunction with the concept of API technology (Application Programming Interfaces), airlines could theoretically build innovative new ways to co-create experiences along and across the tourism value chain for their customers (Bingemer 2018).

Initially, the IATA NDC standard suffered from technical imperfections. Though these hurdles have been resolved in the meantime, airlines still struggle to rethink airline distribution from a co-creation perspective. One important reason is that airlines still think in GDS-dominated process structures that were not built for co-creation purposes.

This paper analyzes how the distribution standard IATA NDC together with the fulfillment standard IATA One Order could help airlines to facilitate co-creation in the airline industry and sheds light on the pitfalls and hurdles that accompany this process, making it an interesting learning case on technology disruption for all industries.

## 2. Method

The research method adopted in this study is developed from a bibliographic search based on ScienceDirect and Google Scholar databases, using the terms "NDC", "New Distribution Capability", "airline", "distribution", "One Order" as well as "co-creation". As the search progressed, additional terms and semantically related expressions (i.e. "personalization", "merchandising") were found, considered, and integrated into the analysis.

The literature review was limited to research journal articles from the past 20 years and has been conducted in order to answer the research questions documented below. When searching for literature that simultaneously addresses the co-creation and airline contexts, only two journal articles could be retrieved (Chen/Wang 2016; Novani/Kijima 2012). In order to find additional relevant studies, we extended the search scope to all journals using the terms “NDC”, “New Distribution Capability”, “airline”, “distribution” and “One Order” but without simultaneously searching for “co-creation”. To cover pre-NDC debates on distribution, we included articles from the ATRS proceedings with a specific focus on airline distribution. Each result was evaluated manually to ensure that relevant insights for co-creation could be extracted.

Our aim is to answer the following research questions:

- *What progress has been made concerning co-creation in airline distribution and what fields remain understudied?*
- *Where are the gaps concerning co-creation in airline distribution most pressing?*
- *How should managerial practice proceed in the future given our findings?*

### 3. Literature Review

There is an abundance of literature connecting co-creation to tourism (Binkhorst/Den Dekker 2009; Buonincontri *et al.* 2017; Buonincontri/Micera 2016; Cabiddu/Lui/Piccoli 2013; Camilleri/Neuhofer 2017; Campos *et al.* 2016; Campos *et al.* 2018; Chatthoth *et al.* 2013; Chatthoth *et al.* 2016; Grisemann/Stokburger-Sauer 2012; Lin/Chen/Filieri 2017; Lugosi 2014; Mathis *et al.* 2016; Prebensen/Foss 2011; Prebensen/Vittersø/Dahl 2013; Prebensen/Xie 2017; Rihova *et al.* 2015; Sfandla/Björk 2013; Sørensen/Jensen 2015; Sugathan/Ranjan 2019). However, most of this literature focuses on co-creation in organizations or destinations and on co-creation from a tourist perspective. For this analysis, we follow the understanding of co-creation as a cooperation on the development or execution of a touristic product, which nowadays is enhanced by information and communication technology (Buhalis/Sinarta 2019). In this respect, co-creation means an enhancement of selective consumption approaches with purely pricing-driven customization of a product like a la carte pricing (Robbert/Roth 2018). For a deeper insight on co-creation and tourism in general, we recommend the literature review by Campos *et al.* (2018).

Moreover, there is ample literature that analyses value co-creation and service dominant logic independent of an industry context (Füller/Hutter/Faullant 2011; Gummesson *et al.* 2014; Lusch/Vargo 2016; Ranjan/Read 2016; Vargo/Lusch 2004; 2008; Vargo/Maglio/Akaka 2008; Yi/Gong 2013). Similar to co-creation literature in tourism, this stream of literature is out of focus for this study given our airline distribution-focussed research questions.

Based on our literature search on airline distribution-related research articles, we identified 12 articles from research journals of the past 20 years dealing with the topic of distribution and/or NDC that contained, or at least allowed us to extract, valuable insights on co-creation in an airline context. Interestingly, we could not identify one single research journal article that deeply analyses the topic of the IATA One Order standard in a prominent way even though it is closely related to IATA's NDC standard.

Table 1 provides an overview of the results of our search for literature. For each article named in the table, we provide a column with the link to co-creation that we

see. Articles that perform an integrative analysis of NDC or its aspects but that do not highlight a specific co-creation aspect are not selected for presentation in table 1 (e.g., *Dembrower/Grenblad 2001; Ziegler/Troester/Sazali 2017*).

As 10 out of 12 articles do not address the topic of co-creation directly, in the column “Transfer of content to a co-creation context” we interpreted the article content and extracted relevant insights for a co-creation context in the domain of airline distribution. The last column combines the perspective (airline/customer) with a categorization of the content.

### 3.1. Personalized Dynamic Pricing

Many of the identified articles stem from the field of revenue management and pricing, especially dynamic pricing. It is worthwhile to mention that dynamic pricing (DP) is not equal to personalized pricing (PP) or the combination of both, personalized dynamic pricing (PDP). “In general, DP is a method whereby the available price changes dynamically over time due to changes in demand, capacity, availability or competitive reactions” (*Krämer/Friesen/Shelton 2018*, p. 293). However, the current state of DP does not reflect price elasticity of each individual customer and thus cannot be called PDP.

PDP is important in a value co-creation context as, for the customer to be engaged in the creation process of an offer, it is necessary to 1) be able to select and unselect offer components and 2) get an individual price as a result of a personalized offer. From the sources under analysis, we conclude that even though dynamic pricing is applied in different variations in the airline industry, there are specific challenges connected to personalized pricing, especially the difficult estimation of customer demand elasticity for an individualized offer (*Krämer/Friesen/Shelton 2018*).

*Bala (2014)* emphasizes the fact that personalized pricing is fully dependent on modern distribution interfaces that allow the collection of the needed customer data for estimation purposes. *Fiig/Le Guen/Gauchet (2018)* extend this view and argue that an integrated revenue management and distribution offer management system (OMS) is needed in order to leverage the full potential of personalized dynamic pricing. *Wittman/Belobaba (2018)* propose a model for customized dynamic pricing, a first step in the direction of personalized dynamic pricing. Based on a set of customer characteristics, the airline can dynamically increment or discount the ordinary calculated price. *Krämer/Friesen/Shelton (2018)* point out that personalized prices are dependent on consumer acceptance, thus being key for implementation purposes.

Authors (Year)	Link to co-creation	Transfer of content to a co-creation context	Perspective – Category
<i>Bala (2014)</i>	Personalized pricing approaches are dependent on modern distribution technology.	<ul style="list-style-type: none"> <li>Revenue Management is heavily dependent on (customer) data provided by distribution technologies.</li> <li>If NDC helps to rapidly transform distribution, that would enable co-creation support in revenue management systems.</li> </ul>	Airline – Personalized Dynamic Pricing
<i>Bildea/Gorin (2018)</i>	Enabling customer-orientated offers, i.e. implementing cross-selling techniques from other industries using the NDC standard	<ul style="list-style-type: none"> <li>Cross-selling techniques could allow airlines to provide more relevant offerings to their customers.</li> <li>New potentials for live value co-creation: Offer optimization that allows not only to display bundles to the customers but also prescriptively assign a price to it in real time.</li> </ul>	Airline – Personalized Offer Creation
<i>Bingemer (2018)</i>	External NDC API linking customer's IoT world with airline merchandising.	<ul style="list-style-type: none"> <li>Co-creation could happen in the future via the customer's own IoT world connected via external APIs.</li> <li>Role of AI algorithms to enable personalized search as a prerequisite for co-creation in the airline offering process.</li> </ul>	Airline – Personalized Offer Creation
<i>Carrier/Figg (2018)</i>	Gaining more insights into individual customer behavior	<ul style="list-style-type: none"> <li>Individual customer behavior as a prerequisite for successful customer co-creation.</li> <li>To unlock customer benefits, the airline industry must remain focused on transforming its legacy distribution systems towards NDC-type distribution.</li> </ul>	Customer – Co-Creation perspectives
<i>Chen/Wang (2016)</i>	Customer participation has a positive effect on value creation that leads to system satisfaction, customer satisfaction and customer loyalty.	<ul style="list-style-type: none"> <li>Co-creation has an indirect positive effect on customer satisfaction and customer loyalty.</li> <li>Co-creation increases enjoyment value, economic value and relational value at once.</li> <li>Managers must take care of the design of the co-creation environment to leverage the co-creation advantage.</li> </ul>	Customer – Co-Creation perspectives
<i>Cheng (2010)</i>	Analysis of airline-owned distribution portal Orbitz	<ul style="list-style-type: none"> <li>Market-based forms of economic activity will inevitably replace hierarchical forms.</li> <li>For co-creation that means an advantage of a flexible offer management system.</li> </ul>	Airline – Distribution Concepts
<i>Figg/Le Guen/Gauchet (2018)</i>	Integration of customer needs into Dynamic Pricing in the context of IATA NDC	<ul style="list-style-type: none"> <li>Co-creation needs to be enabled by an Integrated OMS (Offer Management System) that integrates the customer demand and uses ML and AI to overcome the challenges to pricing.</li> </ul>	Airline – Personalized Dynamic Pricing

Authors (Year)	Link to co-creation	Transfer of content to a co-creation context	Perspective – Category
<i>Fürstenau/Cleophas/Kleiner (2019)</i>	Market standards such as the GDS have the potential to inhibit new digital capabilities that could help to foster co-creation	<ul style="list-style-type: none"> <li>Full use of the NDC capabilities needs a flexible Offer Management System to be in place.</li> <li>Dynamic pricing and GDS standards oppose each other. However, most of the time one falls back on the GDS standard as this is known to all airliners.</li> </ul>	Airline – Distribution Concepts
<i>Krämer/Friesen/Shelton (2018)</i>	Personalized Dynamic Pricing (PDP)	<ul style="list-style-type: none"> <li>Personalized Dynamic Pricing could play a major role in customer co-creation when an efficient price estimation mechanism is needed.</li> <li>Technological advances in data mining and the ability to detect customer preferences will be crucial, including the ability to accurately determine customer's willingness-to-pay by predictive analytics.</li> <li>The use of personal customer data by airlines needs to be implemented, e.g. via IATA NDC.</li> <li>Consumer acceptance of the availability of personal data to airlines is key.</li> </ul>	Airline – Personalized Dynamic Pricing
<i>Novani/Kijima (2012)</i>	Customer-to-customer communication in a value co-creation setup	<ul style="list-style-type: none"> <li>Analysis of value co-creation in a customer-to-customer communication setting for the selection of Airline Service Selection.</li> <li>No focus on distribution.</li> </ul>	Customer – Co-Creation perspectives
<i>Westermann (2013)</i>	Personalized offer creation	<ul style="list-style-type: none"> <li>The way airlines can present their products and services to the customer as part of the shopping process is determined by the capabilities of the distribution systems.</li> </ul>	Airline – Personalized Offer Creation
<i>Wittman/Belobaba (2018)</i>	Inclusion of customer characteristics in customized dynamic pricing	<ul style="list-style-type: none"> <li>Proposition of a heuristic method for customized dynamic pricing of airfares when the observable state of nature includes an observation of passenger characteristics.</li> <li>The customized offer generation problem is decoupled from the well-studied airline revenue management problem.</li> <li>Based on the model, the airline can choose to customize the passenger's offer by dynamically incrementing or discounting the prices that would ordinarily be offered.</li> </ul>	Airline – Personalized Dynamic Pricing

Table 1: Literature on airline distribution with relevant implications for value co-creation.

### 3.2. Personalized Offer Creation

Three authors discuss different aspects of an offer creation system. Such a system is the prerequisite to enabling customer co-creation processes via an Application Programming Interface (API). A well-known system in the market that realizes an offer creation system is the Farelogix Airline Commerce Gateway. *Bildea/Gorin* (2018) suggest modifying cross-selling algorithms from other industries to match airline distribution. They claim that the number of decision points is small in an airline retailing context. Although the argument is understandable, the authors neglect the fact that the available number of ancillary elements is strictly limited by the GDS distribution design. Using an NDC API would allow the sale of almost any item available in an online shop. Of course, this does not indicate that there is a vital business case for such a scenario. *Westermann* (2013) underlines that the way airlines are able to create, sell and price products will be determined by the distribution systems. It is worthwhile to mention that the underlying article dates from the year 2013, only one year after IATA established the NDC standard. *Bingemer* (2018) provides a paper on the critical turning points in the history of airline distribution. In its outlook, the paper underlines the relevance of personalized search and of connectivity to the customer's Internet of Things (IoT) world.

### 3.3. Distribution Concepts

Two of the identified sources have taken a more general approach and have analyzed specific distribution concepts. *Cheng* (2010) analyzed the US legacy carrier's distribution approach via Orbitz and analyzed the effectiveness of the measure. This case demonstrates that the attempt to organize distribution hierarchically was not sustainable as compared to a market-based approach. This is an important indication for balancing an open distribution standard based on external APIs with a hierarchical GDS design. This relation between NDC and the GDS infrastructure is the subject of the study of *Fürstenau/Clephas/Kliewer* (2019). One important argument is that innovative thinking often finds its limits in the discussion with airliners. Those often fall back to the GDS standard as the common denominator, given it shaped their knowledge. This orientation to the GDS standard is a major challenge for a wide application of the new NDC standard, as the airline industry's culture would need to change.

### 3.4. Co-Creation Perspectives

Different to the previous categories, articles in this category take a customer perspective instead of an airline perspective. In their editorial, for a Special Issue of the Journal of Revenue and Pricing Management, *Carrier/Füig* (2018) underline that more insights on individual customer behavior are needed, in order to fully explore the capabilities of airline revenue management processes. They argue that in order to unlock the customer benefits, the legacy distribution needs to be iterated towards a NDC-type distribution. *Chen/Wang* (2016) performed a study on value co-creation in an airline setting. Their research finds that customer participation via value creation has an impact on system satisfaction and via the latter influences customer satisfaction and customer loyalty. Finally, *Novani/Kijima* (2012) propose a study on customer-to-customer communication in a value co-creation context. Despite gaining interesting insights, the study's findings

exhibit no relevant outcome for the design of value co-creation in an airline distribution setting.

The literature review has revealed that only a small amount of literature is present in the field, calling for more intense research concerning this important topic. The existing literature addresses four main aspects with relation to value co-creation: 1) systems of personalized offer creation, 2) design aspects of personalized dynamic pricing systems, 3) challenges in establishing a new distribution standard and 4) general studies on value co-creation but with a focus on the airline industry. Especially the first three categories are useful in order to understand the challenges around IATA NDC.

### 4. Discussion and implications

#### 4.1. Summary

The IATA standards NDC and One Order are of interest with regard to the digitalization processes in the airline industry. The airline industry was one of the few industries profiting from a digital network infrastructure long before the internet was commercialized. With the advent of the internet three developments could be observed: Low Cost Carriers decided to avoid the distribution cost via the GDS and decided to sell their tickets almost completely via the internet, legacy carriers built their own airline websites without leaving the GDS environment and Online Travel Agencies connected to GDS web-interfaces in order to sell legacy carrier tickets via their platforms (Bingemer 2018). With Low Cost Carrier tickets being sold via the internet, the GDS's lost their exclusive role as a single point of truth of Airline Distribution for the first time. Today, the GDS infrastructure persists and despite being brushed-up, face-lifted with modern APIs and equipped with graphical user interfaces in their front-end, their core function principles remain based on technology concepts and restrictions from the 1960s.

With the introduction of IATA NDC in 2012 and its implementation in the last 5 years, the biggest concern for innovative thinkers in the industry is that the prevailing GDS standard inhibits the growth and diffusion of new digital capabilities that are the prerequisite for value co-creation (Fürstenau/Cleophas/Kliewer 2019). Co-Creation of an offer needs exchange between buyer and seller. In contrast to the GDS standard, NDC is built around the idea of an API that works via requests and responses and thus enables exchange instead of pure retrieval. The NDC standard fits very well into an internet-enabled world and is well-documented and easy to understand for programmers with experience in generic, industry agnostic API-programming. Whilst IATA NDC is covering the offer management side of the distribution process, the IATA One Order standard complements the NDC offer creation with an efficient order process. This is especially useful to link modern fulfilment techniques such as Paypal or Apple Pay into the order process. The managerial problem is the parallelism of the modern IATA One Order process with an old-fashioned GDS-based offer process leading to inconsistencies and extra cost.

As Chen/Wang (2016) show, co-creation is positively contributing to customer loyalty. Thus, becoming more active in co-creation via innovative distribution represents a possibility to overcome the airlines' "commodity trap" and allows proper differentiation. Given that the industry overcomes the problems stipulated below, interesting value co-creation use cases might be implemented. The use cases range from small changes with large effects (e.g., purchasing the right for a name change with a flight coupon) to bigger changes

(e.g., implementation of a “request better price” button that leads to interaction with the pricing system of the airline). By integrating different services from shuttle, taxi, train, hotel, mileage, destination services, airport services, support services and product offerings into one consistent offer process, customers could assemble their preferred offer. This will of course only work if the frontend-design is facilitating such co-creation by the customer.

To summarize, based on the literature review and following the managerial debates over the last 5 years, the following critical elements can be identified to realize co-creation in the airline distribution domain:

- 1) Diffusion of NDC APIs among intermediaries and new players in the distribution arena.
- 2) Focus on co-creation processes in the workflow of systems using the NDC APIs (e.g., Agency websites, third parties, new entrants).
- 3) Development of personalized dynamic pricing algorithms and systems in order to be able to quickly price and reprice according to the customer’s changes.
- 4) Excellent frontend designs facilitating co-creation processes and supporting joy of use.
- 5) Relief from the idea that NDC needs to be backward compatible to the GDS structure.
- 6) Implementation of the IATA One Order standard to facilitate document handling (i.e. one order document instead of PNR, eTicket, eMCO, EMD, ...).
- 7) Better insights on relevant offers to the customer for the purpose of value co-creation.

## 4.2. Research Contributions

Our study aims at answering the research questions formulated in chapter 2. Therefore, we will revisit the first two research questions in this section. The third research question will be answered in the following section. One major finding is that co-creation is under-studied as it relates to the special context of airline distribution as compared to its high practical relevance. One reason might be that researchers lack insights into airline distribution technology and thus prefer to perform research from the customer’s perspective rather than from the airline’s perspective.

### What progress has been made concerning co-creation in airline distribution and what fields remain understudied?

The major development concerning value co-creation is that with the IATA distribution standards NDC and One Order and external APIs, there now is a technological foundation available that enables value co-creation processes in airline distribution. However, the existence of these standards alone will not change a lot. To lever the potential of value co-creation, intelligent offers need to be designed that use co-creation to make customers more loyal, more profitable and deeper involved with a brand. With the emergence of co-creation, new opportunities to connect different parts of the value chain using external APIs need to be considered.

### Where are the gaps concerning co-creation in airline distribution most pressing?

Product and service design for new intelligent co-creation offers in the airline distribution arena is an important field that needs more support from scholars. In addition, there is little literature that addresses how value co-creation could be used to rethink the

whole travel supply chain, e.g. to create sustainable travel products. There is a lack of research on customer acceptance of personalized dynamic pricing (apart from segmentation approaches) that should be closed prior to the first applications in the field. Last, the influences of the existing GDS structures on the diffusion of the new distribution standards need to be evaluated with a focus on lock-in-effects and market power.

### 4.3. Managerial Implications

The IATA standards NDC and One Order provide a solid foundation for the establishment of value co-creation.

#### How should managerial practice proceed in the future given our findings?

One important managerial implication is to search for intelligent ways to uncouple the NDC distribution standard from the GDS structure as previous research indicates that the GDS structures might hinder the diffusion of this new standard. An important aspect in this regard might be to get rid of fare distribution via third parties for airline's NDC APIs. By leaving behind static filings, airlines could foster more innovative products.

To prepare for value co-creation, companies need to gain more insights on individual customer behavior. It might be helpful to work on algorithms that allow the extraction of more valuable knowledge from existing data, which enhances the already robust activities in relationship marketing in e.g. the sharing accommodation markets (*Casais/Fernandes/Sarmento 2020*). Another element that could be contextualized as extracting value from existing data is the systematic usage of "presented" in images and videos, focusing on an emotional or aesthetic value of the tourist product (*Conti/Lexhagen 2020*).

Finally, it is important to design customer interfaces that support value co-creation in order to avoid frustration from poor customer interaction that triggers a chain of negative sentiments that result in lower satisfaction and loyalty. In order to keep track of the process, managers should systematically measure customer satisfaction and customer loyalty resulting from their co-creation processes.

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