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Corresponding Author: Mr. Pere Suau-Sanchez,

Corresponding Author's Institution: Universitat Autònoma de Barcelona

First Author: Pere Suau-Sanchez

Order of Authors: Pere Suau-Sanchez; Montserrat Pallares-Barbera; Valerià Paül

Abstract: Airport capacity continues to be one of the air transport issues that creates the most concern. The major environmental constraint for airports is the noise generated by aircraft. Annoyed communities living around airports have become a limiting factor for airport capacity and operability. This paper brings together the existing literature in the fields of airport environmental capacity, non-acoustic factors of noise annoyance, NIMBYism and environmental conflicts. We also analyze the socio-environmental conflict between Barcelona airport and the community of Gavà Mar. This case shows that the lack of trust between parties, the impossibility of predicting noise exposure, the absence of opportunities for civil society to speak and the difficulty of accessing relevant information foster annoyance and mobilization in the communities that live around the airport. In addition, it is shown that, in such a situation, communities' reactions can evolve to a post-NIMBY stage in which proactive attitudes replace reactive ones.

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Incorporating annoyance in airport environmental policy: noise, societal response and community participation

Pere SUAU-SANCHEZ*[1], Montserrat PALLARES-BARBERA[2] and Valerià PAÜL[3]

[1]Department of Geography, Universitat Autònoma de Barcelona, Edifici B – Campus de la UAB, 08193 Bellaterra, Spain
E-mail: pere.suau.sanchez@uab.cat

[2]Department of Geography, Universitat Autònoma de Barcelona, Edifici B – Campus de la UAB, 08193 Bellaterra, Spain
E-mail: montserrat.pallares@uab.cat

[3]Department of Geography, Universidade de Santiago de Compostela, Facultade de Xeografía e Historia, Praza da Universidade, nº 1, 15782 Santiago de Compostela, Spain
E-mail: v.paul.carril@usc.es

*Correspondance to: Pere SUAU-SANCHEZ
Department of Geography, Universitat Autònoma de Barcelona, Edifici B – Campus de la UAB, 08193 Bellaterra, Spain
E-mail: pere.suau.sanchez@uab.cat
Telephone: +34 935814805
Fax: +34 935812100

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Incorporating annoyance in airport environmental policy: noise, societal response and community participation

1. Introduction

This paper presents a discussion about noise as one of the main environmental elements that limits the efficient use of airport capacity, with the aim of including the issue of annoyance in airport policies. Several authors (e.g. Graham and Guyer, 1999; Madas and Zografos, 2008; de Wit and Burghouwt, 2008) argue that physical constraints (e.g. inadequate land-use planning) and opposition to airport capacity expansion (e.g. growing environmental concerns) make it difficult to provide enough capacity to satisfy the anticipated future demand. The main focus of this paper is based on the discussion of airport planning policies and the response from neighboring communities when capacity is expanded. Special attention is given to the importance of transparency and levels of trust for smooth community participation, the power of social agents to influence the decision-making process, and the capacity to predict and diminish noise exposure. It is argued that airport planning and management should integrate all of these factors in a comprehensive way.

Air travel is a fast-growing market. According to the Airports Council International (ACI, 2007), total worldwide passenger traffic reached an all-time high in 2006, moving almost 4.4 billion passengers: an increase of 4.8 percent, compared to 2005 (IATA, 2007). One of the dominant trends of the air transport industry is long-term growth, which has been of "the order of 5 percent a year worldwide, implying a doubling of traffic about every 15 years" (de Neufville and Odoni, 2003, p. 3). Furthermore, long-term traffic forecasts indicate that, by 2025, the number of

passengers will double and will exceed nine billion passengers (ACI, 2007). Other authors indicate that this could even happen by 2020 (EC, 2006a; Eurocontrol, 2008).

The above forecasts of air transport demand and airport capacity saturation were made before the 2007-2010 world financial crisis, which caused a 7% drop in seat capacity for the last quarter of 2008, compared with the same period the previous year (OAG, 2008). Although the 2007-2010 crisis is causing a drop in passengers, imbalances between capacity and demand continue to be present. In addition, by 2011 traffic growth will return to 4%, which will maintain the gap (IATA, 2008).

Nevertheless, "it is the environmental capacity of airports, much more than physical or financial restrictions, which cause imbalances and impediments to growth" (Coleman, 1999, p. 119). The major environmental constraint for airports is associated with the noise generated by aircraft, although aircraft coming off the production line today are about 75% quieter than 40 years ago (ICAO, 2007; Airbus, 2007). Technological improvement has had a positive effect on the number of people exposed to aircraft noise. Results shown by the Model for Assessing Global Exposure to the Noise of Transport Aircraft (MAGENTA) are clear: from 2000 to 2006 there was a reduction of 30% in the population within the 65dB Day-Night Level (DNL) contours. Despite this apparent reduction in noise exposure in airport contexts, Thomas and Martin (2003) argue that three important factors are exacerbating the levels of disturbance faced by people living in such contexts: (a) in spite of individual aircraft noise reduction, traffic has increased; (b) given the noise certifications of the International Civil Aviation Organization (ICAO) and the rates of growth, noise exposure is likely to increase, and (c) disturbance is a subjective issue related to the perception and tolerance of what is causing the disturbance.

The first section of this paper is devoted to the role of environmental factors in airport capacity and 'NIMBYism' phenomena, and the second to noise and non-acoustic factors of noise annoyance. The paper then turns to the case of Barcelona airport, which is discussed in relation to previous existing research. We emphasize the importance of taking into account non-acoustic factors perceived by neighboring communities in airport design –in both the planning of the physical setting and the operating terms.

2. The contribution of environmental issues to airport capacity and 'NIMBYism' phenomena

Airport capacity is made up of several elements (Figure 1), which must operate together; otherwise the whole system works less than optimally. Due to the diversity of infrastructural, air spatial and environmental components influencing airport capacity, the total potential capacity of a particular airport is rarely achieved because capability to accept a certain number of landings and take-offs does not, in practice, necessarily match other environmental or air spatial factors. This increases the problems of meeting demand. In particular, there is a group of factors related to environmental concerns that frames overall airport capacity: noise from aircraft and ground traffic, airside and landside emissions (especially CO_2, NO_x and fine particles), solid waste, water pollution, effects on biodiversity, visual impacts on landscape, etc. (Graham and Guyer, 1999; Upham et al., 2003; Goetz and Graham, 2004). Furthermore, policies directed to limit emissions (Directive 2008/50/EC in the EU, see EC (2008)) and to restrict the noise (Directive 2002/30/EC and Directive 2006/93/EC in the EU, see EC (2002, 2006b)) have a tremendous effect on the operational capacity of an airport (Table 1).

[Figure 1]
Outline of the components of airport capacity.

Environmental capacity is a broad term with many interpretations. A survey of airport stakeholders (Upham et al., 2004) reports that the environmental capacity concept has several interpretations: (a) the extent to which the environment (and the local community) is able to receive and tolerate, assimilate or process, outputs deriving from airport activities; (b) the component of capacity constraint at airports or airspace described by environmental factors; (c) the level of an airport's operational capacity at which those deciding on the future of an airport agree that the adverse environmental and social non-benefits arising from its development and operation outweigh the benefits that the airport would otherwise have brought; (d) the limit of environmental tolerance; and (e) a concept that allows for a certain amount of environmental impact without overt disruption.

[Table 1]

Some of these definitions anticipate the importance of community tolerance for airport environmental capacity given a particular land-use context. Tolerance becomes important because a determining part of the environmental impacts of a fixed airport is socially related. "Environmental capacity is constituted of social as well as physical factors, in the sense that many of its component limits are politically mediated" (Upham et al., 2003, p. 150). Thus, since limits are, in part, socially determined, the definition of environmental capacity should include the fact that this is not only a notion to be objectively considered and measured (Cidell, 2008), for instance, by sound-level meters. Environmental capacity could therefore be defined as the level of airport operational ability that can be reached after airport activity is limited due to socio-

environmental factors. The term "socio-environmental" is used here intentionally in order to stress that environmental issues are often taken into account only because of social response and concerns.

Socio-environmental issues often lead to public argument about contrasting visions of management and planning. This confrontation is usually presented as an intervention from the exterior responded to by local people (Paül, 2007). This relates to the Not In My Back Yard (NIMBY) concept. A notable phenomenon is the widespread occurrence of NIMBY-style campaigns of opposition to new airspaces (Adey et al., 2007). NIMBY refers to local opposition against an initiative determined elsewhere that has effects at a local level, notably its environmental qualities. NIMBYists are widely considered to be parochial, selfish and lacking in solidarity, working against the public interest and usually attributed to the dialectic opposite to it (Dear, 1992; McAvoy, 1999 and also, particularly in airport areas, see Humphreys and Francis (2002) and Adey et al. (2007)). For this reason, NIMBYism is considered as being a "syndrome". However, it must also be underlined that opposition to a noxious facility is driven by other elements such as the expected benefits emerging from the facility and lack of transparency and dialogue in the decision-making process. North American literature (Hestermann et al., 1993; Lake, 1993), French literature (Champris, 1997; Lolive, 1997; Subra, 2007) and Spanish literature (Nel·lo, 2003; Cruz-Gallach, 2006, 2008; Paül, 2006, 2007; Alfama et al., 2007) point out on this issue that NIMBY literature was not directly applicable to their respective case studies and they detected that apparent NIMBY conflicts have the potential to quickly culminate in a "post-NIMBY" stage, where the features that are supposed to form part of NIMBYism are mostly blurred. Two stages can therefore be identified. First, the "NIMBY moment", in which the conflict is more vigorous and the attitudes are clearly reactive, the reasoning is localist,

defending material interests and the affected citizens, and several demonstrations act as "catalysts" for the conflict. The second stage is the point at which NIMBY evolves into a developed social movement in which reactive attitudes are combined with proactive measures; the reasoning also starts to uphold collective values, and the range of actions becomes more diverse and includes other members of society, beyond "the strictly affected" (Alberdi Bidaguren et al., 2002). In the case of airports, May and Hill (2006) have shown how community groups near airports can achieve mature discourses and express a high level of aviation expertise.

3. Noise and non-acoustic factors of noise annoyance in airport contexts

The traditional approach to aircraft noise annoyance has been restricted to the definition of noise contours around airports. These contours indicate the maximum level of sound exposure according to the limits imposed by national legislation. This approach takes into account only the physical side of the problem and forgets about the social side of environmental tensions (see Cidell (2008) for a critical cartography of airport noise). In fact, a number of observers have stated that in some cases there is no correlation between the level of sound exposure and the number of complaints generated by aircraft noise (Lieshout et al., 2006; Gordijn et al., 2006; Lieshout et al., 2008). Noise level descriptors are not able to explain individual levels of noise annoyance (Bröer, 2006; Kroesen et al., 2008). Indeed, according to Guski (1999), approximately only one-third of the variation in noise annoyance can be explained by acoustic factors. What are, then, the other factors explaining noise annoyance?

The Oxford American Dictionary defines noise as a loud or unpleasant sound that causes disturbance. But noise is not just a matter of sound: "It becomes noise because of a particular appraisal of it. Therefore, understanding noise-induced

annoyance requires the understanding of judgmental, attitudinal and, thus, social processes" (Stallen, 1999, p. 69). If sound becomes noise because of a personal appraisal, annoyance is a psychological process in which non-acoustic, as well as noise factors have an effect (Figure 3). Several studies and surveys reveal that non-acoustic aspects are as significant as purely acoustic variables (Job, 1988; Fields, 1993; Guski, 1999; Baarsma, 2000; Bröer, 2006; Gordijn et al., 2006; Stallen, 2007a, 2007b; Kroesen et al., 2008; Lieshout et al., 2008).

[Figure 2]
Stallen's noise annoyance as a form of psychological stress framework.
Source: Stallen, 1999.

Stallen (1999, 2007a, 2007b) has developed a theoretical framework for environmental noise annoyance by considering it a form of psychological stress (Figure 2). This model is based on the psychological stress theory of Lazarus (1966). Stallen states that non-acoustic factors affect the relationship between sound exposure and annoyance. Noise disturbance creates difficulties for achieving a particular goal or action, including sensory and mental processes. Perceived disturbance is not the only determinant of annoyance; non-acoustic factors are also crucial in its generation (Figure 3). Perceived control is a major factor. Perceived control is identified with the predictability of a noise situation, the accessibility of information and transparency, trust and recognition of concern, and voice. High disturbance and high control may be less annoying than moderate disturbance and no control. Perceived control together with other factors influences the level of annoyance and the capacity to cope with it. Also, depending on the possibilities of standing up to the cause of dissatisfaction, the level of annoyance will be different. Coping with annoyance is essentially a reappraisal of the

personal-environmental situation. This reappraisal involves mental change including the formation of new behavioral intentions and the undertaking of corresponding actions. Subsequently, the generation of noise annoyance is essentially a dynamic process in which acoustic and non-acoustic factors (Figure 3) are appraised and re-appraised by the individuals on the basis of their needs and the resources available to meet them. Measures of noise annoyance therefore represent temporary states.

[Figure 3]
Non-acoustic aircraft noise factors.
Source: Flindell and Stallen, 1999; Stallen, 1999.

4. Methodological considerations

The empirical work was based on the analysis of a socio-environmental conflict motivated by the construction of a third runway at Barcelona airport, which caused noise annoyance in the communities living around it. The main source of information has been five semi-structured interviews: two with different municipal council representatives at the airport's Technical Working Group for Noise (GTTS), one interview with a local environmental organization, and two with members of the Gavà Mar Residents' Association. The interviews were selective, not representative, chosen taking into account the expertise of the five participants on the case. An additional interview was held with an air-traffic controller working at Barcelona airport to gain a better understanding of specific technical issues. The names of these people will not be revealed in order to encourage free expression of opinions and to ensure their anonymity (Taylor and Bogdan, 1986). Semi-structured interviews were selected as the most appropriate method as they allow the respondents to introduce new, unpredictable issues and the interviewer to follow up topics more flexibly. Semi-structured interviewing was conversation-like, with a checked set of questions and issues to be

discussed between the interviewer and the interviewee in order to guarantee that a consistent list of matters was dealt with while interviewing. The aim was to obtain a "sincere impression" rather than a "true answer" or the "analyst's opinion" (Ruiz Olabuénaga, 2003). In the interviews, interviewer attitudes showing distance, authority or privilege were avoided in order to maintain a critical attitude (see Crang (2002) for a debate on the establishment of standards in qualitative methods). In this respect Cochrane (1998) argued that interview-based studies often claim an authority in that they relay supposedly privileged and previously hidden knowledge. This authority could make it difficult for the interviewer to maintain critical engagement

As well as interviews, the case study has drawn on several types of information provided by the media and printed or Internet publications. This includes information published by the Resident's Association of Gavà Mar, available documents from the GTTS meetings, airport policy documents and the retrieval of relevant information from newspaper articles found in a search of local and national newspapers (including opinion and letters to the editor sections). All these have been carefully analyzed.

5. The case of Barcelona airport

5.1 Barcelona airport: features and stakeholders

Barcelona airport is located 12km from Barcelona city center, in the municipality of El Prat. It lies in the lower part of the delta of the Llobregat River, occupying former farmlands and wetlands. As shown in Figure 4, the airport's surroundings have different land uses. Farmland has been strictly protected for agricultural use since the 1976 Metropolitan Land Use Master Plan, protection that was reinforced with the implementation of the Agricultural Park at the end of the 1990s (a body managing, promoting and protecting agriculture). The wetlands were protected in

the 1980s, particularly for their valuable avifauna[1]. They consist of two lagoon systems (La Ricarda and El Remolar) with a pine wood area linking them, between the airport and the sea. In 1992 they were included in the Plan for Areas of Natural Interest of Catalonia (PEIN). The wetland area is included in the EU Natura 2000 network and is also an EU Birds Directive-recognized Special Protection Area (SPA). For a detailed account of land uses in the Barcelona metropolitan area see Paül and Tonts (2005).

[Figure 4]
Map of the airport area.

Barcelona airport is Spain's second largest airport in terms of passenger traffic, and, in the period 1996-2001, it was the second fastest-growing European airport. Since the Olympic Games in 1992, passenger traffic has grown by more than 100 percent, such that in 1992 the airport had 10 million passengers and in 2004 it had 24.5 million. With 30 million passengers in 2008, it ranked as the ninth largest European airport. Since 2004, it has had three runways; two of these are parallel and independent and can operate in a mixed mode[2].

A wide range of stakeholders are involved in Barcelona airport. In addition to governmental instances, the following are the most important ones:

(a) Airport manager: Barcelona airport is managed by the Spanish Government's public company Spanish Airports and Air Navigation (AENA). AENA manages the 47 commercial airports in the country and also the air navigation assistance services. Official announcements have recently spoken of dividing AENA into two bodies (one

[1] Avifauna: the birds of a particular region and habitat.
[2] Parallel independent runways can mainly operate in two modes: segregated and mixed. The segregated mode is when one runway handles inbound traffic, while the other is used for departure only. Mixed mode is when both runways accommodate arrivals and departures.

for airport management and another for air-navigation assistance services), while decentralizing the model towards a more autonomous and privatized management of some Spanish airports (including Barcelona), but all of this is still a matter of speculation.

(b) Airlines: Traditionally, the main carrier at Barcelona airport was Iberia. However, Iberia has recently been developing a rationalization strategy for its network. In 2006, Iberia began a process for de-hubbing Barcelona while building a single hub operation in Madrid-Barajas. At the same time, in January, 2007, ClickAir, Iberia's low-cost carrier subsidiary came into operation, based at Barcelona airport. The creation of ClickAir by Iberia could be understood as a way of avoiding a loss in market share at Barcelona airport. In 2009, ClickAir merged with Vueling. The new carrier maintains the latter's name and 45% of its shares are owned by Iberia.

(c) Local municipalities: Barcelona Airport has links with several municipalities, each with its own interests. For its economic benefits, Barcelona has always been the municipal council most in favor of airport growth. The municipality where the airport is located (El Prat), together with other surrounding municipalities (Sant Boi, Viladecans, Gavà and Castelldefels), have had a tenser relationship with it because they receive most of the airport's negative external effects.

(d) Local community: By "local community" here, we mean the neighborhoods directly affected by airport operation. Residents' associations are the vehicle for them to express their opinions. The association in Gavà Mar has been the most active in recent years. Gavà Mar is a relatively small coastal suburb belonging to the municipality of Gavà and lying to the west of the El Remolar lagoon. Compared with the rest of the metropolitan region of Barcelona (RMB), it can be understood to be a wealthy

community. Considering a base level of 100 as the average socio-economic level of the RMB, the Gavà Mar index value is above 126 (Serra, 2003).

(e) Environmental organizations: Major conflicts with environmental activist groups, such as the DEPANA organization ("Natural Heritage Defense League") developed during the airport expansion because of its effects on wetlands, especially at the end of the 1990s.

5.2 Conflict development: first steps

The socio-environmental conflict related to airport noise arose with the expansion of the airport and the construction of the third runway (07R-25L, see Figure 4 for its location). The decision regarding its location was a matter of discussion for several years. The last step of the discussion took place in 1997, when different proposals for the third runway were put forward by the Spanish Government (through the Public Works Ministry), the Catalan Regional Government (through the Public Works Regional Ministry) and the Barcelona Municipal Council. Environmentalists (mainly from the DEPANA organization) also proposed another alternative, avoiding the effects on wetlands, but this was not taken into account. Eventually, the decision was made to locate the new runway at a distance of 1,350m and parallel to the existing 07L-25R runway (allowing the simultaneous operation of both runways).[3] This location had some impact on the wetlands, as 22ha of SPA were declassified.

[3] The decision regarding the location of the new runway was taken in a working group that had two representatives of the Spanish Government, two of the Catalan Regional Government, one of the Barcelona Municipal Council and one of El Prat Municipal Council. The three main options discussed were: (a) a runway parallel to the existing 07L-25R runway and at the north-west of the existing terminals A, B and C; this solution was not feasible because it would have generated a noise impact over a population of more than 100,000 inhabitants; (b) a runway parallel to the existing 02-20 runway; this solution was not feasible because it did not mean a significant increase in capacity; and (c) a parallel runway to the existing 07L-25R runway and near the sea;

In 1999 the airport master plan (AENA, 2001) was published and work began. The main developments were the construction of the new third runway, a new terminal (T1) between the two parallel runways, new access infrastructures and the development of an airport city. The new master plan was to raise the capacity of the airport from 52 operations per hour to 90 operations per hour. Moreover, according to the master plan, the size of the noise contours for the Leq 65 dB during the day and the Leq 55 dB at night would be reduced by 30%.[4]

To comply with the Environmental Impact Assessment document, in 2002 the "Environmental Monitoring Commission for the Barcelona Airport Enlargement Works" (CSAAB) was set up. The functions of the CSAAB were to monitor and assess preventive, corrective and compensatory measures during the works to enlarge Barcelona airport. The CSAAB was also empowered to carry out studies on several aspects of the environmental impact of the airport and take decisions on specific issues, such as emission control, the design of a sound meter system and the definition of the most adequate flight path. Within the CSAAB there were technical groups for the discussion of particular issues. The "Technical Working Group for Noise" (GTTS) was the group in which noise issues were the subject of discussion. The GTTS had a total of 16 representatives: six from the municipal councils around the airport (including Barcelona, Castelldefels, Gavà, El Prat, Sant Boi and Viladecans), three from the airport

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four different distances from the existing runway were considered (1,035m, 1,190m, 1,350m and 1,500m); the distance of 1,350m was chosen because it is the minimum distance to allow simultaneous operations on both the parallel runways and had a lower impact on environmental protected areas than the 1,500m option.

[4] This value was estimated using the Federal Aviation Administration's (FAA) Integrated Noise Model (INM). The INM is based on an algorithm that estimates noise accounting for specific operation mode and other environmental factors. The model was run with a traffic hypothesis of 1,084 daily operations, 956 during the day (07:00 - 22:00) and 128 during the night (22:00 - 07:00). The significance of the reduction in the size of the contours is mainly due to the fact that the simulation was performed taking into account that from 2002 the aircraft included in Chapter 2 of the ICAO's Annex 16 were not going to be allowed in the airport.

manager (AENA), three from the Spanish Environment Ministry, two from the Spanish General Directorate of Civil Aviation (Public Works Ministry) and two from the Catalan Regional Government (one from the Regional Public Works Ministry and one from the Regional Environment Ministry).

Before the third runway started operating, on 11 December 2003 the CSAAB approved the noise footprint associated with the west configuration, with Castelldefels Municipal Council voting against (Figure 5). Consequently, until the opening of the new terminal on 16 June 2009, it was planned that 85% of landing and take-off operations would use the west configuration and 15% the east configuration. According to the CSAAB, both configurations flew over Gavà and Castelldefels but it was outside the Leq 65dB area during the day and the Leq 55dB area during the night, which are the legal limits in Catalonia for noise nuisance.[5]

[Figure 5]
Operational configuration when the third runway started operations on 30 September 2004.

But from 30 September 2004, the day when the third runway started operating, tensions within the GTTS started to become apparent and residents of Castelldefels, and particularly Gavà Mar, organized several demonstrations at the airport. While the master plan and the GTTS announced a reduction in noise exposure, the new configuration created great alarm among the population of Gavà Mar as the suburb was overflown in landing operations using the east configuration. The Gavà Mar Residents' Association website describes the situation in dramatic terms: "Planes were flying over

[5] According to the Noise Pollution Protection Act 2002 (No 16 of 2002, as of 28 June 2002).

Gavà Mar at low altitude creating a thunderous noise and an extraordinary feeling of danger". According to Residents' Association interviews, the feeling of anger, and most of residents' indignation and mistrust resulted from the statement that Gavà Municipal Council had made some months before, guaranteeing that the new runway would create no nuisance whatsoever to Gavà Mar.

This situation forced the Mayor of Gavà to ask, just one week after the opening of the new third runway, for the cessation of operations using that runway flying over Gavà Mar. AENA gave instructions to stop landing operations on the third runway from 9 to 12 October 2004. On 21 October, at an emergency meeting of the CSAAB, AENA pledged to define a new proposal for the east configuration for 15 November 2004 with a minimum use of the 07R head.[6] Unfortunately, AENA did not settle on anything definite until 11 March 2005 when it announced[7] that the east configuration would be used only 7.5% of the time instead of 15%, which meant reducing the use of this configuration to only about 27 days per year. This measure, which might have brought some level of predictability of noise exposure and therefore helped with the situation, was turned into an issue of trust between AENA and the other representatives on the CSAAB. In fact, instead of 7.5%, the actual use of the east configuration was 30% in April, 48% in May and 43% in June (AENA, 2009).

5.3 The "global solution"

The predominant atmosphere of mistrust led to the intervention of the Spanish Parliament, where a political discussion between parties took place. Thus, on 9 February

[6] At that moment, Gavà Municipal Council began a legal complaint process and the Gavà Mar Residents' Association filed a lawsuit against AENA to stop landings at head 07R flying over Gavà Mar.

[7] This announcement came after three noise-measurement studies carried out between November 2004 and February 2005. All of them proved that Gavà Mar was above the legal threshold of Leq 65dB.

2005 the Parliament forced AENA to study the proposals of the Residents' Association and the Municipal Councils of Gavà and Castelldefels. Technical and political commission were set up, both of them with representatives from the Residents' Association and the two municipalities involved. From the work of the two commissions, the so-called "global proposal" emerged (Figure 6), which was passed on to the CSAAB for its approval and application. This proposal was named "global" because it was intended to solve noise and capacity problems at the same time. This proposal was passed on 14 November 2005, but could not be brought into operation until 26 October 2006, because it needed nine months of work on the platform and an additional investment of 24.7 million euros. These additional building works included the adjustment of runway head 02, an airplane by-pass from runway head 07L to enable 95% of take-offs to be made from the new third runway, and a new Terminal Traffic Management Advisor (TMA).

[Figure 6]
The "global proposal".

The 'global proposal' configuration was a very effective measure in technical terms as, from the day it became operative, noise exposure at Gavà Mar was reduced by between Leq 15dB and Leq 20dB (AENA, 2009). The main configuration of the global proposal was the west one. In this configuration, operational during 85% of the daytime, take-offs were leaving from runway head 25L and aircraft were forced to make a 60º left turn to fly over the sea just after take-off, at 1,400 feet. As runway 07R-25L is too short, bigger aircraft had to continue taking off from runway head 25R towards the west. With this configuration, all landings were also on runway head 25R of the old runway.

The global proposal brought a period of relative peace, although the pressure from residents and local councils continued to keep the spotlight on noise management. In fact, from the end of 2008, there were new arrangements. On 3 September 2008, in a bilateral agreement between AENA and Gavà Municipal Council, it was decided that, from then on, the 60º turn over the sea in the west configuration would be at 500 feet instead of 1,400 feet. Just a few weeks later, on 30 September 2008, the Spanish Parliament's Public Works Commission approved a proposal to force AENA to maintain the west configuration with a tail wind of 10 knots instead of five knots, to draw up a new strategic noise map and to eliminate the operations of the most noisy aircraft before 2012.[8] The new strategic noise map was published in December 2008, and all of the other proposals were passed at the 15th meeting of the GTTS (January 2009). At this meeting, AENA also provided the information that with the new runway configuration the airport could continue coping with some additional traffic in the coming years without implementing a mixed runway configuration, and it pledged to maintain the segregated scheme. In fact, this had been demanded by the Gavà Mar residents for a long time. This brought about a meeting on 20 February 2009 of the mayors of the seven municipalities surrounding the airport, the President of AENA, the Director of the Airport of Barcelona and the Head of Infrastructure Planning of AENA. At this meeting, the mayors requested that this measure should continue.

6. Discussion

Through the analysis, several non-acoustic aircraft noise factors can be detected, following Stallen's theoretical framework (1999, 2007a, 2007b) on noise annoyance in

[8] A list of noisy aircraft includes: Boeing B747 (200 and 300), B727 and B737-200; McDonnel Douglas DC-8, DC-9, DC-10; Airbus A300; Antonov An124, An72; Ilyushin Il76, Il62, Il86; Tupolev I34, I54; and Yak-42.

airport contexts. Lack of trust has been one of the elements that has undermined the relationship between Gavà Mar residents and the other the stakeholders. Maris et al. (2007, p. 2001) have shown that "if the exposed has little control over the source, or little trust in the source, the perceived coping resources will be reduced and psychological stress will arise". This also holds true for the case of Barcelona airport. In fact, the loss of trust among residents appears to come from the evident lack of transparency. The communication channels opened by the airport manager and Gavà Municipal Council with public were very limited. In addition, the lack of information made it impossible for residents to predict the time and degree of the noise exposure. Situations mentioned above, such as when the Gavà Municipal Council sent the official statement to all residents saying that the new runway would not create any kind of nuisance (when it was, in fact, doing so) or when AENA announced that the east configuration would be used only 7.5% of the time from that moment on, but in real terms for some months it was used up to 48% of the time, eroded the possibility of creating a climate of trust between the agents.

The lack of transparency and willingness to cooperate by the airport manager stimulated the creation of two information offices by the municipal councils of Gavà and Castelldefels. Both offices have similar goals, basically conveying and providing access to public information about the airport. Both offices make information accessible, including the runway configuration, announcements about temporary runway closures and changes of configurations, publications of documents released by the airport manager, as well as other general information. Also, both websites[9] include a form to group noise complaints together and channel them to the airport manager. It

[9] Gavà Airport Information Office website:
http://www.omsa.gavaciutat.cat/esp/aeroport
Castelldefels Airport Information Office website:
http://www.castelldefels.org/es/aeropuerto

seems these offices are a good step forward for providing residents with updated information and transparency. However, it should be stressed that they were set up to compensate for the deficiencies of the airport manager.

The Gavà Mar Residents' Association suggested to Gavà Municipal Council that sound-level meters and radars for tracing aircraft paths in real time should be installed. Gavà Municipal Council adopted this proposal in February 2009. AENA had its own radars but refused to provide this kind of information for security reasons. The Gavà radar network has therefore enabled the municipality to have its own data. This is in line with May and Hill (2006, p. 448), when they state that it is necessary to develop and promote discourses "that challenge the prevailing hegemony of the business-political nexus".

The lack of a voice for residents and representation on airport management bodies, and even in the round-tables where decisions are taken, i.e., the CSAAB and the GTTS, is clear. This is in accordance with other cases; for example, see Lidskog and Soneryd (2000) for public participation exclusion in Örebro airport, and André (2004), who reports similar motivations for protests related to the expansion of Boston airport. However, the global proposal that brought a little peace emerged from the technical and political commissions set up by the Spanish Parliament on which the public were represented through the Gavà Mar Residents' Association. This is an interesting point, as the solution to the conflict came from the grass roots, that is, from civil society itself. It was necessary to create new forums in order to obtain a solution, as the CSAAB and the GTTS were not useful. The necessity of overcoming the "traditional" political institutions and the tendency towards new governance mechanisms and tools is a feature of this conflict. This point does not support Humphreys and Francis (2002) or Adey et al. (2007) when they maintain that airport NIMBYism is reactive. Our results show that

NIMBY groups in airport contexts can indeed be reactive, but also clearly proactive and they should, therefore, be considered to be at a post-NIMBY stage.

For years, the Gavà Mar Residents' Association has been accumulating important social capital, evolving from initial complaints and active demonstrations into constructive proposals, that is, from reaction to proposing specific improvement measures. Among its members the association has pilots and air-traffic controllers who build proactive proposals to justify and give an added value to the complaints. Examples are the global proposal for a solution for the conflict and the organization's website,[10] which constitutes a real encyclopedia of the conflict including its own studies and reports. May and Hill (2006) also show, in the case of Canberra airport, the importance of the presence of members with aviation expertise as a key element in channeling community efforts. Hence, in some cases, as in Gavà Mar, this kind of citizen movement can create social capital and knowledge.

So, the socio-environmental conflict between the Gavà Mar community and the airport development cannot be considered simply a NIMBY reaction. The transition towards a second or post-NIMBY stage was very fast. In addition to this, the importance of non-acoustic factors in relation to Gavà Mar community reactions has also been shown.

7. Conclusions and future prospects

At Barcelona airport, citizens affected by noise have been able to learn and make use of their social capital to come up with an operational proposal that avoids flying over Gavà Mar while allowing Barcelona airport to operate properly. But the key issue for Gavà Mar continuing to be outside flight paths is whether the global proposal can

[10] Gavà Mar Residents' Association Website: http://www.gavamar.com

provide and guarantee enough airport capacity in the long-run if traffic increases. The global proposal follows a segregated configuration scheme. However, to cope with future traffic increases, an eventual shift to mixed runway configurations might be needed. As a drawback, a mixed runway configuration would create a bigger noise contour and would reduce the possibilities of avoiding populated areas for safety reasons. In other words, if the runway configuration shifts from a segregated to a mixed mode, noise will return to Gavà Mar and the conflict and annoyance might return. A study by Desart et al. (2001) reports an increase of 25% for inbound traffic peaks and 30% for outbound traffic peaks with the mixed runway configuration in comparison with segregated operations for Helsinki-Vantaa airport, which has a relatively similar runway layout to Barcelona airport.[11] Taking this into account, a mixed runway configuration at Barcelona airport could be considered as an option if peak traffic demand increases. This would happen if an airline establishes hub operations at the airport with a wave-system of inbound and outbound traffic.

As the interviews showed, if the shift is made without including the local community, the noise conflict will be reopened. This leads to the conclusion that policy shapes annoyance, as the protection of one's own backyard is radicalized and fostered because the distribution policy has eroded existing institutions that might channel local demands (Bröer, 2006).

We have shown how important it is to include noise annoyance and non-acoustic noise annoyance factors in airport environmental policies. Non-acoustic factors are many times more important than the noise itself. Regulatory noise policy is almost always focused on physical noise levels, whereas effective noise management usually

[11] Barcelona airport has a parallel runway system direction 07R/25L and 07L/25R, and Helsinki-Vantaa airport has a parallel runway system direction 04R/22L and 04L/22R. In both airports, the runway separation is 1,350 meters.

involves non-acoustic factors as well (Flindell and Stallen, 1999). Airport policies should therefore include non-acoustic factors in order to solve the noise conflict. This kind of conflict damages the quality of life of the communities surrounding the airport, and at the same time, generates important constraints on airport capacity and operations, as airport capacity is not only dependent on the infrastructure itself (runway, terminal, taxiways, apron, etc.) and air-space capacity (ATM, etc.), but also on environmental constraints and the social conflicts resulting from noise pollution.

In particular, the case of Barcelona airport has demonstrated that the lack of trust between parties, the impossibility of predicting noise exposure, the absence of opportunities for civil society to speak and difficult access to information foster annoyance and the mobilization of the communities that live around the airport. Furthermore, the Barcelona airport case study has shown that, in such a situation, communities do not always adopt a simple oppositional attitude based on selfish complaints that could be classified as NIMBY behaviour. Gavà Mar residents have evolved into more proactive behavior, which could be classified as post-NIMBY. They have also been one of the keys in proposing technical solutions that found the balance between the airport needs and the community needs. Thus, neighboring residents appear to be a basic stakeholder to be taken into consideration in any airport planning or operating decision, not in a passive manner but rather in an active one.

As the needs of Barcelona airport will undoubtedly change over time, depending on the type of traffic, and community sensitivity will not only be dependent on noise exposure but also on non-acoustic factors, the current agreement might be reviewed in the future. Despite the high level of fragmentation and lack of collaboration of the agents involved, the way the conflict has evolved should encourage all of them to find new ways of including all parties in the decision-making process for finding the balance

between airport capacity and noise pollution. Further research should look into the best way of including all agents in the planning and operating decision-making process at Barcelona airport. Benchmarking and comparative studies can provide valuable insights, but the particularities of each airport make the adaptation of the world's best practices into tailored organizational schemes essential. There is no straightforward way to do justice to what people experience (Bröer, 2006). Further research should also look into management frameworks and their influence on the relationship between regions and airports.

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Figure 1
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Fig. 1. Outline of the components of airport capacity.

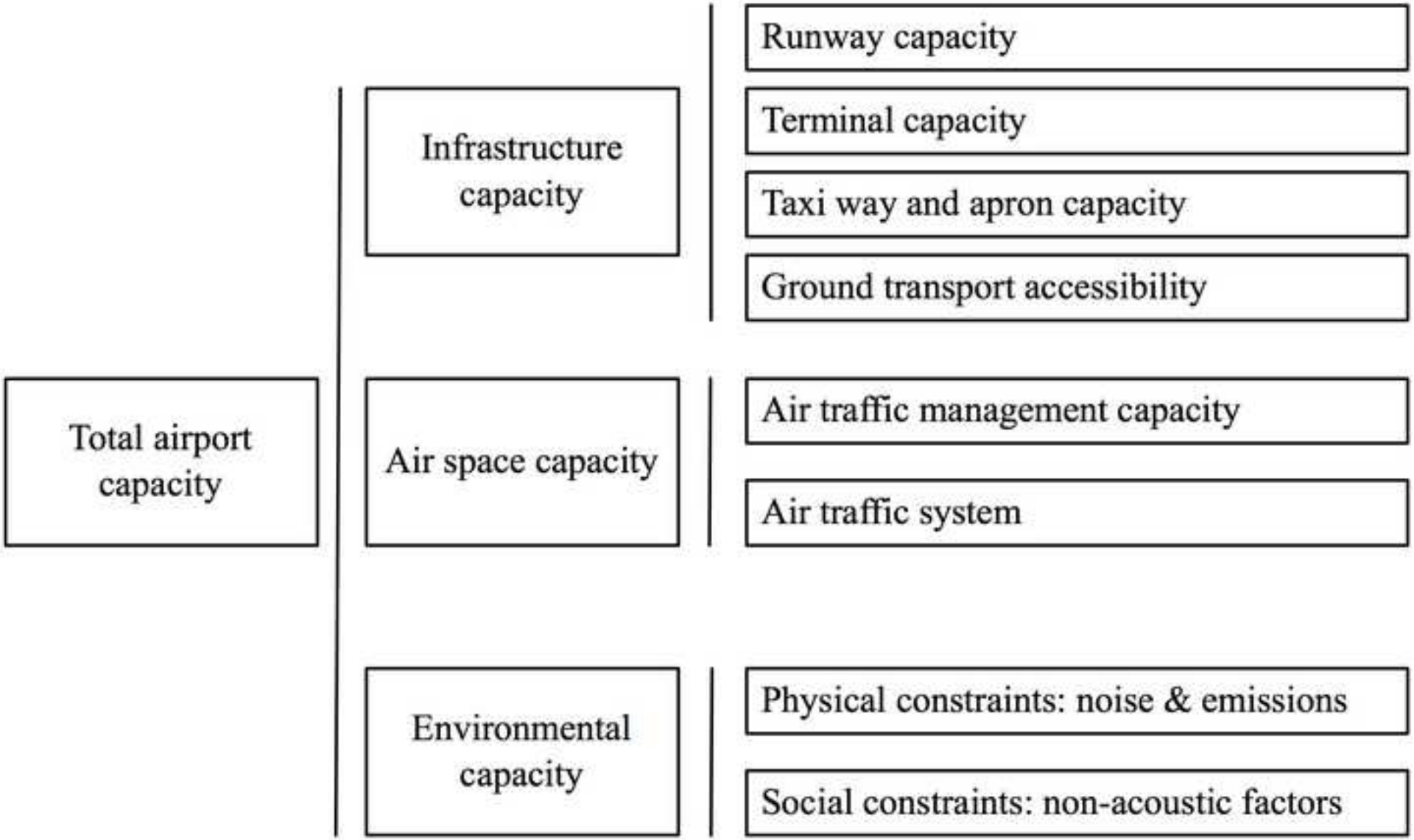

Figure 2
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Fig. 2. Stallen's noise annoyance as a form of psychological stress framework.
Source: Stallen, 1999.

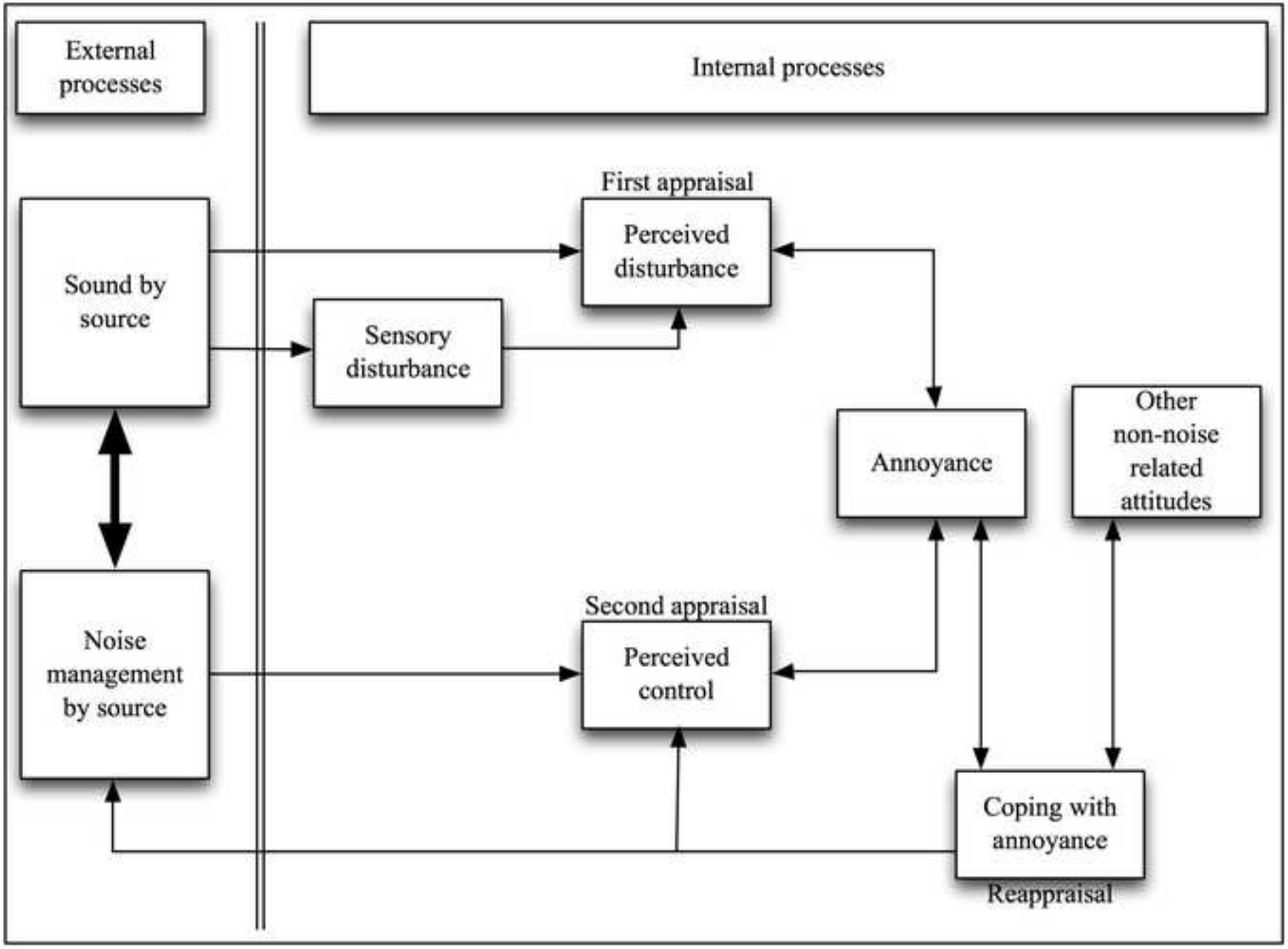

Figure 3
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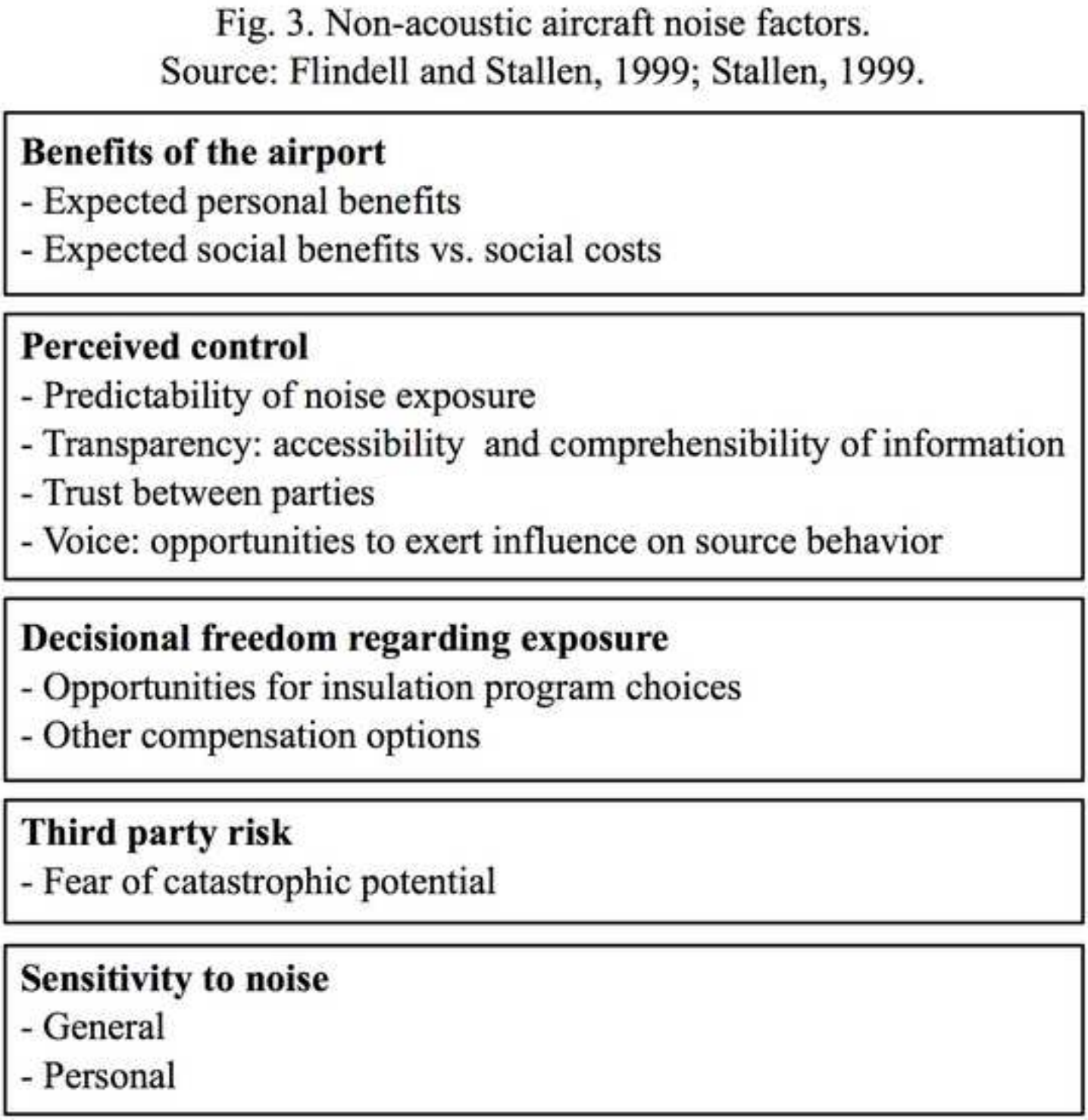

Fig. 3. Non-acoustic aircraft noise factors.
Source: Flindell and Stallen, 1999; Stallen, 1999.

Figure 4
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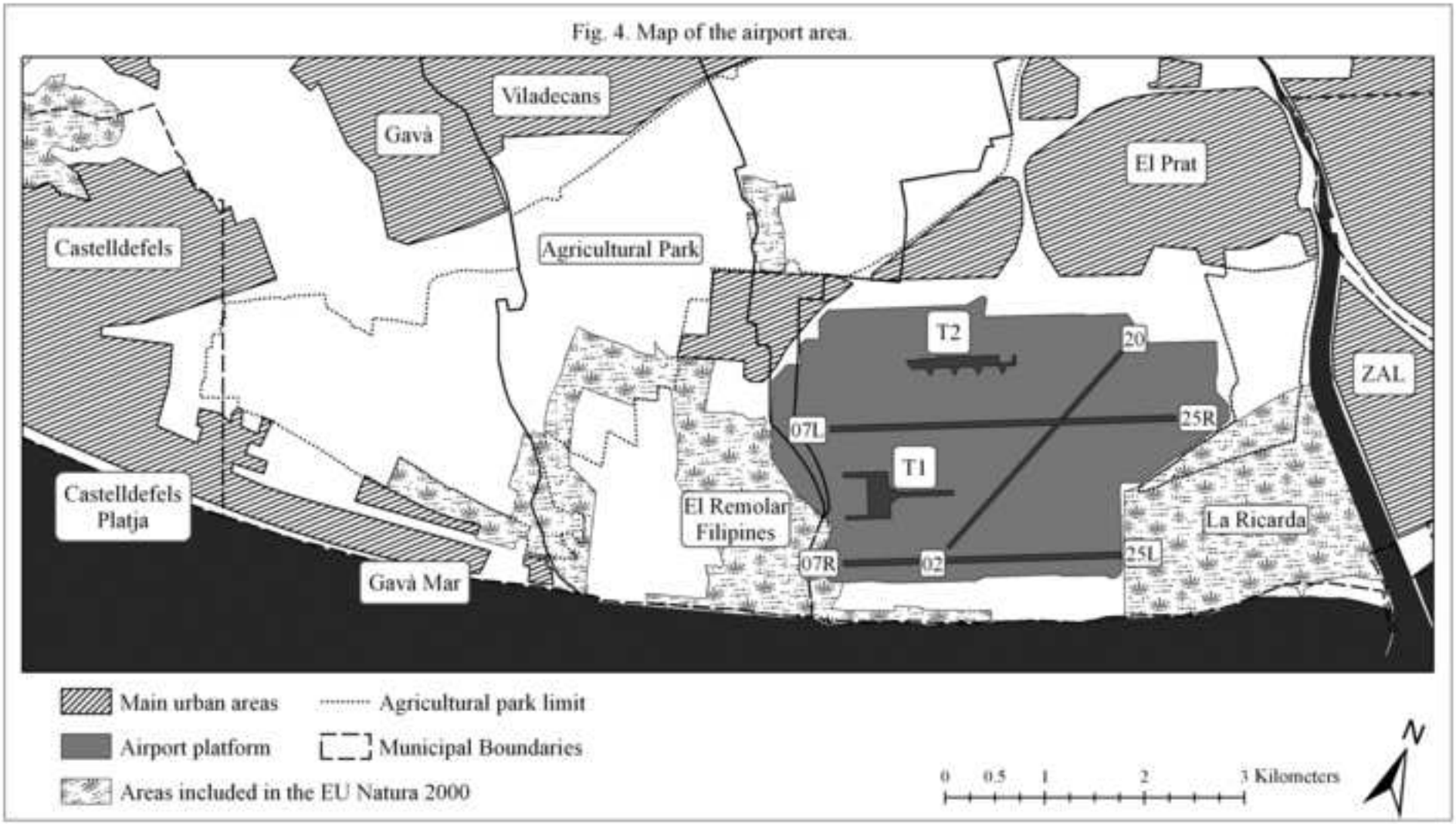

Fig. 4. Map of the airport area.

Figure 5
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Fig. 5. Operational configuration when the third runway started operations on 30 September 2004.

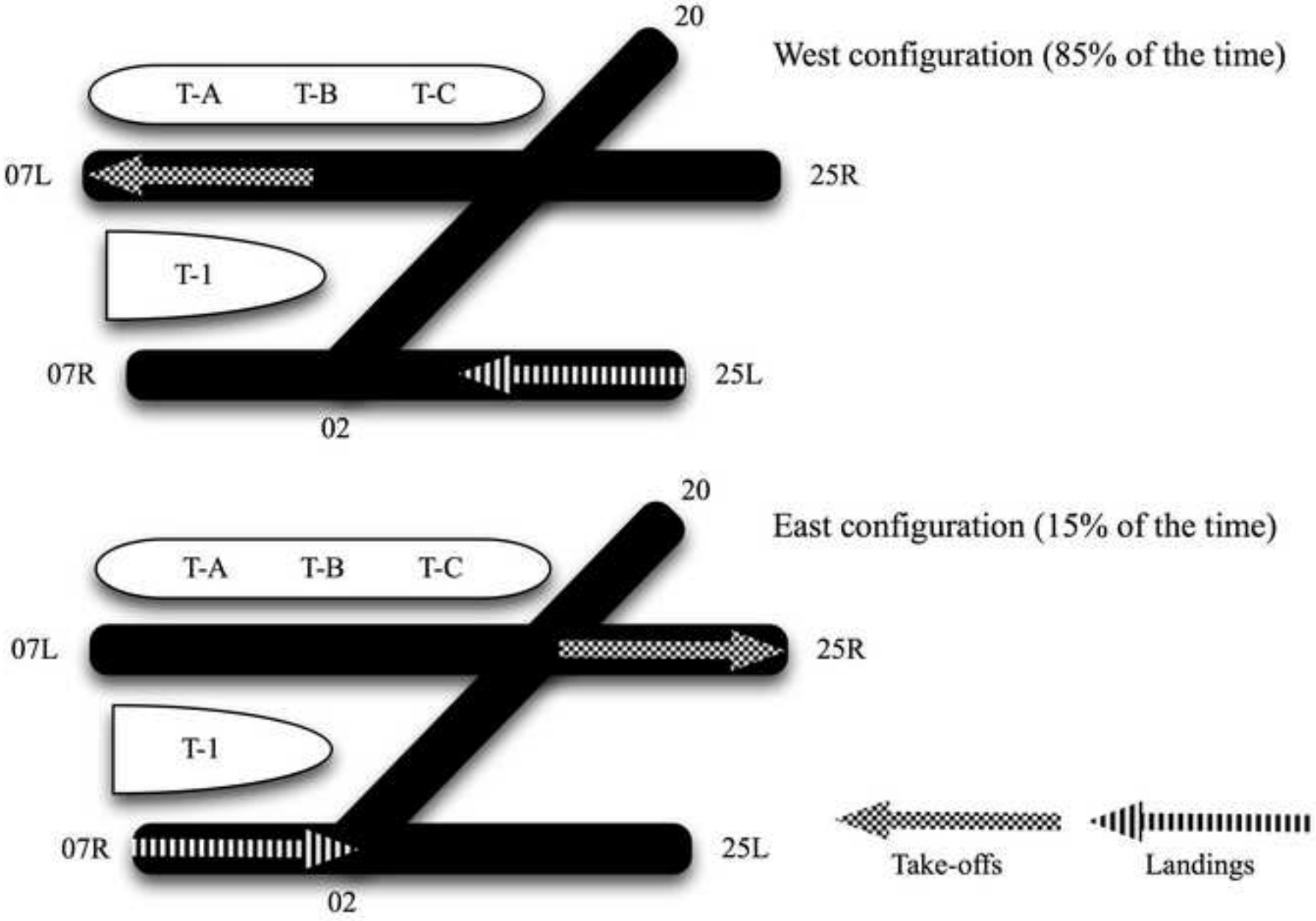

Figure 6
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Fig. 6. The "global proposal".

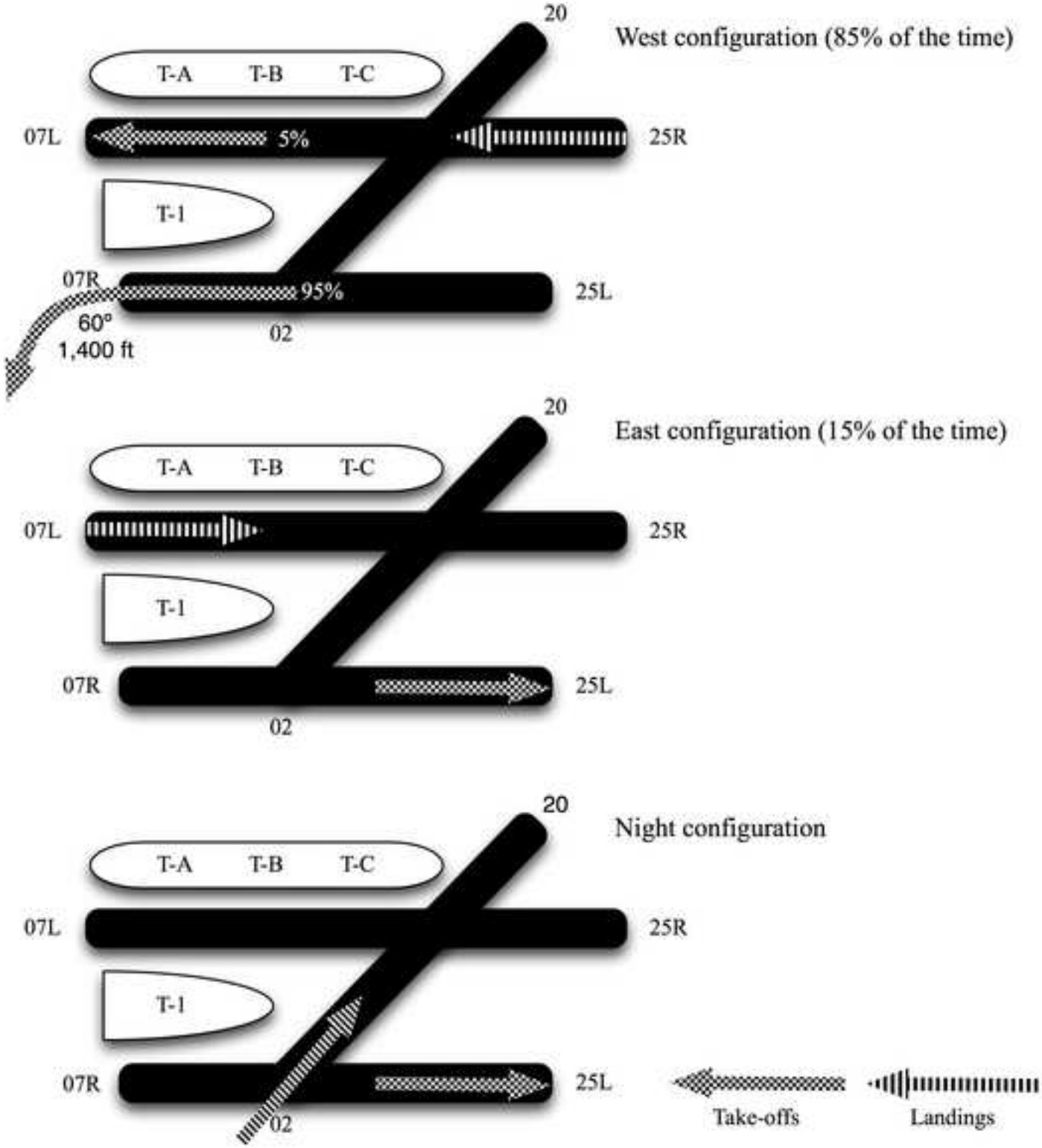

Table 1
Number of airports with noise and emissions restrictions per country.
Source: Boeing, 2008.

Country	Num. of airports	Country	Num. of airports
US	302	Switzerland	7
UK	37	Austria	6
Germany	28	Belgium	5
Italy	25	Brazil	5
France	24	Romania	5
Sweden	17	Ireland	4
Canada	16	Portugal	4
Spain	12	South Africa	4
Australia	9	Taiwan	4
Denmark	7	The Netherlands	4
Finland	7	Other countries	98
Japan	7		
Norway	7	Total	641

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Incorporating annoyance in airport environmental policy: Noise, societal response and community participation

Suau-Sanchez, Pere; Pallares-Barbera, Montserrat; Paül, Valerià

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