Path creation in the passenger transportation industry: What can air learn from rail?

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Abstract

For advancing airline sales infrastructure to the technological state-of-the-art, the industry's association IATA currently aims at forming a new distribution standard. We take this issue to shed light on the motivation for agreeing on commercial standards in passenger transportation and their historical development in the railway and airline industry. We then reflect on lessons that can be learnt both from economic theory and prior standardisation experiences.

Keywords: Passenger transportation, path creation, sales technology, economic history, standardisation

1. Research problem

In an extended effort, the airline industry association IATA currently attempts to establish a new commercial standard for passenger reservations. Passenger reservations refer to the joint process of issuing tickets and making seat reservations. With its new distribution capability (NDC) project, IATA focuses on airlines' indirect distribution channel via travel agents and global distribution systems (cf. IATA 2013). The target distribution standard consists of written resolutions – that is, documents that IATA suggests its members and affiliates to comply with – as well as technical specifications and IT implementations for prototypical airline shopping interfaces. IATA picks up one of the key issue areas in airlines' business models. Reservations are one of the core processes enabling airlines to develop advanced marketing and pricing. While direct internet distribution offers airlines flexibility to design new products and promote them to individual customers, the indirect channel via global distribution systems (GDS) exhibits restrictions due to legacy technology. In contrast to the internet eXtensible Markup Language (XML), GDS use pre-internet teletype (TTY) and/or EDIFACT standards for message transmission among airlines, travel agents and others. This, for instance, causes practical problems for some airlines to implement alternative pricing strategies (cf. Isler & D'Souza 2009; Pölt 2011).

In this paper we ask: What can IATA learn from economic history and theoretical insights on standardisation in order to ensure that the initiative gains momentum? This is interesting as other passenger transportation industries, e. g., railways, show similar characteristics and already passed through comparable standardisation processes. We select rail as a case of comparison for three reasons. First, both, rail and air are network industries and offer – on an abstract level – similar reservation services. From a business point of view it is thus quite natural to compare standardisation among these industries. Second, as we will show theoretically, reservation systems in both industries are characterised by massive network effects. Both will thus be susceptible to positive feedback and path dependent dynamics. Third, both air and rail feature multiple actors with diverging interests who need to form coalitions to enable standardisation. Our analysis of air vs. rail thus enables us to draw conclusions on the abstract features of the NDC standardisation and lessons IATA may take into account. Consistent with this view, in what follows, we present our theoretical background of network effects and path creation (Sec. 2). We then briefly describe the history of OTIF & CIT – major drivers of standardisation in the railway industry, followed by the history of IATA (Sec. 3). We move towards our empirical contribution by analysing and

comparing the path creation processes in passenger reservations for the railway and airline industries (Sec. 4). Finally, we discuss the findings, implications and future research directions (Sec. 5).

2. Theoretical background

In his seminal work on path dependence, Arthur (1989) explains the emergence of technical standards as being triggered by increasing returns to adoption: the more agents choose a specific technology, the more it gets improved and experience is gained with it (cf. ibid: 116). The outcome of a process of many individual selection decisions to adopt a standard is "not necessarily superior to alternatives, not easily altered, and not entirely predictable in advance" (ibid: 128). David (1985) illustrates this view with his well-known example of the QWERTY keyboard. An example of path dependence in spatial networks is the standardisation of railway gauges (cf. Puffert 2002, 2009). Thus, the process of the formation of standards can be path-dependent and bears the potential of an inefficient outcome or the "wrong" standard to be prevalent. In this paper, we extend the notion of individuals adopting a standard to firms choosing a common technological or commercial platform of co-operation. Involving more deliberate action of relevant firms, we see the process of implementation of a technological norm as a path creation process (cf. Garud & Karnoe 2010), considering that firms may have a vital interest in implementing their technology as an industry role model. With their example from research & development consortia in the semiconductor manufacturing industry, Sydow et al. (2012) point out that paths may be deliberately created by collective agency. This "collective agency for structuring the organi[s]ational field" (ibid: 915) involves organising supporters around an idea, establishing technical feasibility and to define rules related to the innovative technological project (cf. ibid: 928).

Direct network effects, or network externalities, describe the phenomenon of a good or service being more beneficial as the number of users of that good or service increases. Thus, network effects can be conceptualised as a source of increasing returns. The classical example for this phenomenon is a telephone network (cf. Katz & Shapiro 1985). Thus, generally, the size of a network can directly determine its utility, even though these effects do not necessarily occur automatically (cf. Afuah 2013). Indirect network effects refer to complementing goods or services that make a focused good or service increasingly useful (cf.

Koch et al. 2009). Because of increasing returns phenomena in the industry, both the railway and airline history have frequently been subject to research on technical path dependence (cf. Scott 2001; Copeland & McKenney 1988). There are two perspectives on network effects of fare standards in and among passenger transport organisations: Firstly, there is a coordination effect, in other words an advantage of co-operation if firms take similar action in setting their fares. The larger the number of "bookable" destinations of the transport network is, the more traffic it can attract (cf. Arthur 1988). Secondly, considering air and rail as a transport system with high initial investments and structural capacity reserves in the sense of increasing returns to adoption, every additional user attained to the system generates lower average cost per unit (i. e. cost per passenger kilometre). Because cost-lowering feedback is usually considered in the output allowed by the production technology of a firm, Puffert (2009: 248) characterises this situation as "increasing returns […] on the demand side of a market". Depending on the intensity of competition, this would theoretically lead either to increasing margins or to a feedback loop of lower prices and more users until the full capacity on the trains and planes is utilised. Thus, the network size effect is triggered by the cost degression generated by additional passengers.

Several strategies to get out of lock-ins have been suggested in the area of standardisation theory: they can be tracked on a continuum between evolutionary strategies of backward compatibility and revolutionary strategies of compelling performance (cf. Ciborra et al. 2000: 69 ff.). According to Ciborra et al., these strategies reflect an underlying tension when the forces of innovation meet up with network externalities: Is it better to "wipe the slate clean and come up with the best product possible (revolution) or give up some performance to ensure compatibility and thus ease consumer adoption (evolution)" (ibid: 68). The work by David and Bunn (1988) for instance shows that electricity converters where able to build two separate networks for alternating and direct current by developing appropriate adapters that could couple the two networks together. This prevented an immature decision (ibid: 69).

3. A brief history of passenger reservation standardisation

This section reviews briefly the history of passenger reservation standardisation in the railway and airline industry. For railways we thereby portray the Intergovernmental Organisation for International Carriage by Rail (OTIF) and the International Rail Transport Committee (CIT). For the airline industry we focus on the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO).

3.1 Rail: OTIF and CIT

Though the first international long-distance line in Europe had already been opened in 1843 between Antwerp and Cologne, initially, the networks of European railways were dispersed. Before these networks became interconnected, there was no need to align business conditions among the firms for encouraging through-traffic. First national activities for business standardisation and through-tariffing could be observed in Britain in the 1840s (cf. Bagwell 1968). Railways did not start to co-operate internationally in scheduling their trains before 1872 (cf. Schnell & Paganetti 1989) and to exchange technical information through the International Railway Congress Association by 1885 (cf. Funk 1992: 1344). It took another eight years before the first International Convention concerning the Carriage of Goods by Rail entered into force in 1893 (cf. CIT 2013). This convention created an "administrative union" with a permanent secretariat. Administrative unions of the time were "institutionali[s]ed continuations of international diplomatic conferences" (OTIF 2013: 1), the most important being the world Postal Union. Thus, they represented the most elementary point of a path creation process in the area of socio-technical business conditions for transporting passengers and goods. Nevertheless, passenger transportation continued to be left behind from any common rules before the basic foundations of the administrative union gained momentum. The Genoa Conference of 1922 was a pioneering initiative for intensifying the co-operation between railways: it was the trigger for the foundation of the International Union of Railways (UIC) late in the same year (cf. Fink 1984). It took until 1928, when finally the goods carriage agreement was extended to the passenger branch with the entering into force of the Convention on the International Carriage of Passengers and Luggage by Rail (cf. CIT 2013). The International Rail Transport Committee (CIT) which had been independently created by railways in 1902 in order to coordinate the details of the goods agreements was now put in charge for elaborating a detailed framework of international passenger transport by rail. The committee helped railways to apply the convention and augmented and explained the legal texts in the Uniform Rules concerning the Contract for International Carriage of Passengers and Luggage by rail (CIV). These juridical rules comprised basic elements of a transport contract with different carriers, they provided that "international tariffs shall contain all the special conditions applicable to carriage, in particular the information necessary for calculating fares" (OTIF [COTIF] 1980b: 2, see also OTIF 1980). A central element was the form and content of tickets, defining the minimal indication of departure and destination, route, class, fare and validity for all participating companies. Other than the legal framework,

the UIC arranged commercial activities such as the clearing of revenue between carriers in the Central Compensation Bureau. The relations between the International Rail Transport Committee and the UIC were not always free of tensions (cf. Bertherin & Leimgruber 2002). The conflict between the two industry associations was solved by separating technical and commercial co-ordination made by the UIC and the legal framework administered by the CIT. Since 1959, a common codex on international tariffing which was fully compatible with the rules of UIC *and* CIT was applied (cf. UIC leaflets 106, 130). According to leaflet 106 (p. 3 f.), this common tariff comprised the exchange of

- Routings and distance tables
- The conditions of carriage of the railway
- A schematic map of the lines
- Optional: special offers concluded between carriers

A distinct event of extending the bookable network of railways through co-operation was the creation of a common rail pass offer at UIC's 50th anniversary in 1972. A central milestone in the development of stable institutions for organising international rail transport was in 1985 with the set-up of the OTIF – the Intergovernmental Organisation for International Carriage by Rail – supervising all legal agreements. The creation of OTIF as an international legal body monitoring common rules forms the end point of a development which started with loose agreements between single firms.

3.2 Air: The International Air Transport Association (IATA)

An initial conference on the international regulation of civil air transport was convened 1910 in Paris shortly after the advent of the airplane. A first international air convention dealing with all technical, operational and organisational aspects of civil aviation was signed in 1919, also in Paris. Between the World Wars, countries developed several subsequent agreements limited to Europe or America. A conference held in Chicago 1944 first agreed on a worldwide set of rules and regulations regarding air transportation as a whole. All states having signed the 1944 Chicago convention on International Civil Aviation agreed on implementing its content into national regulation. An international organisation – the International Civil Aviation Organization (ICAO) – was set up to overlook the agreement. ICAO, headquartered in Montréal, Canada, first concentrated on technical questions like wavelengths, norms for navigation equipment, airports, licensing of flight personal or

charging of taxes. Then ICAO began to mesh international conventions with US air transport law to set up a legal base for worldwide air transport. ICAO developed Conditions of Carriage - the contract between the customer and the transporting airline. One basic item on these conditions was for instance the airlines' liability for passenger injury or death and cargo damage or loss. In its commercial standardisation efforts, the airlines supported ICAO. IATA thereby represented the airlines' interests.

IATA is a private association of commercial airlines. In 2013, it had some 240 members that represent approximately 94% of the worldwide air ticket sales (IATA 2013). Most full service carriers are IATA members. Low cost carriers and charter carriers often stay out of IATA. The association came into being in 1945 in Havana, Cuba. It succeeded the International Air Traffic Association founded in The Hague in 1919. Like ICAO, IATA headquarters in Montréal, Canada, and holds executive offices in Geneva, Switzerland. IATA launches initiatives to simplify and standardise airline processes, e.g. for ticketing and baggage provision. IATA historically focused on price setting and interlining. Price setting, i.e. "which prices are to be charged?", was a relevant question after world war two because governments insisted on the right to oversee the prices charged by international airlines but could not, in practical terms, develop those prices for themselves. Thus, IATA was delegated to hold traffic conferences for this purpose starting in 1947, with all fares and rates subject to final government approval. IATA partly withdrew from price setting with increased deregulation since the late 1970's. Interlining concerns how airlines divide up the money from multi-airline journeys and how airlines settle their accounts. IATA has been involved early to answer these questions. IATA for instance set up an international settlement system – the billing and settlement plan – which helps airlines to settle accounts with the worldwide travel agent community. The billing and settlement plan, which was introduced in 1983, includes also an airline clearing house. Over 300 airlines participate in the program today, besides 60,000 IATA-accredited travel agents. When IATA lost importance for price setting, it engaged more in other fields like standardisation. Ticketing illustrates that and many similarities to the railway case arise: In the 1920s, each airline used a different form of passenger ticket with no standard conditions of carriage. The industry recognized the need to standardise traffic documents, regulations and procedures for increasing the network of available transport service. This issue became the main focus of the IATA Traffic Committee which developed a standard ticket for multiple trips as early as in 1930. Later, in 1972 IATA developed a standardised paper ticket that could be processed by several GDS. An initiative

of IATA introduced an automatic ticket and boarding pass in 1983. The electronic ticket then based upon the standard paper ticket. It is in full operation around the globe since 2008. IATA passenger service conference resolutions proposed standardised formats and technical specifications for tickets and other documents that were adopted by most airlines (IATA and non-IATA members) including

- The booking record of a flight (or passenger name record)
- The booking class of a flight (or reservation booking designator)
- Records of ancillary revenues (electronic miscellaneous documents)
- Publication of schedules and slot management
- Schemata for exchange of data on the bar coded boarding pass

3. Creating a new path with the New Distribution Capability project

In this paper, we focus on IATA's most recent standard setting activities in passenger airline distribution. In particular, IATA launched an initiative in 2012 to replace the less flexible pre-internet message protocols when selling through the indirect channel (GDS/agents) by up-to-date distribution standards based on internet/XML protocols. Basically, IATA and most of its members argue that when using GDS, airlines provide limited information about the products they sell, and do not have information about the customer until she or he checks in for the flight. This model has been designed 40 years ago, when IT resources where extremely limited and the internet, PC's and mobile phones did not exist. Nevertheless, this is the way of handling passenger booking data that still exists today. It is important, as GDS still account for 43% of overall ticket sales or 1,400 billion US dollars (cf. Amadeus 2012).

The goal of the New Distribution Capability initiative is to close the gap between the direct (airlines own websites) and indirect channel by enabling more personalisation and (product) customisation via the GDS/agent channel. After passing a resolution to develop the new distribution capability in 2012 (resolution 787), IATA has soon afterwards licensed an XML schema from a not-for-profit airline organisation as the basis for the new standard. IATA has also been engaged with travel agents, IT companies, GDS including Sabre, Amadeus and Travelport and others to clarify requirements and to promote their initiative. In June 2013, NDC has entered a pilot phase and several carriers have announced their interest to participate in pilot projects to further develop the IATA XML standard and to test and validate the

assumptions. After pilot reviews have been conducted, IATA plans for business adoption of the new standard in 2014.

4. Comparing IATA's new distribution approach to attempts in the railway sector

In this section, we compare IATA's situation to the one of the neighbouring railway industry. We chose this approach because international sales of railway tickets for passengers have similar network properties as airline ticketing. We compare the different elements of the development of IATA and respective railway organisations (OTIF, UIC, CIT) to shed light on similarities and differences between them to derive recommendations for IATA's current tentative of creating a new path of passenger reservation.

While both industrial institutions have their origin in decisions made at diplomatic conferences, there are some differences in the implementation of technical-commercial standards established in the two industries. Generally, in both cases the standards are adopted by voluntary choice of independent organisations. These organisations are transport operators who co-operate by an own interest in profit-making despite a wide heterogeneity of interests and market position of those transport undertakings. In other words, participating airlines and railways can be considered as seeking for network effects. Even though reservations are less important in the railway industry because not every ticket is sold together with a reservation, in the purely technical sphere, both industries have developed and documented data exchange formats allowing them to exchange necessary information on passenger requests. Like ferryboat companies and railways, airlines were among the first organisations that interchanged information on a large scale and some of the data exchange standards are older than the commercial internet. The respective technical standards thus often have a proprietary character specific to the airline industry. They are deeply embedded in the infrastructures in use.

In general, both industries operate on a sound base of legally binding minimum standards that ensure save operations. The character of technical-commercial standards, however, differs between air and rail. Commercial agreements that do not distort competition can be made discretely in working groups of the International Union of Railways. In contrast, IATA's standard setting initiatives depend on the willingness of commercial airlines, GDS, software vendors and travel agents to adopt those standards. While railways remunerate the distribution channel of more or less dependent travel agents by paying a sales provision, it is a specific characteristic of passenger airlines that their sales structure is three-sided involving the airline, the independent GDS *and* an eventual travel agent (see Figure 1). Railways usually control all IT towards their sales agents including travel agents, but GDS have succeeded to gain considerable degrees of freedom. GDS brought another layer of complexity into standardisation efforts as these companies pursuit their own interests and (commercial) goals. While it is sufficient for railways to conclude standards among themselves, airlines have to include GDS into their coordination effort if they want to gain network effects out of this distribution channel.

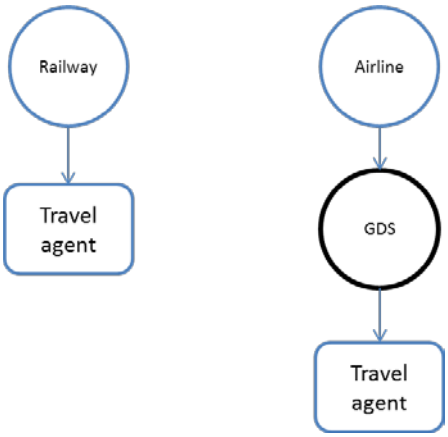

FIGURE 1: SPECIFICITY OF AIRLINE SALES THROUGH THE TRAVEL AGENT CHANNEL

In the spatial structure of the reservation networks in both industries, we observe a strong centralisation of airlines around the Global Distribution Systems oligopoly. Three main vendors – Amadeus, Sabre and Travelport – dominate the distribution market for travel agents. Most airlines interface with these systems as the travel agent market segment is still more than significant (approximately accounting for 43% of overall revenues in the airline industry in 2012). Communication with GDS relies on EDIFACT standards, maintained by IATA's Passenger and Airport Data Interchange Board (cf. Table 1), and other proprietary

teletype formats. Figure 2 indicates that airlines use other, XML-formats for internet-based distribution and for airline to airline message exchange, but these formats are not in use for GDS distribution. Figure 2 also shows that few airlines stay out of the GDS distribution, which increases the pressure to mimic the other organisations. Compared to that situation, railway reservations systems are rather a network of many different but interconnected solutions of individual carriers.

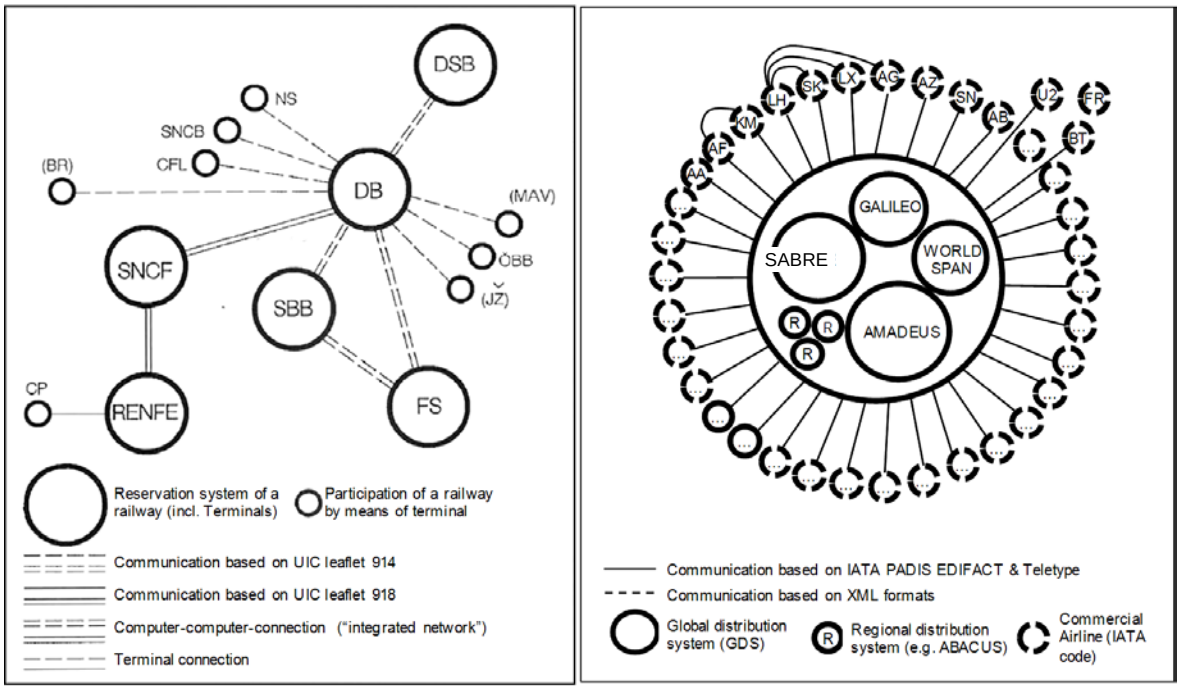

FIGURE 2: COMMUNICATION STRUCTURE OF RESERVATION SYSTEMS IN RAIL AND AIR INDUSTRIES. SOURCE: OWN FIGURE BASED ON SELBITZ (1989)

To sum up, the features of the historical development of technical and commercial standards are quite similar in some aspects, but show structural differences as GDS play an intermediate role between the carrier and passengers. The following table provides an overview on the characteristics we observed in the focused industries:

Aspect	Air (ICAO, IATA)	Rail (UIC, OTIF, CIT)
Foundation history	Diplomatic conferences (particularly Chicago 1944) IATA foundation (1945, Havanna)	Diplomatic conferences (particularly Genoa 1922)
Legal framework	Chicago convention and annexes	COTIF, amendment CIV
Commercial framework	Passenger and Airport Data Interchange (PADIS) Board, supported by two committees and several working groups	UIC working groups
Technical framework - Communication - Data - Ticketing	 IATA PADIS EDIFACT standard IATA PADIS EDIFACT standard Electronic Ticket (ET) and electronic miscellaneous documents (EMD)	 UIC leaflets UIC leaflets UIC electronic ticketing provisions, CIT specimen
Importance of reservations	high	low
Sales structure	three-sided (airline, GDS, travel agent)	two-sided (railway, travel agent)
Network structure	centralised	polycentric

TABLE 1: COMPARISON OF AIRLINE AND RAILWAY STANDARDS

5. Conclusion

Our aim has been to add our understanding on what IATA can learn from economic history and theoretical insights on standardisation in order to ensure that the “new distribution capability” initiative gains momentum. Using a comparative approach with the railway industry and theoretical insights from standardisation theory, we have highlighted several common features of the standardisation initiatives and several specific characteristics of the airline industries NDC initiative that must be considered at IATA.

We conclude with the following statements: First, network effects matter. Thus, IATA must address collective action problems within the population of airlines by targeted measures to get the bandwagon rolling. Airlines differ in size (large vs. small), business model (full service carrier vs. low cost carrier), marketing strategies and other characteristics. This naturally means varying expected benefits from the new standard. Some may also encounter high switching costs as these airlines operate legacy reservation systems. Others may have recently updated their infrastructures and will thus not be willing to switch again soon. Excessive waiting and penguin effects may be the result. From standardisation theory it is

known that redistributing standardisation costs among players often helps to influence players in their standardisation decision. As large players may be willing to standardise anyway, it might be wise to convince small, uncertain airlines by relocating standardisation costs to large players (cf. Weitzel et al. 2006).

Second, the specific, three-sided industry structure in the airline industry requires building economic incentives for GDS to participate in the initiative. IATA standardisation would be much easier with and not against GDS. GDS, on the other hand, encounter high switching costs: Messaging and data standards are deeply embedded in the architecture of their systems. Reservations are for instance one of the core legacy components of the Amadeus GDS. The reservations core of Amadeus has its origin in 1987. It was even then carried over from another GDS (System One). Most GDS share common technical roots going back to the first reservation system from American Airlines in the early 1960's. GDS incentive structure thus favours an incremental development strategy and is not well-equipped for a radical change. Given that fact, IATA should consider an evolutionary (in contrast to a revolutionary) strategy to takes into account GDS's high switching costs. IATA may decide whether it prefers a slow evolution based on backward compatibility or a fast evolution based on gateways. Growing a completely new distribution network for travel agents and linking it later with the established GDS network (fast evolution strategy) bears high risks of failure and may thus be considered as a fallback option. In contrast, ensuring backward compatibility with existing GDS standards (slow evolution strategy) may require additional efforts but could help to get the GDS on board. With respect to these insights, it should be considered whether the licensed core of the new distribution standard may be subject to a competitive process between more core applications. A loose coupling of core applications with more scope of freedom for airlines, GDS and travel agents to adopt one or another could be more effective than defining a single technical solution in a top-down manner. Arthur's models show that standards do not have to be set up by central institutions, but emerge from the individually rational adoption decisions of agents.

Finally, transport history shows that there is a steady interest of players to take profits of network effects, but the process of implementing a framework which allows doing so is extremely time-consuming (cf Bertherin & Leimgruber 2002). It appears that IATA's initiative has good chances to advance airline distribution if pilot users perseveringly put effort into it and industry associations rather set incentives instead of forcing members to join in.

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