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edited by

Filippo Bosi, Paolina Ferrulli and Elisabetta Fossi

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Disposable terminal design

Elisabetta Fossi
PhD Candidate, XXIX cycle
Università degli Studi di Firenze, Dipartimento di Architettura

Abstract

An airport terminal design must face a continuous growth in passengers. When an airport doesn't provide a good planning and programming of the infrastructure, the flow of passengers that the terminal must process reaches the system break-down. This determines the end of service of that specific terminal layout. There are even other reasons that determine the end of service for an airport terminal: the obsolescence of most of its parts; the technological solutions and systems achieving the end of service cycle. At this point it is necessary to establish the terminal location with respect its entire life cycle. Then it will be considered among available alternatives: the necessity of renewal and/or expansion or replacement of the terminal facility.

Given the short service cycle, the airport terminal design is an evolutive design process that should pursue both the economic and environmental sustainability. So, the qualitative judgment of the architectural solutions, the evaluation of the levels of service and the assessment of the initial investment are not enough. Indeed the whole life of the terminal must be considered, since the life-cycle is well-defined.

So it is necessary to understand which solution is the most fitting, among the expansion and substitution ones, stressing the economic and environmental sustainability. Both these aspects are relevant, considering the short service cycle of the terminal.

Life Cycle Costing methodology can help, as a tool for the project design management. This kind of evaluation can be integrated to a qualitative analysis (of the proposed architectural solutions) and to a quantitative assessment (of the levels of service granted). This family of tools, properly customized, can address the best choice in the terminal design, and it can be used at the final design stage.

Desk research is necessary, in order to examine in depth the Italian and European positions on the adoption of a life-cycle approach in public procurements (ISO 15686-5:2008 is about application of Life Cycle Costing on buildings and their parts). It is necessary to understand

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the current tools and methodologies adopted in design management by the airport design teams. LCC should be investigated to achieve better planning of economic sustainability trends in airport projects. The inventory of the missing data could be solved by developing average values, collecting European data. Once the tool has been tuned, it should be applied to a proper field experimentation.

Keywords
Airport Terminal Design, Evolutive Design, Project Design Management, Life Cycle Costing, Green Procurement

Introduction: design of an airport terminal

The airport terminal is the main building in an airport and is intended to accomodate and process departing and arriving passengers. This essential function of the terminal is accompanied by the need to ensure an adequate level of service, to be achieved through careful design of environments and locations. But the upward trend in the number of passengers per year and in the index of Typical Peak Hour Passenger (TPHP) means that the terminal must be readjusted periodically to ensure an adequate level of service. Therefore, the airport terminal is characterized by a short overall service cycle and short service cycles of its parts.

Concerning Italy, the airport owners have internal technical offices, which are in charge of airport planning and of terminal design. The entire planning and design process is supervised directly at a ministerial level. The goal of a proper design, pursued by both sides, is the "creation of a quality intervention and technically valid, in accordance with the best relationship between the benefits and the total costs of construction, maintenance and operation" .

Framework

Snapshot: The problem identified

The main problem that is intended to be solved is due to the necessity of renewing the terminal at the end of a service cycle. The possibilities are renewal/expansion or substitution when the airport reaches its ultimate last service life cycle . It is necessary to evaluate them according to the objectives of the capacity of the structure over time, the adequacy of the level of service offered, the environmental sustainability of technological and architectural solution, compared to

the entire life cycle cost.

The research, that is at a starting point and that is going to be presented in this essay, refers to the European and the Italian contexts.

The operating context

In the following paragraphs the problem leading to the research focus is described more in depth.

The European picture

The European context is now defined by the so-called "single sky" for air transport. The frame of needs is indicated by Eurocontrol report "Challenges of Growth" and the European Programme for Research H2020 - Mobility for Growth.

Here is clearly fixed a frame of growth in the air transport demand; the growth, of course, involves even Europe. The single airport will be invested by the problems of managing the air traffic of the system. It is a knot of the entire air transport net, through which the traffic of vehicles and of passengers is moved.

According to forecasts, Europe, as a part of the global trend, will face an increase in demand for air transport, which will remain unmet; the unsatisfied demand for air transport will be 1.9 million flights in 2035. Achieving and maintaining the capacity of an airport in a congested network is therefore one of the challenges identified by the European system. In addition, the challenge of promoting sustainable growth of the entire air transport network and the resilience to climate change has been underlined.

Design of an evolutive terminal

An airport terminal, as was mentioned in the introduction, is part of an overall infrastructure (the airport), which is characterized by the need to initially be oversized. At the scale of the airport terminal, the capacity is achieved with proper programming, planning and design. The terminal must be able to accommodate flow of users (passengers) increasing over the years. The building, which has to process an increasing number of passengers, will be characterized by subsequent service cycles, short and well defined, that will show as a whole the entire life cycle. Over time, the terminal (that was initially oversized) reaches

an inadequate Level of Service (LOS) , due to the saturation of space.

Also other causes condition the configuration of the service and life cycles, in addition to growth and capacity. Among these can be counted obsolescence of technological systems and subsystems, IT systems, machinery (e.g. BHS system), etc.

Thus, the terminal is designed to develop, ending more than one service cycle, until the completion of the entire life cycle. At the end of each operational (or service) cycle it is necessary to evaluate between the possibility of expansion and replacement of the building.

The challenge in planning and design actions is also in the pursuit of environmental and economic sustainability of the building (which is another European target), given the short service cycle of the airport terminals. These elements are all necessary when introducing a new design action.

Towards a solution

Snapshot: Hypothesis of solution

The main idea is to enhance the tools that are currently used by the design team, focusing on the cyclical nature of the terminal operation. The aim is to merge the architectural design with the concept of cost, intended as a parameter for measuring the efficiency of the solutions analyzing the life cycle of the terminal. To stress the economic parameter in architectural design means also to relate the architectural design and the environmental issues.

Life cycle costing of the design options at the end of the service life is an interesting tool, from the point of view of the design team. Beside other tool already used in the design process (e.g. LOS analysis), it can direct the design action towards the best design solution. LCC analysis, indeed, considers the entire life cycle of the design option (not only the initial costs of construction) to measure its cost, relating it to the requests of environmental and economic sustainability. The evaluation of the life cycle cost of the design option could help in the decision process, directing the following design steps.

LCC analysis, applied to the airport terminal design, should be integrated with a qualitative analysis of the architectural solution and

with a quantitative analysis of the level of service offered over time.

This kind of analysis, of course, is intended to be before the construction; it could be followed by the monitoring of the operation costs of the terminal, in addition to other kind of monitoring actions already adopted by the airport operator. In this way it could be possible to intervene when, where and in the way it is necessary.

Essentials of state of the art

The airport terminal is a building project in evolution, that at the end of service life is renewed/expanded or substituted if it is quite coincident with end of its life. This cyclic nature must be definitely faced during the design stage, considering the economic and environmental aspects, beside considerations about the level of service. Architectural design is usually oriented to the consideration of the only construction costs, which are not sufficient in the case of a strategic and evolving building. A different approach that takes care of the life cycle costs is necessary. On one hand, the approach pointed out by an ACRP research (described in the following paragraph) faces the life cycle proposing a method of a business-drive planning (instead of cost-oriented). On the other hand, a solution in the decision process is the life cycle cost analysis of the options (touched on before).

A business-driven airport planning

From 2006 to 2011 a research program has been conducted, promoted by Federal Aviation Administration (FAA), inside the Airport Cooperative Research Program. Its aim was to produce a step-by-step guide to conduct the designers in an evaluation of the design options of an airport terminal.

The process of evaluation proposed by the Guide is flexible and clear. It is all focused on the concept of business-driven planning and indicates different economic analysis at different stages of the design/planning action. At a first stage, the team acquires and establishes clear and achievable aims. Then it will be possible to formulate the design options, responding to those requirements; then the analysis process (financial analysis and comparison with the previous objectives) will indicate the best solution.

The researchers, referring to the American context, have not found any literature that could relate the economic analysis in the design process with the design options. The research team is aware that some airports use tools for the management of the facilities, but their

number is little and does not comprehend the airports that have been interviewed during the research program. In this program it has been pointed out the importance of considering the total life cycle costs, instead of just the initial capital cost. This kind of analysis is usually not included in the master plan action. But it is clearly important in such a stage, previous to the design action.

The life cycle cost analysis in construction

On the other hand, the literature leads, of course, to the application of the Life Cycle Cost analysis to the building and constructed asset (ISO 15686).

In the method proposed by ACRP, which, however, is focused on a vision of the life cycle, the LCC analysis is only one of the steps you must take to achieve a business-driven project and at the same time is not highlighted effectively the element of environmental sustainability. Then, the application of life cycle costing is only one of the analysis required by the guide ACRP that has been treated before. In the guide, in fact, LCC is required at the time of the definition of objectives; it is not included at the stage of comparison of project options.

Life cycle cost analysis is flexible. The integrated project team may choose to introduce it in the planning stage, or in the design phase; to analyze the outcomes of the project activity, or to compare two different projects. It allows you to keep under control the costs of the entire life cycle of the project solutions and to compare them, without losing sight of the impact of environmental sustainability in the economy of the final project.

The international standard ISO 15686 has been adopted in the Community unevenly. In recent years the European Union has commissioned a research program aimed at identifying a common procedure at Community level for the application of that legislation related to the construction industry. At present, the international standard ISO 15686- 5 (and all the corresponding series) has not been adopted in Italy. The Government is planning the adaptation of the procurement process to the European trend; it follows the need to adopt also in Italy the LCC as a way to achieve the Green Procurement.

Configuration of the research path

Goals and beneficiaries

The ultimate goal is to provide an operational tool for designers and supervisors, aimed at the project management of the airport terminal. It should be capable of adding quality to the final product, by accompanying the development of design alternatives with an economic analysis conducted on the entire life cycle.

Methodology

The identification of the next steps of the research, for now only configured at a preliminary stage, will come from the state of the art integration, with the assessment of the procedures actually used by the Italian and European airport owners to monitor the life cycle of the terminal, to define its end, to direct the design process from the economic point of view. The search path is then characterized by an initial modeling phase of the life cycle of an airport terminal, and the continuous monitoring of the relevant literature and of regulatory process. Then, a first draft of an operational tool (including numerical data and quality of the environments of the terminal in addition to the data provided by an LCC analysis) will be prepared. It will be essential to the comparison with other research environments, operating in the two areas covered by this research (economic and planning). This will correct and finalize the instrument. To conclude, it will be necessary to apply the tool to a proper case study.

References

EUROCONTROL (2012) Challenges of Growth 2013 – Summary Report

EUROCONTROL (2012) Challenges of Growth 2013 – Task 6: The Effect of Air Traffic Network Congestion in 2035.

EUROCONTROL (2012) Challenges of Growth 2013 – Task 8: Climate Change Risk and Resilience.

OFFICE OF GOVERNMENT COMMERCE (2007) Achieving Excellence in Construction Procurement Guide - Whole-life costing and cost management.

OFFICE OF GOVERNMENT COMMERCE (2007) Achieving Excellence in Construction Procurement Guide - Sustainability.

OFFICE OF GOVERNMENT COMMERCE (2007) Achieving Excellence in Construction Procurement Guide – Project procurement lifecycle: the integrated process.

ZAMAGNI A. (2013) From LCA to Life Cycle Sustainability Assessment: concept, practice and future directions. In "International Journal of Life Cycle Assessment.

ESPOSITO M. A. (2010) Tecnologie di Progetto per il Terminal Aeroportuale", FUP, Firenze.

TROMBETTI M. (2014) Il ruolo di Enac nell' airport design, in "World Architecture Seminars 2014 – JAHN Airport Design", Dipartimento di Architettura – UniFi, Firenze, 2014 (*publication pending*)

ENAC (2006) Circolare Enac Serie Aeroporti APT 21.

AIRPORT COOPERATIVE RESEARCH PROGRAM (2012) Report 068 – Guidebook for Evaluating Terminal Renewal Versus Replacement Options", Transportation Research Board.

RICONDO&ASSOCIATES INC. (2012) Final Report – Evalutating terminal renewal versus replacement options", ACRP,.

INTERNATIONAL STANDARDISATION ORGANISATION (ISO), (2006) ISO 15686-5: Building and Constructed Assets – Service Life Planning: Part 5 - Whole-Life Costing", ISO, Geneva.

LANGDON D. (2010) Development of a promotional campaign for Life cycle costing in construction: a common methodology – Final Report.

LANGDON D. (2007) Life cycle costing (LCC) as a contribution to sustainable construction – Guidance to the use of the LCC Methodology and its application in public procurement.

LANGDON D. (2007) Life cycle costing (LCC) as a contribution to sustainable construction: a common methodology - Literature Review.

LANGDON D. (2007) Life cycle costing (LCC) as a contribution to sustainable construction: a common methodology - Specification framework for software development.