

**DEPARTAMENTO DE INGENIERÍA CIVIL: TRANSPORTE Y  
TERRITORIO**

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS DE  
CAMINOS, CANALES Y PUERTOS,  
UNIVERSIDAD POLITÉCNICA DE MADRID

**AVANCE DE RESULTADOS  
CIENTÍFICOS DE LA TESIS**

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## 1. ARTÍCULOS EN REVISTAS SCI

### 1.1. Artículo I

| ARTÍCULO          | INFO.   |
|-------------------|---|
| Autores           | <b>Hernández, Sara</b> , Monzon, Andrés, de Oña, Rocío  |
| Título            | <b>Urban transport interchanges: a methodology for evaluating perceived quality</b>   |
| Revista           | <b>Transportation Research Part A: Policy and Practice</b> , TRA1658. DOI 10.1016/j.tra.2015.08.008<br>Accepted for publication |
| Factor de impacto | 2,789 (Q1) (ver Anexo)  |

#### RESUMEN:

Travel patterns in urban areas are becoming increasingly complex, and many public transport users need to transfer between different modes to complete their daily trips. Transport interchanges play a key role as urban transport network nodes, and the quality of the service provided in an urban transport interchange therefore has a direct influence on travellers' daily experience. This study proposes a useful methodological framework to identify the potential strengths and weaknesses of urban transport interchanges and to manage resources more efficiently. It is based on a two-step analytical procedure combining the classification and regression tree model and importance-performance analysis. A travellers' attitudinal survey was carried out in the Moncloa transport interchange (Madrid, Spain) and the methodological framework was applied to the data collected. The greatest strengths of the interchange from the users' point of view are the information provision through signposting, the features of the internal design of the interchange which have a direct influence on aspects related to safety performance, and security conditions, particularly during day-time.

## 1.2. Artículo II

| ARTÍCULO          | INFO.  |
|-------------------|--|
| Autores           | <b>Hernández, Sara, Monzón, Andrés</b>   |
| Título            | <b>Key factors for defining an efficient urban transport interchange: users' perceptions</b> |
| Revista           | <b>Cities</b><br>JCIT1526. DOI 10.1016/j.cities.2015.09.009<br>Accepted for publication      |
| Factor de impacto | 1,728 (Q1) (ver Anexo)   |

### RESUMEN:

The sustained increase in the urban population and the trend towards urban sprawl in European cities has led to a change in mobility patterns, and many public transport users now need to combine several modes or transport services at urban transport interchanges before they reach their final destination. Therefore, they have become an everyday experience for users where, in addition, users spend time inside. This paper aims to identify the key factors both from a functional and psychological perspective for defining an efficient transport interchange. Since the users' perceptions of their experience are particularly important for achieving the most appropriate policy measures for interchanges, an ad-hoc travellers' satisfaction survey was designed and carried out in three European transport interchanges. The assessment methodology used here –Principal Component Analysis– is proposed as a useful step-by-step procedure. The results of this research highlight the ambivalent nature of the urban transport interchanges. The key functional aspects identified contribute to make easier the transfer and reduce the waiting time, while the psychological factors make the stay more comfortable for users.

## 2. CAPÍTULOS PUBLICADOS EN LIBROS

### **LIBRO:**

CITY-HUBs: Sustainable and Efficient Interchange Stations. Oxford: Taylor and Francis

### **RESUMEN LIBRO**

At a time when transport is considered a key factor in urban sustainability and social inclusion within the political agenda, and decision-makers have started implementing a wide range of policy measures towards sustainable urban transport, the need is increasing for the defining of measures which can influence travellers' behaviour and encourage a move to public transport and to innovative and sustainable mobility modes. The quality, accessibility and reliability of urban transport become increasingly important with the growth of population and urban sprawl, not least with the need to promote public transport through intermodal trips.

This book on urban transport interchanges is a readable guideline from more than ten European experts in the field. It demonstrates why transport interchanges are crucial for improving the use of public and sustainable transport, and shows how much integration is needed for maximizing efficiency in terms of coordination, use of information systems, management models, and the internalization of environmental negative externalities.

This book includes a highly readable set of guidelines for European transport operators, authorities, end-users' organizations and policy makers who are challenged to implement new urban interchanges or to upgrade them. It outlines the required steps from interchange planning to operation, defines the functions and the logistics of an interchange, and assesses interchange status. The guidelines offer introduction for checking the viability of the interchange through financial planning and the evaluation of urban and economic impacts of an interchange.

This Book has been developed based on the findings of the City-HUB project. The research project was financed by the 7<sup>th</sup> R&D Framework Programme of the European Union. The project aimed to address, in a practical way, the research topic "*Innovative design and operation of new and upgraded efficient urban transport interchanges*". The EU support made it possible to gather together practitioners, experts and researchers working together from the years 2012 to 2015

## 2.1. Capítulo I

| CAPÍTULO  | INFO  |
|-----------|---|
| Autores   | <b>Hernández, Sara</b> , Monzón, Andrés                             |
| Título    | <b>Making the interchanges attractive for users</b><br>(capítulo 6) |
| Libro     | CITY-HUBs: Sustainable and Efficient Interchange Stations.          |
| Editorial | Oxford: Taylor and Francis  |
| Editores  | Andrés Monzón y Floridea DiCiommo                                   |

### RESUMEN CAPITULO

Chapter 6 '*Making the interchanges attractive for users*' presents how to acquire information about the needs and requirements of users, and identify priority domains of actions for obtaining an attractive urban interchange from the users' point of view.

## 2.2. Capítulo II

| CAPÍTULO  | INFO  |
|-----------|---|
| Autores   | Monzón, Andrés, Di Ciommo, Floridea, <b>Hernández, Sara</b> , Andersen, Jardar, Christiansen, Peter and Poppeliers, Ricardo |
| Título    | <b>The City-HUB Model</b><br>(capítulo 7)   |
| Libro     | CITY-HUBs: Sustainable and Efficient Interchange Stations.  |
| Editorial | Oxford: Taylor and Francis  |
| Editores  | Andrés Monzón y Floridea DiCiommo   |

### RESUMEN CAPITULO

Chapter 7 '*The City-HUB model*' explains the logic of the City-HUB Model based on the description of the key relationships among the elements of the process that have been described in previous chapters. This model covers all the stages of an urban transport interchange.

### 3. ARTÍCULOS PUBLICADOS EN CONFERENCIAS INTERNACIONALES

#### 3.1. Artículo I

| ARTÍCULO          | INFO.   |
|-------------------|---|
| Autores           | Harmer, Clare, Millard, Katie, Palmer, Derek, Ubbels, Barry, Monzon, Andrés, <b>Hernández, Sara</b>               |
| Título            | <b>What makes a successful urban interchange? Results from an evidence review.</b>                                |
| Conferencia       | Transport Research Arena, 2014<br>5 <sup>th</sup> TRA Conference: Transport Solutions from Research to Deployment |
| Fecha & Localidad | 14-17 Abril, 2014<br>Paris, Francia   |

#### RESUMEN:

The City-HUB project (a European Commission 7th framework programme research project) aims to contribute to the design and operation of seamless, smart, clean and safe intermodal public transport systems. This paper presents findings from the first few stages of the project, which through various tasks, have identified the numerous factors that need to come together to make a successful interchange. The methods used include literature reviews (covering research, policy and guidelines), 18 practitioner interviews (with transport operators, local transport authorities and the business community involved in planning, designing and operating successful interchanges) and surveys of passengers at interchanges across Europe.

### 3.2. Artículo II

| ARTÍCULO          | INFO.  |
|-------------------|--|
| Autores           | <b>Hernández, Sara</b> , Monzon, Andrés  |
| Título            | <b>Efficiency of urban transport interchanges: key factors for seamless urban mobility</b> |
| Conferencia       | NECTAR<br>Network on European Communications and Transport Research Activities             |
| Fecha & Localidad | 24-25 Abril, 2014<br>Liège, Belgium  |

#### RESUMEN:

The European trend of urban sprawling and the low demographic density of new suburbs increase the need of mechanized trips. This aspect increases the costs of transport externalities in the European cities (congestion, pollution and CO<sub>2</sub> emissions). Therefore urban trips increasingly made of several stages combining different transport modes, including several mechanized transport modes (private or public) and soft modes. In this context, urban transport interchanges play a key role within urban public transport networks since they represent physical integration among transport modes. The European research project "City-HUB" of the Seventh R&D Programme 2012 aims to develop an integrated approach covering various aspects related with their efficiency, environmental sustainability and accessibility for all users.

The passengers' point of view is very important for design and management of successful multi modal interchanges. A travellers' attitudinal survey has been conducted in 5 European interchanges in order to capture the views and preferences of travellers on different aspects and elements for defining a smart interchange. It has been done through an ad-hoc on-line survey with the main goals of identifying the main drivers of intermodal travel behavior, the travellers' satisfaction levels with the current interchange services and the behaviour of users groups with special needs (i.e. women with children or other circumstances, disabled people, etc.). On the other hand, energy aspects of all activities that occur within the interchange



building as well as carbon footprint of the interchange operation have been also taken into consideration.

The results of the attitudinal surveys show that the main drivers of interchanges users' behaviour are basically four: information; communication of transfers between modes; security, and traveller's services such as ticket purchase, luggage store, etc. Conversely, shops and cafes facilities, access to the interchange and waiting areas are the aspects least valued for the users. These findings suggest a number of policy measures to improve multimodal trips, and consequently public transport efficiency.

### 3.3. Artículo III

| ARTÍCULO          | INFO.   |
|-------------------|---|
| Autores           | <b>Hernández, Sara, Monzon, Andrés, De Oña, Rocío</b>   |
| Título            | <b>Urban transport interchanges: Importance-Performance analysis for evaluating perceived quality</b> |
| Conferencia       | PANAM 2014<br>XVIII Congreso Panamericano de Ingeniería de Tránsito, Transporte y Logística           |
| Fecha & Localidad | 11-13 June, 2014<br>Santander, Cantabria  |

#### RESUMEN:

As the world becomes more urbanised, urban public transport needs to provide a viable alternative to individual car transport. At an urban level, interchanges in public transport systems provide for the easy transfer between and within different modes and should facilitate seamless travel. This study proposed a methodological framework to identify the key factors of an urban transport interchange. A Travellers' Attitudinal survey has been undertaken in order to collect information about the users' perceptions and requirements in the Moncloa interchange of Madrid, Spain. The results obtained, from the Importance-Performance Analysis (IPA), show that aspects related to signposting to different facilities and transport services, internal design of the interchange and the surrounding area, and safety and security aspects are the core strengths of the interchange.

### 3.4. Artículo IV

| ARTÍCULO          | INFO.   |
|-------------------|---|
| Autores           | Monzon, Andrés, <b>Hernández, Sara</b>  |
| Título            | <b>Sustainable and efficient urban transport interchanges</b>                             |
| Conferencia       | PANAM 2016<br>XIX Congreso Panamericano de Ingeniería de Tránsito, Transporte y Logística |
| Fecha & Localidad | 28-30 September, 2016<br>Mexico D.F.  |

#### RESUMEN

This paper presents the main outputs of the City-HUB project (2012-15) financed by the European Union 7th R&D Framework Programme. It focuses on the design of sustainable and efficient interchanges, aiming to provide guidance and recommendations to enable seamless mobility, travel efficiency, user satisfaction and improved performance of the interchange.

The approach is based on the detailed analysis of 11 cases of study, complemented with interviews to stakeholders and practitioners in 26 interchanges, from 10 European countries. City-HUB adopted a holistic vision of interchanges, taking into account different perspectives to assure the quality of transferring among transport services, the interest of stakeholders and users, and the city itself. The figure shows the City-HUB vision of interchanges.

The approach will help frame pathways to obtain maximum efficiency by upgrading existing urban interchanges or by building new ones and make these more efficient and accessible to all users. The findings of City-HUB project depicting the necessary actions and steps to be undertaken towards delivering a successful interchange include the following three main dimensions:

- Governance - it incorporates the identification of the stakeholders, and interchange users, their roles, methods for developing a cooperative scheme for efficient and mutually accepted decision-making, development of business models and monitoring and assessment of the implementation performance.
- Services – they are related to the physical design, transportation modes, and information provision at the interchange about the interchange and the trip, and visitors' facilitation during their stay at the station.
- User needs and expectations into the interchange design and operation, which involves conducting surveys for data collection about expectations and perception on service quality assessment.

### 3.5. Artículo V

| ARTÍCULO          | INFO.   |
|-------------------|---|
| Autores           | Monzon, Andrés, <b>Hernández, Sara</b> , Di Ciommo, Florida   |
| Título            | <b>Efficient Urban Interchanges: the City-HUB model</b>   |
| Conferencia       | Transport Research Arena, 2016<br>6 <sup>th</sup> TRA Conference: Transport Solutions from Research to Deployment<br>Moving forward: Innovative solutions for tomorrow's mobility |
| Fecha & Localidad | 18-21 Abril, 2016<br>Warsaw, Poland   |

#### RESUMEN

Multimodal trips are increasing in metropolitan areas, making PT less attractive. There is a need for integration in order to achieve effective seamless mobility. One dimension of integration is to reducing the disruption of transfer among modes and interchanges appear as the best solution when big number of travellers has to transfer.

The City-HUB 7FP project has developed a new model for deployment new interchanges and improving existing ones. The model start by identifying two groups of dimensions that define Interchange key features. The first dimension is related to Physical&Size, including passenger demand, modes of transport, services and facilities and location in the city. The second dimension is related to Local Impacts such as developing of new activities –housing, offices, nearby shopping-, jobs creation and its connexion with the local Development Plan. The combination of the elements of the two dimensions define the following key features: building design, stakeholders' involvement and the type of business model. The findings are based on interviews to practitioners undertaken in 26 selected interchanges in 10 EU countries.

According to these key features, the interchange should organize the space among three different zones: access-egress zone; facilities zone; and arrival-departure-transfer zone. The first one is where links to the local area and access to transport modes are focussed. The last one caters for intermodal transfers. Travel information and intermodal services are spread across both zones as well as the facilities and retailing.

Users' perceptions should be collected to improve interchange efficiency. To that end a travellers' attitudinal survey has been carried out in interchanges in 5

European cities. From the user point of view the most important factors identified in the surveys are safety and security, transfer conditions, emergency situation, information, design, services&facilities, environmental quality and comfort of waiting time. All these elements define the interchange from two different perspectives: “as a transport node” and “as a place”. The first one is related to the functionality as a node of the transport network; the second includes all the features for make the transfer experience more attractive and efficient.

The project has identified a number of recommendations for developing urban transport interchanges. Some of them refers to users, other to operators and the third part deals with local impacts, governance issues and business models.

All these findings have served to develop an integrated concept of interchange: City-HUB model. It considers the requirements and needs, the building design and the aspects for a good atmosphere, integration in the urban fabric and local activities and governance.

## ANEXO I: FACTOR DE IMPACTO DE LAS DOS REVISTAS (JCR)

### TRANSPORTATION RESEARCH PART A: POLICE AND PRACTICE

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Sum: 1639    Sum: 460

## ANEXO II: PORTADA LIBRO - CITY-HUBS: SUSTAINABLE AND EFFICIENT INTERCHANGE STATIONS

