"Green" terminals: the Italian state of the art. Qualitative overview of the current situation in core network airports

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Abstract

The paper reports the results of a study that was aimed at revealing the state of the art of green terminal design in Italy. The Italian airport network was reorganized in 2013 leading to a classification in core and comprehensive networks. The survey involved the ten infrastructures of the core network. A brief introduction of the network is provided in the paper.

The importance of green terminal design is due to the very short life cycle of passenger terminals (10-20 years). Moreover, the entire airport has a great impact on the environment. The European strategy, both in the construction and in the transportation industry, is focused on a sustainable approach both in the project design and in operation. Besides environmental sustainability, of course, social and economic sustainability have to be considered in airport planning and terminal design.

The study has been structured with reference to some key issues in the green approach. These were used to formulate a survey, that consisted of qualitative and quantitative questions. The aim has been to obtain a synthetic but efficient picture of the state of the art of Italian green terminal design, made by the technical departments of the airports themselves.

The study reveals a static situation concerning the level of sustainability of passenger terminals and an attention to sustainability topics which is not at a competitive level. While international airports are growing in competitiveness, adopting new and innovative green architectural technologies, in Italy the process is slower. The present airport terminals are, in most cases, old buildings, despite the fact that in other countries the life cycle of these structures is quite short. In fact, a terminal life cycle usually ends with the end of the effectiveness of the terminal itself. Italian Airports are now slowly recognizing the environmental, economic, and social importance of a sustainable approach in terminal design, while in other countries this is already considered a real challenge.

1. Introduction

The government directive act for the Italian airport development plan (January 2013) is aimed at a reorganization of the airport network in terms of infrastructure, management and service quality. This document incorporates European directives, which aim at the creation of a Trans-European Network-Transport (TEN-T) in the field of air transport, as well as in other transport sectors. The transport network TEN-T is intended to divide the Community transports into two levels: a Core network, the backbone of the European common market and a Comprehensive network, the global network that provides full coverage of European boundaries. , This action has identified airports belonging to the European Core network, namely those of primary interest, necessary to provide the main transport channels, both at European level, and the national level as well. This reorganization first introduces the Italian airport system.

Furthermore, a significant worldwide growth of air transport demand is expected in the next few years. Despite the economic crisis that has limited the numbers that had been foreseen in recent years, the demand continues to grow in Europe although not so rapidly. The decision to identify an airport Core network, means that the progressive growth in demand for air transport in Italy will be indirectly conveyed to a limited number of infrastructures, ten to be exact. It is hoped that there will be a rise in the level of quality, and thus, efficiency and safety of the service offered to passengers and benefits for European and national economies are also expected.

For this reason, our research focused on understanding the state of affairs in the ten airports that fall within the Italian Core network and the state of affairs regarding issues of primary importance concerning architecture, environment and territory. All the issues considered are equally important in airport terminal design, given the ambition and complexity of facilities of this type. The infrastructures included in the Core network are: Roma Fiumicino, Milano Malpensa, Milano Linate, Bergamo Orio al Serio, Venezia Tessera, Bologna Borgo Panicale, Napoli Capodichino, Palermo Punta Raisi, Torino, Genova.

2. Presentation of the problem

A. Aims of the survey

This study was conducted through a survey. The survey was carried out for the purpose of obtaining a concise picture of the Italian core network in relation to many issues: the

design of the terminal spaces considering the standardized international method, the level of attention and adoption of "green" building technologies, the development of economic strategies, the local territorial accessibility to strategic airport infrastructures, the architectural accessibility in passenger terminals. Ultimately, the survey was aimed at understanding the state of the art in Italy in order to encourage a discussion comparing them with the international targets and standards.

B. A list of the Italian Core network airports

A list of airports, addressed by the questionnaire used in our research is shown below. They are listed in descending order by number of passengers per year, with an indication of the location, name and acronym by IATA (International Air Transport Association) encoding:

- Roma Fiumicino "Leonardo da Vinci" (FCO)
- Milano Malpensa "Città di Milano" (MXP)
- Milano Linate "Enrico Forlanini" (LIN)
- Bergamo Orio al Serio "Il Caravaggio" (BGY)
- Venezia Tessera "Marco Polo" (VCE)
- Bologna Borgo Panigale "Guglielmo Marconi" (BLQ)
- Napoli Capodichino "Ugo Niutta" (NAP)
- Palermo Punta Raisi "Falcone e Borsellino" (PMO)
- Torino Caselle "Sandro Pertini" (TRN)
- Genova Sestri "Cristoforo Colombo" (GOA)

3. Performances taken into consideration

The analysis focuses on passenger terminals and, in some cases, on the infrastructure landside by exploring the issues that make its design a very complex and multifaceted challenge. For this reason, an introduction to the issues under

1 – The Italian Core and Comprehensive airport network.

investigation is provided in this section, namely the question of space design, intermodality, building technologies and the "green" terminal concepts.

A. Designing spaces through international standards

An airport passenger terminal is a building that is used to process the passengers from their entrance until boarding and from landing until exiting. Its main job is to accommodate the functions needed for boarding. Boarding stages are mutually consequential and the passengers have to go through all of them in order to reach their departure gate. Clearly,it is necessary that the whole process, say from the entrance to the gate, be extremely efficient. The requirements for efficiency are accompanied by the need to make the process enjoyable and pleasantly memorable. Passenger satisfaction is closely related to the duration of the process (i.e.,waiting times related to the length of the queues). In fact, in the design development (and beyond) we consider the comprehensive concept of passenger experience that today is one of the greatest concerns of an airport society.

Passenger flow peak (TPHP) is the reference for a terminal being dimensioned properly. As the passenger flow always varies, both during the day and throughout the year, the terminal has intensely busy times which must not undermine the processing system. Moreover, from the time that a new terminal is opened, there will be a continuous increase in flow over the years. The terminal building must be designed in a flexible way, to effectively process this growing flow until the end of its life cycle, followed by its demolition and replacement. In fact, the life cycle of the terminal is composed of one or more service cycles, which are characterized by the refurbishment or expansion of an existing terminal.

Given all this information and input, a proper design of terminal spaces is needed. Since 1975 IATA (International Air Transport Association) has offered and updated spatial standards for the evaluation of the terminal spaces and calculation formulas for airport design. Established Levels of Service (LoS) make it possible to assess the quality of the service offered to the passenger. To this purpose it is necessary to compare the design values with appropriate threshold values, expressed in m^2/pax or time, etc. Spatial performances are evaluated with a mark from A (which corresponds to the maximum) to F (that is the collapse of the processing system).

In addition, when designing and dimensioning the spaces of a terminal, paths should be plain and intuitive, with a clear orientation for passengers. A good orientation must also be guaranteed when designing the retail spaces (they are a source of huge non-aviation revenues for the airport companies), since these should not be a hindrance to the rigorous and timely processing of passengers. In Asia, the concentration of retail areas within the terminals is usually high. This turns out to offer a substantial revenue for the owner; for instance, in Indian airports, their revenue is in a range of 50% to 70 % of the total. Similar numbers are not achievable in Italy, where such services are seen by the Regulatory Authority as a barrier for a proper passenger processing.

Other important revenues for the airport society come from the real estate outside the airport boundaries. The terminal involved can accommodate activities that are in symbiosis with air transportation and that can benefit from proximity to the airport infrastructure. In fact, the airports have become over the years a "centrality" (as urban planners would say). These house different facilities and services all clustered around an intermodal hub. The more efficient the hub is, the more businesses that benefit from airport proximity will be located in its vicinity, as we can learn from the interesting examples of airport cities (the core concept of an "aerotropolis") around the world. For instance in Asia, while we can find activities such as "techno cities" in the airport surroundings (e.g. Hyderabad Airport, India), it is also possible to find real "aerotropolises" (e.g. Andal, Cochin e Bangalore).

B. Building technologies in a "green" terminal

1) Disposable airport terminals

When there is an initial oversizing of the terminal, there will be a progressive saturation of its capacity which will happen in a few years. At that point, the airport company will face a crossroads: the choice of decommissioning the terminal to build a new one properly sized or the alternative of expanding the existing one. In each of these cases, the predominant element is speed and systemic concept of the construction/demolition processess. It is necessary to reduce the inconvenience for passengers, for airlines and, thus for the airport owner itself. From an operational standpoint, a terminal expansion becomes operative gradually, module by module, up to full operation until the end of construction. Work is accelerated during the design stage, by the restricting the use of traditional technologies It would require time for drying and it also has environmental and economic impacts for demolition.

When dealing with a building with a very short life cycle (of a few decades, varying between different countries and case by case), another key issue is the environmental impact created by the installation and disposal of a huge quantity of materials in a short time. Consequently, construction elements that can be easily reused and recycled/recyclable should be favoured for waste reduction. Therefore the continuous growth and evolution of the terminal should encourage the selection of certified materials.

2) Energy efficiency

The efficiency of the terminal begins with the preliminary planning stage, and continues with the detailed design and

the design for construction. In each stage the temporary nature of the terminal itself should always be considered. As explained in the previous paragraph, terminal life cycle is scheduled in a few years, given the increasing quantity of passenger traffic and the related need for infrastructure development. A period of 10-20 years is frequently observed. Therefore it is necessary to use recyclable and reusable components,and it is evident that there should be a preference for dry laying rather than wet.
This, on the one hand, requires less energy for their disposal, and, on the other hand, prevents waste of energy for the production of new material. For instance, metals are currently used in constructions with large spans. Energy costs for recycling are less than the ones required in the production phase.
An airport terminal is an industrial building of considerable size, whose operating costs are independent from the number of passengers going through it. Energy consumption is necessary to provide lighting; to provide operation of electronic devices and equipment necessary to perform boarding activities, and to provide heating and cooling systems. While it is important to increase green energy consumption, it is also necessary to optimize the use of energy itself.
In recent years, many Italian airports have solved the problem of reducing their power consumption, through a review of the electricity management plans and through simple maintenance tasks such as replacing light fixtures with LED elements. Others have introduced systems for green energy production, by applying them on the envelope of the terminals themselves.
Moreover, the designer plays an important role by introducing efficient and innovative systems for energy use optimization. An interesting example is the Bangkok International Airport terminal, designed by JAHN Architects. Columns of air treatment have been properly studied. These ensure that only the lower volume of air (the ones actually lived in by passengers) is heated/cooled. The remaining air volume becomes an insulation cushion that stands between the envelope and the lower air volume.
Furthermore, in airport terminals it is difficult to control the heat loss, because of the presence of large glass surfaces, required for natural lighting. There must be a proper balance between thermal insulation and large air volumes to be treated. This also has to be considered by the design team, who must come up with effective and experimental solutions. The goal is to design a structure that could be built rapidly. This would produce considerable life cycle savings through proper green solutions. Furthermore, it could be aesthetically improved by good design.

C. Green Airports

Let us now widen our focus and move on from the terminal area to the entire airport view. This includes runways, taxiways, aprons, hangars, control towers, offices, and other facilities. In short, the airport infrastructure looks like a city. As such, it imports goods and produces wastes, it consumes energy in relation to the various functions and services by its subsystems, and consumes large amounts of water for very different purposes.
Given the European policy framework, environmental sustainability becomes one of the requirements in airport design and operation. The European Climate-Energy Package is meant to establish a goal for European partners in terms of climate change prevention. This goal was known as "20/20/20", and has now been updated with new goals for 2030: Europe should reduce gas emissions by 40%, increase energy savings to 27% and increase green energy consumption to 27%. In the transport industry this goal has also been set for 2030. This step is intended to reduce CO2 emissions until 2050. By this time, CO2 emissions are going to be 60% lower than in 1990. The near future and the immediate present in Italy for airport planning are taking these international objectives into consideration.

D. Designing accessibility

1) Local accessibility and environmental sustainability
An airport is the gate to a city and its surroundings; in many cases it is the gate to the country, for people and goods. It is a node where many transport modes get in touch: air, road, railway. For this reason it is essential that the intermodality of this hub work well and efficiently, in order to give support to the local, national and international economies. By 2050 the main European airports are going to be connected with high speed train service. This is a common goal for the European economy. It is also an essential step for achieving European environmental goals, with a considerable reduction of CO2 emissions. In fact, European travelers are already able to reach most airports by train (almost 50%); in the USA passengers still prefer to reach airports by car. High speed train service could increase these numbers.

2) Design for all for social sustainability
When assessing sustainability it is necessary to consider also the social aspects of a global increase in passenger flow. With an increasing number of passengers worldwide, even the number of elderly passengers, children, and disabled increases. A sustainable design should provide terminals with space accessibility and should address every passenger category. Design for all should mean, for instance, that the main spaces for queuing should be provided with seats; it should mean a reduction in the distances to be covered by foot and it should mean clear signage and a good light-design.

4. Results

A. Methodology

This survey involved the infrastructure development and planning offices of ten airports that are part of the Italian Core Network. A questionnaire was submitted, dealing with the main topics that have been written about in the preceding paragraphs.

The following airports answered the survey: Genova (GOA), Torino (TRN), Napoli (NAP), Venezia (VCE), Milano Linate (LIN), Milano Malpensa (MPX).

In some cases it was necessary to submit a second version of the same questionnaire; this was shorter and thus did not take into consideration some of the topics.

Further data were used for running controls and making additionss to the data collected. These additional data were collected through documentary research. The references in this case were: web databases, program contracts, service charters.

In this paper we will not show all the graphs and tables that were compiled and created using the results of the survey, in order to give a more concise overview, however, we will touch upon every consideration that ensued from the answers received.

The purpose of the questionnaire was to comprehend and outline the approach to sustainability and related issues for each of the airports involved from a qualitative point of view. The aim was not, therefore, a detailed technical assessment for each of the topics covered; in fact, this should be further investigated through separate and properly conceived and designed surveys.

The airports addressed in this paper with their IATA codes, are:

- Roma Fiumicino "Leonardo da Vinci" (FCO)
- Milano Malpensa "Città di Milano" (MXP)
- Milano Linate "Enrico Forlanini" (LIN)
- Bergamo Orio al Serio "Il Caravaggio" (BGY)
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- Torino Caselle "Sandro Pertini" (TRN)
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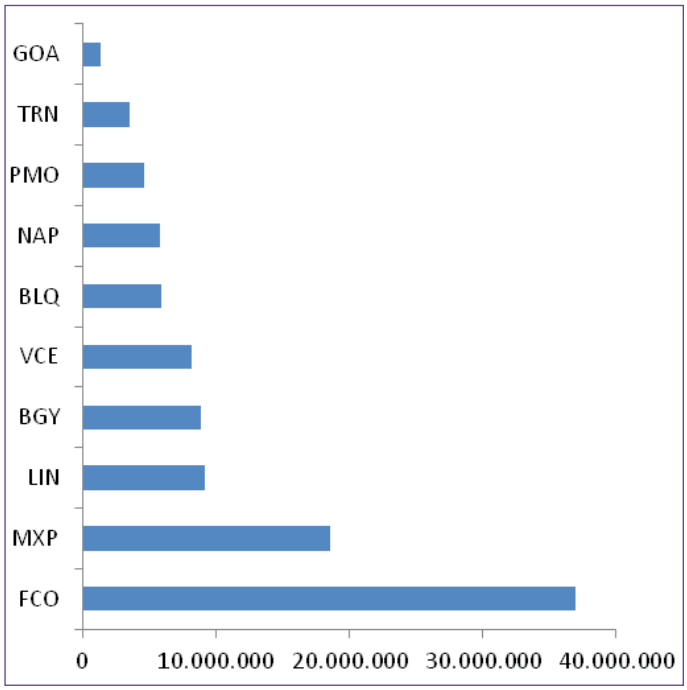
B) Qualitative profile of the airports

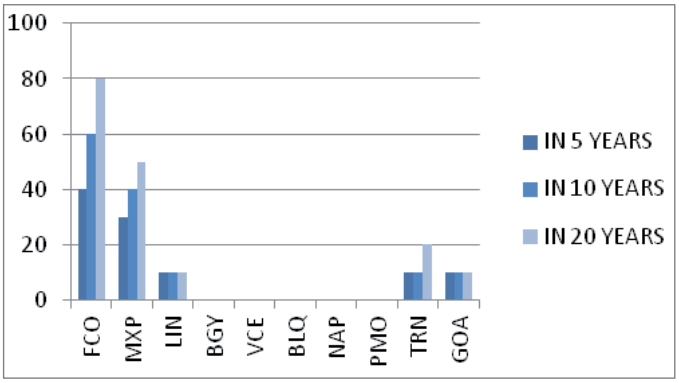
1) Size, numbers and future growth

The 10 core network airports are not the first ten airports for their annual numbers of passengers and cargo. In Italy, airport capacity is limited. The only airport that exceeds 30 million passengers per year is FCO. The concentration of infrastructures belonging to the Core network is in proximity to the major economic centers of the country, in consistency with European goals. The rest of the countrys is served by the Comprehensive network airports.



2 – Core network airports for passenger flow in 2013. Reference: Assaeroporti data.

Fiumicino is the main Italian airport and the number of annual passengers (chart 2) leads to a higher number in square-feet for the terminal system, a higher number of runways, annual movements, consumptions and savings than any other Italian airport (table 4). Second comes the Milan area which, with its three airports, exceeds the Rome-Fiumicino numbers. All the other infrastructures follow in the list (chart 2). The list ends with Genova, with its limited cargo and passenger numbers per year, although this airport is near to a leading Italian sea port.



3 – Passenger traffic forecasts, in ranges. Source: survey.

The expected growth of passenger flow is proportional to the current number of annual passengers (chart 3). Within the

next 20 years Fiumicino is going to reach the threshold of 80 million passengers, with respect to a current amount below the threshold of 40 million. Genova now accomodates traffic amounting to 1,380 M, while it is expected that in 2027 it will meet and exceed the threshold of 3 million passengers. In both cases the number of passengers at a distance of roughly two decades doubles.

It is easy to evaluate the larger airports in the range indicated in the survey (chart 3). The review should be conducted by means of reduced ranges in order to also evaluate the growth of smaller airports. In any case, the data shown in chart 3 are significant, because in the next few years the threshold of 10 million pax per year will not easily be exceeded.

Below is a table summarizing some key information processed by the Italian Civil Aviation Authority (ENAC), in order to complete the framework for the infrastructures that were observed in the survey (table 1).

Given the topics set out above, we asked the offices participating in the survey to express a qualitative judgment about the adequacy of their current terminal systems. This qualitative opinion was given about the adequacy of their current terminals with respect to the forecast of increase in passenger flow. More than half of the responses received indicated a lack of capacity of the infrastructures as now configured. This is an interesting factor that should be carefully analyzed in the planning actions of each one of the survey participants.

C) Green Airports and Green Terminals

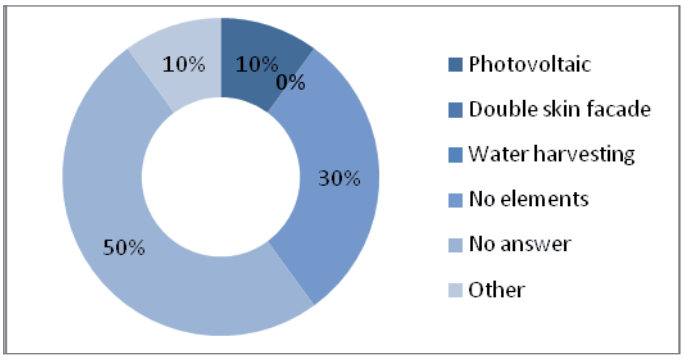
When addressing the question of green terminals, reference should be made to a considerable number of evaluation criteria. As described in the opening paragraph, some topics of interest were identified. For a quick understanding and an immediate response to the questionnaire, technological solutions adopted in terminal buildings and the materials used were investigated.

The power management and consumption of a terminal system begins with a proper design of the envelope. The envelope was examined for its contribution (positive and negative). Then we asked the recipients some questions, in order to understand if the envelope was properly designed, with satisfactory results in terms of heat loss and energy savings. It was shown that most of the envelopes analyzed were designed without the use of technological solutions contributing to the reduction of energy consumption; no further maintenance work offered any solutions of this kind (chart 5). The contribution of the envelope to power management could be "active"; in this case the reduction of power consumption is met by the envelope energy production supporting the plant system. Active envelope technologies are typically solar or photovoltaic panels. The contribution could also be passive; in this case, these technologies minimize the activity of the plants in the terminal by controlling heat transfer and lighting. For instance, passive technologies are screening systems for the control of solar radiation and for the reduction of glare; buffer spaces for the protection from cold and heat in both the winter and summer periods. As chart 5 clearly shows, since the actual terminal systems are not recent buildings, the attention to integration in the envelope of green technologies is quite low. Therefore the envelopes were not designed already integrated with photovoltaic systems (whose contribution in the energy balance of a passenger terminal is, in any case, very small). The envelopes were been provided with passive solutions in relation to the local solar diagrams: neither solar greenhouses, nor double skin for the reduction of heat loss, nor screening devices.

There are many constraints and issues in airport design . These come from international standards, the masterplan, the functional requirements that impose fixed patterns for the circulation of the flows and so, up to now the environmental requirements and technologies associated with these have been of minor importance. But a proper planning must take into account sustainability issues.

4 – Italian Core network airports. Source: Enac (2012) Italian Aiports Atlas.

	Pax.	Mov.	cargo (t)	RW	Surface (m^2)	Pax area	Commercial
FCO	36.980.911	309.719	143.244	4	318.200	48%	15%
MXP	18.537.301	174.892	414.317	2	315.000	40%	11%
LIN	9.229.890	120.463	19.807	2	85.000	33%	17%
BGY	8.890.720	74.220	117.005	2	35.000	44%	14%
VCE	8.188.455	84.233	40.887	2	53.000	48%	13%
BLQ	5.958.648	67.529	40.645	1	44.000	49%	10%
NAP	5.801.836	61.113	5.282	1	30.700	58%	20%
PMO	4.608.533	42.925	2.367	2	35.400	50%	3%
TRN	3.521.847	51.773	10.543	1	51.150	51%	27%
GOA	1.381.693	24.416	3.430	1	12.500	51%	17%

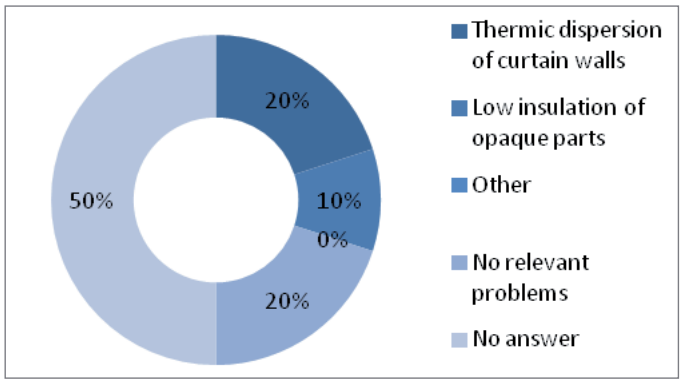


5 – Active or passive power integration envelope systems. Source: survey.

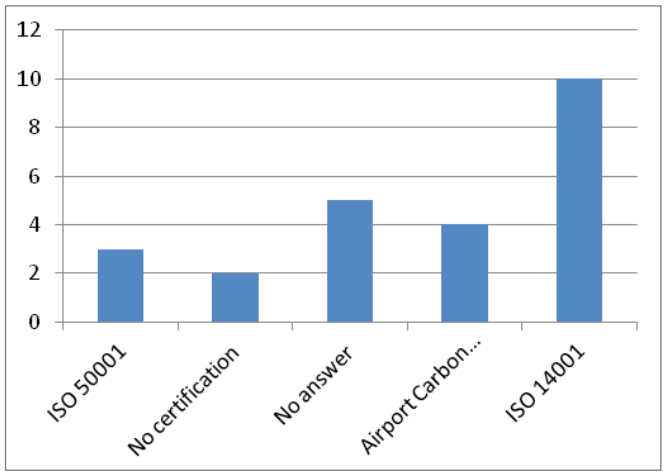
Moreover, the insulation performance of the envelope is not satisfactory. The terminal envelope is inadequate both in the transparent parts and in some cases in the opaque parts (chart 6). In fact, three airport planning offices reported that the glass parts showed excessive loss. They intend to limit this deficiency with actions such as applying films on curtain walls in order to limit the dispersion and accumulation of heat.

However, curtain walls are essential in a passenger terminal. In fact, given the size of the terminal floors they are necessary to ensure an adequate natural lighting.

There are numerous kinds of environmental certifications of the buildings and they have proliferated in recent years. The most common certification scoring method is certainly LEED, the American protocol recognized worldwide especially for buildings (in this specific case, the terminal). Green Airplanes and Energy Star are always used by Americans; the UK recognizes the Breeam, and the list goes on. Consistent with what has been written so far, none of the terminals we examined is LEED certified. Only a few cases have an environmental certification of the infrastructure (eg: Airport Carbon Accreditation). The Airport Carbon Accreditation assesses the performance in terms of CO2 emissions. Three airports have an ISO 50001 (Energy Management Systems) certification.

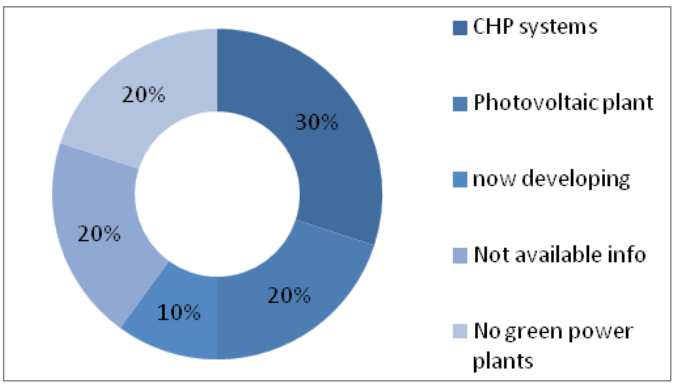


6 – Level of satisfaction with the envelope insulation performance. Source: survey.

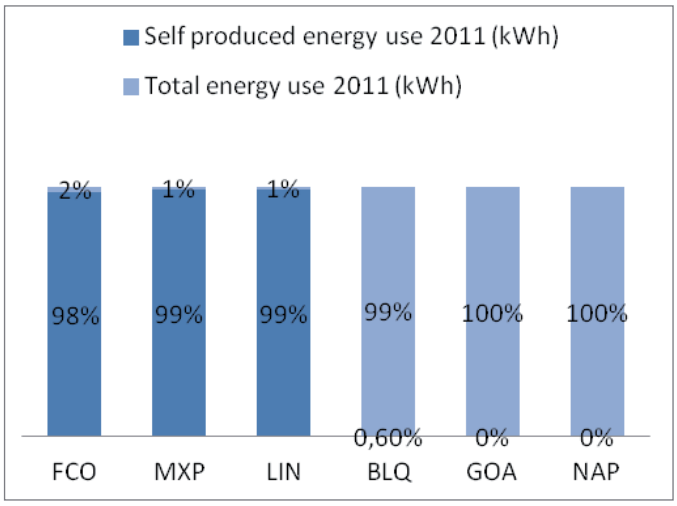


7 – Environmental certifications: infrastructure and terminal. Source: survey.

The power requirement of an airport is significant, depending on the number of facilities, on the extension of the areas and volumes and on the climate. The power is mostly taken from the outside. In some cases, it is integrated with energy produced directly by facilities of the airport. This is the case of power plants for the production of renewable energy. These are integrated to the building envelope or, more often, consist of independent plans. The numbers (in kWh) actually consumed are not available in all cases. Energy is produced directly at the airport when its size would cause excessive expenditure. In these cases, the airports become self-sufficient. Coverage of energy needs is achieved by CHP plants, which in some cases produce energy that is sold even outside. As revealed in chart 9, these numbers are very high (eg: 167 852 926 kWh for CHP consumed by FCO in 2011). In the present analysis the production of energy for CHP has also been factored in . CHP systems provide a savings thanks to the production in the same process of heat and electricity, through a reuse of damps for heating. Given the huge consumption and thus the power production necessary for an airport, a process of this kind has a much greater impact on the environment, compared to a photovoltaic system, since its efficiency is much lower (charts 8, 9).

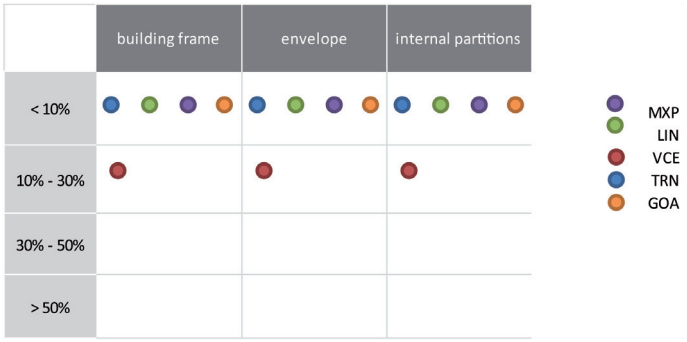


8 – Power plants in situ. Source: survey and financial statements.



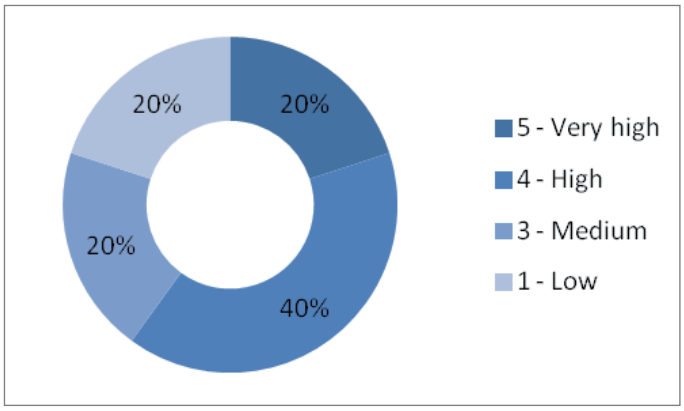
9 – Power consumption in relation to self sufficiency. Source: survey and financial statements.

The offices participating in the survey gave an indication of the percentage of building materials (used in their terminals) equipped with environmental certification; the numbers are very low and only in one case exceeded 10% (table 10). To use certified materials in terminal design (for a completely new building or for retrofitting the envelope) means choosing a production process with lower environmental impact; choosing to userecycled materials in a new product; choosing the possibility of recycling the material itself at the end of its life. Moreover, we have previously addressed the issue of Airport Carbon Accreditation. This kind of certification takes into account a huge number of parameters, including: direct emissions; indirect major energy-related electricity purchased and heat; indirect emissions such as secondary transport materials, outsourced activities, waste disposal. In a passenger terminal this issue can be controlled by choosing certified building products.



10 – Certified materials in airport terminals. Source: survey.

In conclusion, an easy to understand graph summarizing the contents of the previous charts is shown below. The airports participating in the survey were required to make an assessment about the importance of sustainable technologies and approach in their planning and in development policies, at the state of the art (chart 11). The answers are a confirmation of the results assessed by previous charts.



11 – Importance of green efforts in airport planning actions. Source: survey.

D) Airport accessibility

In a second stage, we analyzed accessibility. This means local accessibility but also accessibility in terms of design for all, as illustrated in the opening paragraph.
Intermodality is a critical element in the Italian network. This is crucial to increase the catchment area of the airports, to give a positive contribution to the national and local economies, and to contain the environmental impact of the national transport system. Throughout the country there is a lack of overlap between the various transport networks (and their hubs), as we are going to demonstrate below.
The airports studied are interconnected with road transport. They all have a number of parking areas for private vehicles, a primary source of non-aviation revenues; they are also well connected with the nearest towns by bus services, which have their appropriate parking areas or stations.
Unfortunately, the airports are mostly lacking direct rail connections. In many cases, it is necessary to cover the gap between the railstations and the airports by a special bus service. This is a confirmation of the absence of overlap of our transport networks. This deficiency worsens considerably if we look at the high-speed rail. An efficient connection with the high-speed rail is a target for the national agenda, and will be implemented in the next few years. In fact, the connection between air transport and high-speed trains began with the new connection Venice-Fiumicino (4 high-speed trains a day since December 2014). But t considering the growth of the passenger flow per year this decision was made by authorities too late. Unlike Italy, in Asia when dealing with these problems the planner starts from scratch. Asian airports are often built without having to deal with any existing infrastructure; while designing an airport, the planner imme-

diately envisioned a connection with high-speed trains. The result is much greater efficiency.

5. Discussion

The analysis carried out so far reveals the complexity of the national scenario. It is hard to find an example of a terminal building designed according to sustainability requirements, that could become a model for national and international designers. The planners have to deal with old buildings, which have grown for decades through additions and refurbishments.

Moreover, the national situation is fragmented: we have many small and limited infrastructures. The efficiency of the terminal begins in the preliminary planning phase and continues with the detailed design and the design for construction. In each phase sustainability should be achieved through the identification of requirements at a proper level of detail. The response to these requirements by the design team should then be verified at the end of each phase by the airport owner, who must also make sure that all the other requirements involved have been satisfied. In a preliminary and detailed design phase they are, for example, the compliance with capacity and flexibility needs and a proper management of the flows, issues that the airport owner is usually more concerned with, since they directly influence passenger experience. Attention has to be directed to these issues too, in agreement with the European trend both in the air transport sector and in the construction industry. Moreover, a sustainable approach to airport planning and design clearly has a direct strategic impact on cost savings during the life cycle of the infrastructure.

This survey aims to detect the state of affairs in Italy and environmental sustainability has been set as its major issue, but the revolution in planning and design should also include an integration with social and economic sustainability, as parts of the same sustainability concept.

This is an issue that, after much delay, is now finally consolidating. Again, the struggle to implement these requirements depends very much on the fact that our country always tends to maintain the existing rather than to get rid of what no longer satisfies efficiency levels.

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