

**MANAGEMENT MODEL FOR HIGH-
TRAFFIC AREAS**

eko *na*

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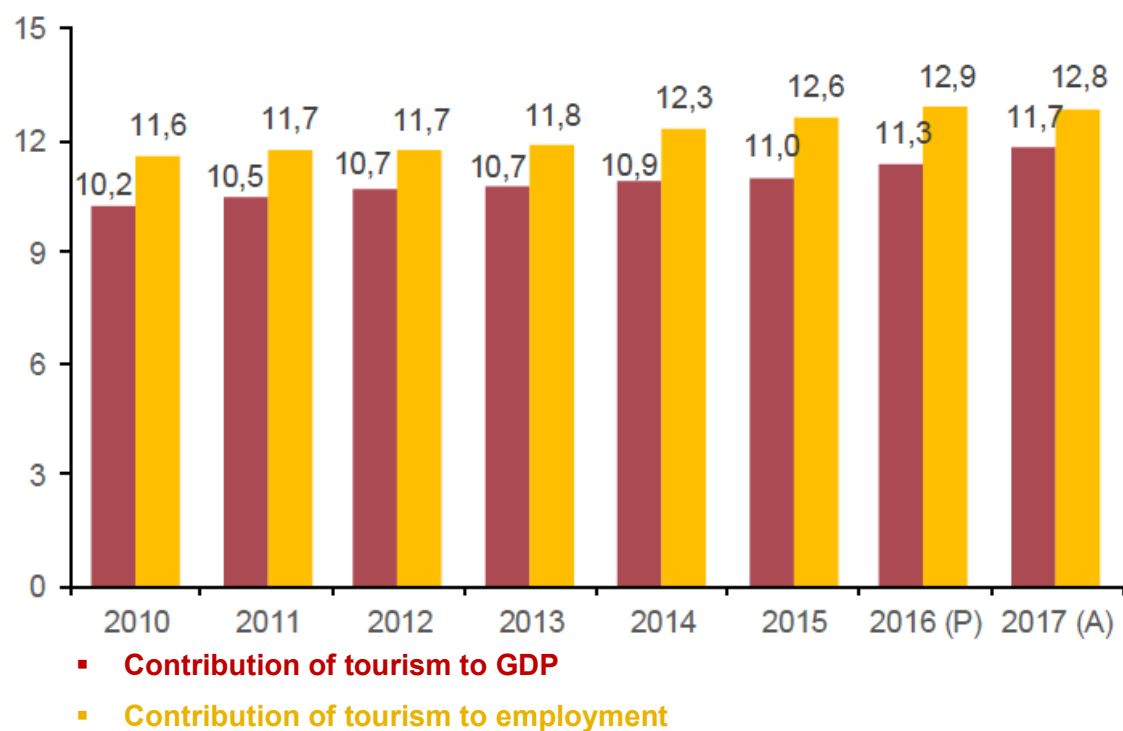
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High-Traffic Areas

The tourism sector has had a significant presence in the Spanish economy and society for decades. According to data from the Spanish Tourism Satellite Account (CSTE) of the National Institute of Statistics (INE), tourism accounts for around 11% of GDP, while its share of employment is almost 13%.

Table 1. Contribution of tourism to GDP and employment. Percentage. 2018



Source: INE

With regard to the number of tourists in 2018, the distribution by autonomous community is shown in the following table. In total, there were almost 83 million tourists in the whole country, although their distribution was quite uneven.

Table 2. Number of tourists by autonomous community. 2018.

	Number of tourists
Total	82.808.413
01 Andalusia	11.681.256
02 Aragon	545.530
03 Asturias, Principado de	299.357
04 Balearic Islands	13.851.598
05 Canary Islands	13.752.022
06 Cantabria	381.181
07 Castile and Leon	1.374.464
08 Castile - La Mancha	235.011
09 Catalonia	19.196.344
10 Valencia	9.206.908
11 Extremadura	468.286
12 Galicia	1.512.511
13 Madrid, Community of	7.139.775
14 Murcia	1.134.189
15 Navarre	323.730
16 Basque Country	1.552.389
17 Rioja, La	142.926

Source: INE

Table 3. Ratio of tourists to population by Autonomous Community. 2018.

	Ratio of tourists to population
Total	1,77
01 Andalusia	1,39
02 Aragon	0,42
03 Asturias, Principado de	0,29
04 Balearic Islands	12,27
05 Canary Islands	6,46
06 Cantabria	0,66
07 Castile and Leon	0,57
08 Castile - La Mancha	0,12
09 Catalonia	2,53
10 Valencia	1,85
11 Extremadura	0,44
12 Galicia	0,56
13 Madrid, Community of	1,09
14 Murcia	0,77
15 Navarre	0,50
16 Basque Country	0,71
17 Rioja, La	0,45

Source: INE

Table 3 shows that the number of tourists is around twice the size of the Spanish population and in some regions it is even higher. The most striking cases are the two archipelagos, although Catalonia also has more than two and a half times as many tourists as its population. In the case of the archipelagos, due to their size, the geographical distribution of tourists is relatively homogeneous, while in cases where the territory is larger and the ratio of tourists to population is high, there may be areas of very high concentration.

Usually, the areas where tourists are most concentrated during their visits are associated with specific places that have a certain tourist appeal, such as monuments, historical or emblematic sites, recreational areas, etc. These areas are called High Traffic Areas (HTA), both for tourists and the local population. In some places, their management poses a very significant problem for the municipal government, giving rise to conflicts related to safety, coexistence, mobility, waste and trade, among others.

In addition to the conflicts mentioned above, high-traffic areas also bring together conflicts of interest: between municipal tax and fee revenues and the increase in public spending they generate, and between the interests of tourism companies and local populations. These contradictions have recently intensified and generated a social debate that is difficult to ignore.

Without going into an analysis of the various conflicts of interest between the actors involved, the public management of High Affluence Areas poses a challenge to the social metabolism of the populations in which they are located. Like other phenomena found in nature, their indefinite growth leads to their extinction due to the depletion of inputs and saturation of sinks.

The search for balance in their management, combining restrictions and incentives to prevent their collapse, is at the centre of the reflection in the development of a model based on not exceeding the carrying capacity of the space.

Carrying capacity

The carrying capacity of a biological species in a specific environment is the maximum population size that the environment can support indefinitely over a given period, taking into account the food, water, habitat, and other necessary elements available in that

environment. In population biology, carrying capacity is defined as the maximum load on the environment, which is different from the concept of population equilibrium. Therefore, carrying capacity is the number of individuals that an environment can support without significant negative effects on the given organism and its environment. Below carrying capacity, populations typically increase, while above it, they typically decrease.

Carrying capacity, in the context of High-Traffic Areas, defines the maximum amount of traffic and use of space that allows for sustainability and proper use. This concept is often used in complex systems, such as ecosystems, due to its difficulty in understanding and management. The convergence in a specific space and time of different actors, with specific characteristics and interests, and in conditions that may evolve, requires the development of concepts and methods of analysis that allow the information hidden within the complexity to be unravelled.

Carrying capacity defines the maximum pressure that a space can withstand due to its conditions, which does not mean that the scenario it sets is the optimal one. This implies that, in most cases, the optimal scenario is (well) below the limit set by the (maximum) carrying capacity.

Carrying capacity has not often been used in the management of urban or highly anthropised spaces, which may lead to prejudice due to its origins in biology and ecology. In any case, its potential usefulness for the management of high-traffic areas suggests that it would be worthwhile to experiment with the development of a management model for this type of location.

Basis of a management model

If the starting point is a place defined as a High Traffic Area (HTA), the purpose of the management model for that area would be to establish annual targets for reducing the burden on the space. Given the link between the number of people and the resources they use, as well as the waste they generate, in HTA, the load to be reduced would be linked to the flows and stocks of materials (goods and waste) and flows of people, until sustainability is achieved. Stocks refer to warehouses or stocks of various materials, while flows are the inputs and outputs of those materials.

The objectives should be based on the appropriate density for neighbourhood environments, which are the most sensitive to the location of High Traffic Areas. To this end, the three types of existing uses of space should be taken into account:

- A. Stable spaces.
- B. Temporary spaces. Temporary spaces are those that are set up at specific times for specific cultural, educational, demonstration, or other activities. These spaces are dismantled once their purpose has been fulfilled, which usually lasts for a few hours.
- C. Traffic or movement of people

Considering the conditions of this type of place, the space load indicator will have to link the influx of people and its progressive reduction in line with sustainability objectives, with targets for reducing waste generation, material input and the ratio between trade aimed at the local population and trade aimed at visitors.

People

Since the influx of people could be considered the main driver of the process of space saturation, the fundamental basis of a space management model that uses carrying capacity as a modulator should begin with an analysis of this variable. In this context, the raw number of people is not a useful indicator to start the model, as it lacks sufficient nuances related to the type of activity they are engaged in, their preferences, flow speeds, etc. Considering these other factors, the variable that should be chosen to begin work is the comfort of people in such environments.

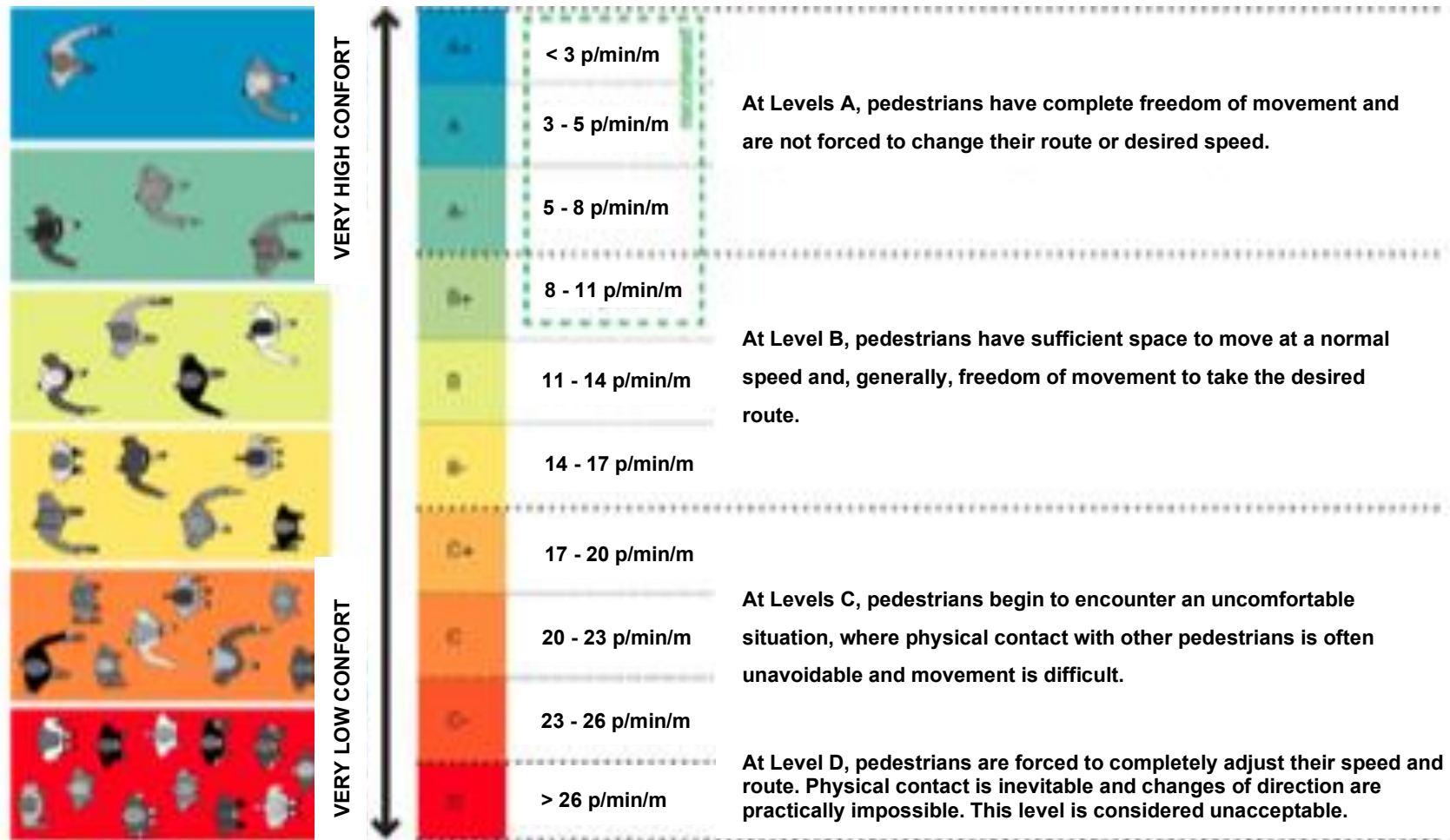
Although comfort may be perceived as a highly subjective indicator, the qualitative work used to establish the scales that define degrees of comfort allows for reasonable adjustment to the rigour requirements necessary to develop this type of model.

For example, Barcelona's Special Plan (see Figure 1) establishes a series of comfort intervals for the use of space based on the density of people in it. Thus, the maximum density for areas of traffic or movement of people is set at 11 p/min/m. This limit, which marks the boundary between the freedom to move at the speed and along the route chosen by pedestrians and conditions in which such freedom of movement does not

exist, is still far from being considered a comfortable scenario. The figure of 11 p/min/m could be considered the first saturation limit required in this type of area, although the ultimate goal would be to achieve 8 p/min/m, in order to enter comfortable scenarios, in which neither the route nor the desired speed are affected by the influx.

For spaces where people linger (both permanent and temporary), the usage density margins would have to be at the lower end of the scale, i.e. between 3 and 5 p/min/m.

Figure 1. Degrees of carrying capacity on public space



Source: Barcelona City Council

Based on the comfort standards established in Figure 1, a management model for high-traffic areas can be developed with a view to not exceeding the carrying capacity of the location.

If we consider the surface area of each of the zones (traffic or movement of people, stable stay, temporary stay), it should be possible to define the carrying capacity related to the influx of people in the HTA for each time of the year, based mainly on the programming of the temporary stay spaces.

To do this, we must first consider the specific space to which the reduction in affluence should be applied within a defined time interval. This time interval could be between 5 and 7 years to achieve the affluence reduction target. For example, on day X, the following conditions are established:

If the number of people who can be in the temporary spaces is **Ef** (depending on the programming of this type of activity), as a result of the surface area occupied by these spaces and the maximum permitted density of **3-5 p/min/p**.

If the number of people who can be in the stable stay spaces is **Es**, as a result of the surface area occupied by these spaces (preliminary urbanisation project) and the maximum permitted density of **3-5 p/min/p**.

And if the politically defined reduction percentage is **tp**, which has an associated load target of **Tp**, the traffic load target will be the result of:

$$T = Tp - Ef - Es$$

which, over a period of between 5 and 7 years, may not exceed **11 p/min/m**.

The percentage reduction in load will therefore be the result of the following calculation:

$$tp=100*[(Tp-1)-Tp]/Tp-1$$

Table 4. People load indicator

Day: X	Temporary stay 3-5 p/min/m x area	Stable stay 3-5 p/min/m x area	Traffic 8-11 p/min/m x area	TOTAL p/min	TOTAL % reduction
People	Ef	Es	T=Tp-Ef-Es	Tp	tp

Source: own elaboration

Waste

With regard to waste reduction targets, these will be linked, on the one hand, to the targets for the local population living permanently in the area of influence of the space in question and, on the other hand, to the ratio of trade aimed at the local population compared to trade aimed at visitors and the distribution of types of economic activities permitted in the area by municipal regulations in each case. The annual reduction percentages will have to be similar (and not lower) to those for the reduction in the influx of people. In other words, if by 2020 the reduction in the influx of people compared to 2018 has to be 5%, the reduction in waste generation cannot be less than 5%.

The annual waste reduction target will depend largely on the unit generation by type (local population, trade aimed at the local population, trade aimed at visitors) and the rate at which housing measures (to increase the local population) are implemented.

Consequently, the following conditions are established for day X:

If the number of people living permanently in the area is **p** (depending on housing measures), it can be estimated that they produce **x kg/p/d** of waste (based on residential waste standards), and therefore, waste production is **P**.

If businesses targeting the local population are of a type with a specific unit waste production, the total waste production **CI** will be the result of the number of each type of business multiplied by the unit production of that type.

And if the reduction percentage defined politically is **tr**, which has an associated load target of **Tr**.

The load target for businesses targeting visitors will be:

$$T = Tr - P - CI$$

The percentage reduction in load will then be the result of the following calculation:

$$tr = 100 * [(Tr-1) - Tr] / (Tr-1)$$

Table 5. Waste load indicator

Day X	Local population Kg/p/d x p	Local trade Kg/€/d x €	Tourist trade Kg/€/d x €	TOTAL Kg/d	TOTAL % reduction
Waste	P	CI	Tr-P-CI	Tr	tr

Source: own elaboration

Goods

Something similar would occur in the case of materials or goods. The annual targets for reducing goods will be linked, on the one hand, to the targets for reducing storage capacity in the area of influence of the space in question and, on the other hand, to the ratio of trade aimed at the local population compared to trade aimed at visitors and the distribution of permitted types of economic activities. The annual reduction percentages will have to be similar (and not lower) to those for the reduction in visitor numbers. In other words, if for the year 2020, the reduction in visitor numbers compared to 2018 would have to be 5%, the reduction in goods (incoming and warehouses) could not be less than 5%.

Therefore, for day X, the following conditions are established:

If the businesses aimed at the local population are of a type with a specific unit goods requirement, the total goods requirement **CMI** will be the result of the number of each type of business multiplied by the unit goods requirement for that type.

And if the reduction percentage defined politically is **tm**, which has an associated load target of **Tm** and a storage capacity of **M**.

The load target for shops aimed at visitors will be the result of:

$$T = Tm - M - CMI.$$

The percentage reduction in load will be:

$$tm = 100 * [(Tm-1) - Tm] / (Tm-1)$$

Tabla 6. Indicador de carga de mercancías

Day X	Warehouses	Local trade	Tourist trade	TOTAL Kg/d	TOTAL % reduction
Goods	M	CMI	Tm-M-CMI	Tm	tm

Source: own elaboration

Coordination and consistency

Although the reduction targets for the three areas must be consistent with each other in order to form an overall target for a sustainable reduction in the burden, the implementation and control mechanisms will have to be independent. In other words, action must be taken separately on supply (quantity and type of goods and warehouses) and demand (quantity and type of people), as well as on by-products (waste), so as to minimise the effects of possible tensions between supply and demand. If reductions in each area occur in parallel, tensions will be less. This will

prevent, for example, there being more products for sale to visitors than the number of visitors allowed to pass through the space in question.

On the other hand, the definition of annual load reduction targets will have to follow a double criterion to avoid inconsistencies and dysfunctions.

1. Establishment of the target (quantitative and qualitative) with the corresponding political support.
2. Implementation of effective management mechanisms associated with the areas on which the targets depend.

This implies that, for the carrying capacity model to function properly, objectives cannot be defined independently of the mechanisms that ensure they are effectively met, and vice versa. For example, the annual 5% reduction in waste generation will necessarily be associated with the mechanisms included in the municipal regulations in each case to change the type of businesses catering to visitors, and without the implementation and application of these mechanisms, it will not make sense to set significant annual reduction targets (beyond the always necessary process efficiency mechanisms).

The coordination and consistency of a management model such as the one described must be based on a system for controlling and monitoring the information generated in the High Traffic Area. To this end, the control and monitoring system will be designed with two interrelated sections:

- A. The collection and processing of data through reliable sources of information.
- B. Automatic and adaptable mechanisms for controlling flows and funds.

Types of actions or mechanisms

The actions and mechanisms that can be implemented to achieve the objectives in the manner explained above may be diverse in nature. They may be regulatory actions related to licensing conditions, public concessions, planning, subsidies and other incentives.

Table 7. Summary and conditions of load indicators

Day: X	Temporary stay 3-5 p/min/m x area	Stable stay 3-5 p/min/m x area	Traffic (T) 8-11 p/min/m x area	TOTAL p/min	TOTAL % reduction
People	Ef	Es	Tp-Ef-Es	Tp	tp
	Local population Kg/p/d x p	Local trade Kg/€/d x €	Tourist trade Kg/€/d x €	TOTAL Kg/d	TOTAL % reduction
Waste	P	Cl	Tr-p-Cl	Tr	tr
	Warehouses	Local trade	Tourist trade	TOTAL Kg/d	TOTAL % reduction
Goods	M	CMI	Tm-M-CMI	Tm	tm
Conditions	$tp \leq tr$	$tp \leq tm$	$tr \leq tm$		

Source: own elaboration



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