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THE IMPACT OF NEW AIRPORT PASSENGER SERVICE TECHNOLOGIES ON THE SHAPING OF TERMINAL BUILDING LANDSIDE AREAS

WPŁYW NOWYCH TECHNOLOGII OBSŁUGI PASAŻERA PORTU LOTNICZEGO NA KSZTAŁTOWANIE PRZESTRZENI STREF „LANDSIDE” W BUDYNKACH TERMINALI

Abstract

The changes that are taking place in the airport passenger service technology allow for the increase of passenger traffic in terminal buildings. Novel technologies in identification, check-in and security control in passenger service areas impact the way architectural spaces are being shaped. This article describes an algorithm for analysing a terminal building space with respect to passenger service area standards, taking into account new technologies and through put-change assessment.

Keywords: airport, terminal, capacity, technology, passenger

Streszczenie

Zmiany zachodzące w technologii obsługi pasażera portów lotniczych umożliwiają zwiększenie przepustowości obiektów terminali. Nowe technologie identyfikacji, odprawy bagażowej i kontroli bezpieczeństwa w strefach obsługi pasażera zmieniają sposób kształtowania przestrzeni architektonicznej. Artykuł jest opisem budowy algorytmu umożliwiającego analizę przestrzeni budynku terminala, w odniesieniu do standardów obowiązujących w strefach obsługi pasażera z uwzględnieniem nowych technologii i oceną zmian przepustowości.

Słowa kluczowe: lotnisko, terminal, przepustowość, technologie, pasażer

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1. Introduction

Passenger service spaces at airport terminals are founded on technologies. The facilities where the passengers and their baggage pass from the “land side” to “air side” may be divided into zones defined by service tasks performed by the airport personnel. In a classic arrangement, they include baggage and ticket check-in, control of safety and entrance gates from the terminal (through waiting lounge, air jetty, shuttle buses transferring passengers onto the plane deck). Each zone is equipped with the technologies enabling the performance of the service tasks that require the participation of both parties concerned. As far as passengers are concerned, there are different sub-types and categories: travel classes[1], carriers/ airlines, plane crews, privileged passengers (VIPs, special need passengers). At the other side there are carrier’s staff, border guards, customs officers, immigration offices, safety and technical service staff such as baggage sorting workers. Both parties are supported by technical systems involving information exchange, enquiries, transport and control. All technologies utilized at the airport terminal need specific installation space, operation and maintenance. To be properly designed, the systems require the definition of specific conditions and maximal values of their operation. In the case of the airport, the value that defines the scale of the complexity of the infrastructure elements is the quantity of passengers (PAX) serviced by the airport per year and at “peak” times. The peaks are specified on the grounds of the maximal number of passengers flowing through the airport in a time unit, such as an annual or a daily peak, irrespective of particular service zones. The number of passengers is very important for programming the size of passenger service zones in a terminal or terminals of the airport. Newly designed terminal facilities must be described in terms of surface area and cubic capacity that secures passenger service at peak times forecasted for many years ahead. The existing facilities frequently reach their maximal throughput earlier that the predicted simulation values and calculations. Therefore, the existing structures require organizational intervention and modernization schemes to look for reserves and to postpone or plan extension investments in due time. Hence, airports strive x to increase their throughput during continuous processes of the optimization of personnel work and technical infrastructure operation in specified architectural space. Airport management often encounters the problem of the necessity of modernization or extension without the possibility of closing down the facilities while maintaining the required throughput.

The passenger service systems at the terminal, involve the zones supporting the work of the personnel. According to the above description of the zones, the following types of technologies may be distinguished:

- for the baggage and ticket check-in information systems (terminal access to databases of airlines), baggage service system (weighing, identification, transport to baggage stock) and the information system for identifying the destination check-in stand,
- for the safety control zone information system supporting the technologies of identifying threats, scanning and screening equipment (usually the magneto-metric gates for personal passenger check and hand baggage screening),

[1] Passenger classification depends on the service standard of economy, business and first classes. The classes are defined by the standards set forth by International Air Transport Association = IATA).

- for the boarding gates information system (terminal with access to the databases of airlines) and destination gate identification.

Each of these systems must be integrated and embedded in the terminal building space. The presented equipment options may be evolutionarily different in a wide range of functional models, especially as far as the safety control zone is concerned, where various models are applied[2], for example:

- safety control at the Boarding Gate before entering the airplane deck (without departure lounge),
- safety control before entering the departure lounge in the so called "Holding Area",
- safety control before the hall leading to the check-in gates in the so called "Concourse Area (centralized system).

Manufacturers of furnishings, technical and informational equipment for airports are working on new ranges of products to provide user comfort, reliability, flexibility and increased efficiency. The introduction of new technologies and their elements, requires spatial adjustments involving refurbishing works, reorganization of the existing space, extension and construction works to enhance the flexibility of the space that has become inefficient and technically inadequate. New products entail new forms of use. For the baggage and ticket check-in zone, they may include self-check in stands/kiosks and "self bag-drop solutions".

2. Kiosks/Stands

Kiosks are multifunctional systems. Their main advantage is the option of increasing the number of ticket check-in stands and accelerating the activities associated with the service of departing passengers. An additional benefit for the airport and airlines is the possibility of staff downsizing and consequently, employment costs reduction. The kiosks enable a wide range of service activities and their functionality depends on the installed system software, which may be easily and conveniently updated and remotely controlled at nighttime without significantly hindering the efficiency of the system. The kiosks enable a number of tasks:

- departing passenger identification (on the bases of passport data, reservation code or other information),
- confirmation of reservation for a selected flight with options for changes planned by the airline for given reservation types,
- printing of the boarding pass,
- obtaining the information on the departure, gate number, boarding time and other activities to be performed before passing through the successive service zones,
- availability of a wide range of information and service activities (internet access, xx hotel booking, transport reservations, banking services, etc.).

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[2] *Currently there are no rigid rules obliging design architects or airport management to use uniform schemes, or safety control models. The crucial obligation is to subject the passengers and their baggage to safety checks before boarding the plane. Accordingly, there are several "safety control structures"* – Piotr Uchronski, *Wpływ infrastruktury terminalowej na ochrone lotnictwa cywilnego (influence of the airport terminal infrastructure on civil aviation protection)*, Silesian University of Technology 2011, Transport, 72/1860

The range of services offered by the kiosks depends on the software and additional equipment such as printers or other I/O options (credit card readers). The installation of the elements making up the system of the kiosks, requires access to the infrastructure of the facility and appropriate spatial layout with extra space for users. The space provided for one kiosk should secure free accessibility and a guarantee of minimal privacy in the course of using the system. The spatial layouts of the kiosk installation zones (Ill. 1) are conditioned by the dimensions of the space selected from the classic waiting hall and communication in the direct vicinity of the baggage check-in.

Ill. 1. Kiosks at the international air port in Hong Kong (source: http:// upload.wikimedia.org, author: Mike Goch, Creative Commons license)

Ill. 2. Scan&Fly baggage service system – identification and marking of the baggage is done by the passenger. One of the advantages of this system is easy integration with the existing check-in stands (source: advertising materials of Scan&Fly, http://www.scanfly.aero)

3. Baggage service systems

Baggage service systems are developed towards shifting the moment of baggage transfer from the passenger at the early stage x of boarding the airplane, to reduce the check-in time at the airport. Currently available systems of baggage transfer are available at three travel stages:

- before starting air travel in the departure city at the selected "check-in" points, usually situated at public transportation junctions such as the railway station and communication line to the airport,
- at the car parking lot in the "airport city" before reaching the terminal,
- upon arrival to the terminal.

Each of the above may function on the grounds of classic "check-in" solutions with the participation of the airline or supported by innovative automatic self-service systems. The two examples discussed in the paper differ in the manner of interference with the existing infrastructure of the airport.

The Scan&Fly (Ill. 2) system operates the most important functions concerning baggage, enabling passengers to mark their baggage with an identification number, to print the boarding pass, scan, read and compare the data on the baggage identification card and the boarding pass, and make excess baggage limit payments. The system is easy to operate and is integrated with the existing baggage receipt system already functioning as classic “check-in” stands, for example: Rotterdam, The Hague.

Ill. 3. ALSTEF baggage control system – the identification and marking of the baggage is performed in a self-service manner. The system requires adjustments, re construction and architectural design of “check-in” to meet new solutions (source: ALSTEF advertising materials, http://www.alstef.com)

Ill. 4. Scanning gate, system ProVision® 2 (source: L-3 Communications Security and Detection Systems advertising materials, http://www.sds.l-3com.com)

In another of the discussed systems (Ill. 3), a solution is dedicated to the newly constructed terminals or “check-in” zones subjected to profound modernization, integrating stand, self-check identification and baggage transfer at the airport. Such solution modules can perform all basic tasks and initial safety assessments of the deposited baggage. See Paris Orly West Terminal operating since 2011.

4. Personal control zone

The safety control zones are equipped with complex information and technological systems supporting the tasks of identifying the threats to which airplanes, passengers and crews are exposed during the flight. The threats involving bringing hazardous objects onboard may be reduced by advanced threat detection techniques. After several acts of terrorism, international aviation organizations and agencies of the countries that are particularly exposed to such terrorist attacks have undertaken efforts to improve the standards in the areas of implementing new methods of detecting and identifying objects, materials, substances and devices that may constitute elements of explosives or weapons used for attacking the plane crew or the passengers. The events of 09.11 have evoked many discussions on techniques and methods of personal control, leading to public debates on the infringement of personal rights as a result of too detailed screening of passengers in the course of passport and border control procedures.

The majority of the existing control zone types operate on the basis of the scheme presented in Dr. Antonio A. Trani "Advanced Airport and Airspace Capacity" seminar materials [1].

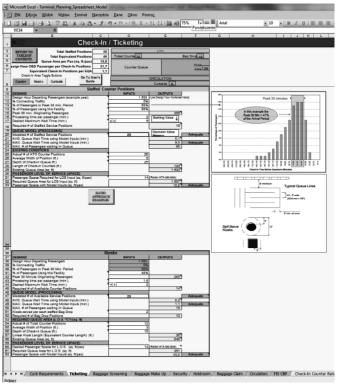
Similar sources designate different values of the surface area destined for organizing one control stand. The required space ranges from $36m^2$ to even $130m^2$. Surely, by introducing new technologies and optimizing the time required for verifying safety hazard, in the course of passenger passage through the control zone, the objective is to achieve the throughput of the system at the concurrent reduction of the demand for the space where the task is performed. The scanner presented in Ill. 4 is characterized by a high efficiency of hazards detection and their instant identification with simultaneous restriction of the information on the personal features of a passenger that undergoes the verification. Such solutions minimize the space required for the performance of personal control tasks and eliminate additional processes involved in the passage through magneto-metric gates, resulting in time reduction and possibility of compacting the number of check stands, which in view of the absence of spatial reserves at terminals, increases the throughput.

5. Algorithm

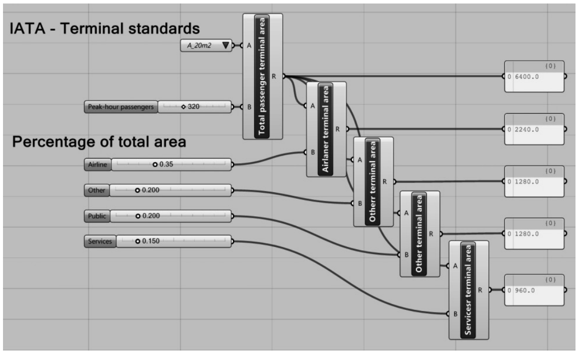
The search for methodologies of programming the size of the functional zones of airport terminals has been spurred by the problem of processing statistical and computational information to the form of graphic representation in terms of a simplified model of an object in a linear system. Accordingly, the author utilized a widely applicable tool to construct an algorithm for testing various options of detailed architectural solutions and design decisions. The possibility of testing various partial solutions, should enable changes in the results of calculating the throughput of the terminal in relation to its size, with specific consideration of the passenger service zones. The tests of the solution are based on the following tools:

- Input data in the form of numerical information on the infrastructure, standard and estimated throughput of the terminal are calculated by means of the Terminal Planning Spreadsheet Model (Ill. 5) devised by Transportation Research Board of the National Academies under the framework of the Airport Cooperative Research Program, sponsored by the Federal Administration of the USA Aviation, Report No. 25, Volume 2, 2010, supplemented by the devised calculation tool and made available to all stakeholders.
- The algorithm importing the input data contained in the calculation model is processed in the Grasshopper environment. The tool is currently developed by the author to be applied for transforming the numerical data to optional forms on the bases of given geometrical representation criteria and their arrangement in mutual spatial interrelations (a part of the devised algorithm– analysis of the size of the functional zones in relation to IATA standards and the number of passengers at the throughput peak (Ill. 6).
- CAD – Rhinoceros, version 5.

The entire elaboration is currently prepared and shall be based on a case study reusing the numerical data on one of the regional EU airports. The conducted experiments of processing the numerical data into their graphic representation are utterly simplified diagrams of the functional zones of a linear system of an airport terminal. The next step is to devise more detailed solutions for specific zones of the terminal and to test the elaborated solutions in view of the theoretical model relation and in-situ observations of the existing terminal.



Ill. 5. Spreadsheet for Check-in zone, a part of ACRP – Terminal Planning Spreadsheet Model (source: elaborated by the author)



Ill. 6. Fragment of the calculation algorithm (source: elaborated by the author)

6. Conclusions

New technological solutions introduced into the space of airport terminals, should optimize the processes of transferring passengers through different service zones, to achieve economic and organizational benefits and improve the quality of passenger service. More passenger service points increase the throughput of the zone. Nevertheless, to balance the relation between the number of service points and the number of passengers served in a given time unit, tests of the functional efficiency of the system are required. The calculations performed on the grounds of the data provided by manufacturers of the systems, often overestimate their real capacity. Therefore, new solutions are continuously monitored to verify their effectiveness and availability. In consideration of limited space provided for passenger service at airport terminals, new technical solutions enable changes of the factors that are variables in the function of system efficiency. They include:

- Quality of passenger service in space (LOS – Level of Service), described as;
  - surface area of the zone calculated into the number of served passengers,
  - ease of passenger flow through the zones and the so called, “bottlenecks”,
  - waiting time;
- Number of service points,
- Accessibility of service.

Self-service kiosks and self bag-drop solutions have altered passenger service processes, bringing about the following advantages for airports:

- reduction of check-in time, increasing throughput,
- reduction of manned service points, lowering staff employment costs,
- spatial efficiency,
- dispersal of waiting lines.

The introduction of the latest standards, is often hindered due to psychological resistance of users who must learn to use the new solutions. Interaction with service staff is still considered more convenient and safer for many air travelers. Each new technology, when first encountered, tends to evoke discomfort because it requires users to acquire new skills. Passenger service at airport terminals, which involves information exchange, should be uncomplicated. However, limited options of languages for communication with the system is often a barrier for users. The discussed algorithm devised for the analysis should be a very complex model for testing various options applicable to the needs of researchers and users. Its construction and testing is conditioned by the opportunities for collecting the data required for simulations. The expected results should enable a graphic representation of design decisions and modifications of the arrangement of the terminal space proposed by clients, with special consideration of passenger flow through different service zones.

References

[1] Trani A.A., *Associate Professor of Civil and Environmental Engineering Virginia Tech*, Airport Landside Analysis and Modeling, Advanced Airport and Airspace Capacity Seminar, June, 2002.
[2] Uchroński P., *Wpływ infrastruktury terminalowej na ochronę lotnictwa cywilnego*, Silesian University of Technology, Transport 72/1860, Gliwice 2011.
[3] ACRP (Airport Cooperative Research Program) Raport nr 25, *Airport Passenger Terminal Planning and Design*, Transportation Researche Bard of the National Academies (TRB), 2010 National Academy of Sciences, Washington D.C. 2010.
[4] ACRP (Airport Cooperative Research Program) Raport nr 10, *Innovations for Airport Terminal Facilities*, Transportation Researche Bard of the National Academies (TRB), National Academy of Sciences, Washington D.C. 2008.
[5] ACRP (Airport Cooperative Research Program) Raport nr 68, *Guidebook for Evaluating Terminal Renewal Versus Replacement Options*, Transportation Researche Bard of the National Academies (TRB), National Academy of Sciences, Washington D.C. 2012.
[6] http://www.scanfly.aero, day 28.06.2013
[7] http://www.alstef.com, day 28.06.2013
[8] http://www.sds.l-3com.com, day 28.06.2013