# THE CONTRIBUTION OF ERGONOMICS TO THE DESIGN OF MORE INCLUSIVE TRANSPORT SERVICES

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# THE CONTRIBUTION OF ERGONOMICS TO THE DESIGN OF MORE INCLUSIVE TRANSPORT SERVICES

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**Abstract**: *The paper provides a critical review of the contributions a holistic, user centred approach can make to the design, inclusivity, effectiveness and efficiency of existing transport services, using the Hexagon-Spindle model [1 and 2] as a reference point. A systematic, multifaceted approach to the human centred transport systems is articulated, using ergonomics as a means of co-ordinating system design which needs to optimise performance of individual elements (such as the design of information points) through to the whole service offering. The use of such a model recognises that each stage of the journey needs to be optimised for each traveller, while the user centred methods pioneered by the ergonomics and design communities facilitate the capturing and monitoring of responses to user needs. The use of such an approach is exemplified by the outputs of the METPEX project.*

***Key Words: Ergonomics and human factors, design, transport, whole journey experience, inclusive design, humane city***

## 1. INTRODUCTION

A goal of the EU is to establish a transport system that meets society's economic, social and environmental needs which is conducive to an inclusive society and a fully integrated and competitive Europe[1]. The ongoing trends and future challenges point to the need for satisfying rising demand for travel or 'accessibility' by offering safe and seamless transport and mobility to all European citizens, in the context of growing sustainability and accessibility concerns and an ageing population.

The image of public transport is a major barrier for those wishing to persuade people to move away from private forms of transport (e.g. [3]). Likewise the physical realm (city infrastructure) in itself may provide significant barriers to those wishing to engage in active

[1] European Commission ( 2009), Memo: Future of Transport Communication, Brussels

forms of transport, or more to transport gateways. Inaccessibility may be designed in to legacy structures and lack of investment (e.g. through steps or uneven pavements) or barriers created through the abuse of the road network (e.g. parking on roads). The consequences of poor planning decisions, engineering and service competition has rendered many parts of the city inaccessible to many users (e.g. those with mobility and communication issues, those on poor incomes).

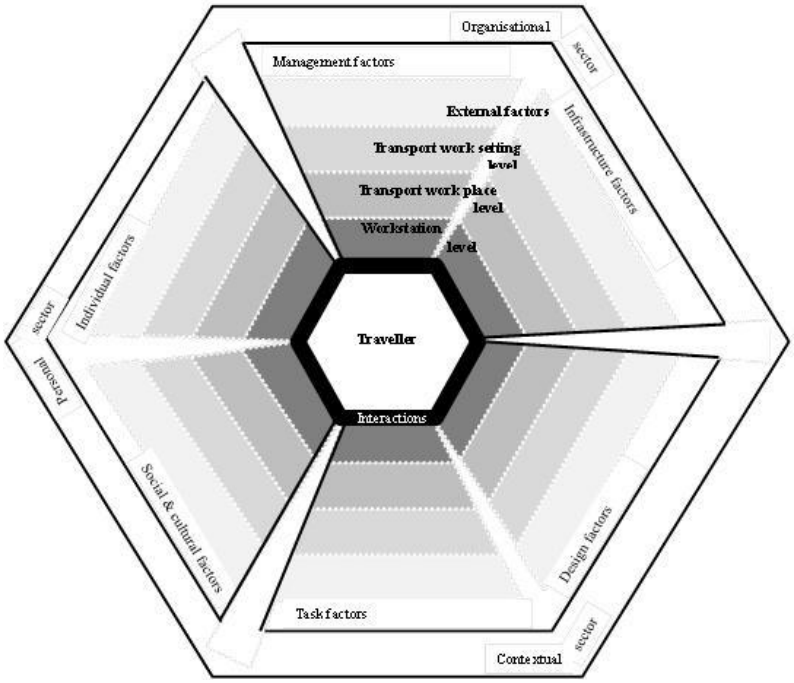


*Figure 1: Hexagon model [4]*

To create an accessible transport system requires the consideration of many factors, operating at many different levels, all of which may influence a traveller's interaction with one aspect of the transport service. Optimising the whole journey experience, for all travellers needs to recognise:

1. A means of plotting these factors
2. A means of consultation with different transport user groups
3. A means of prioritising the measures or user requirements
4. A means of designing to meet traveller needs at different levels (e.g. vehicle, infrastructure and service design)
5. The creation of incentives to address service inequalities and poor design

It is argued that ergonomics/human factors can provide help in each of these areas.

## 2 THE HEXAGON SPINDLE (H-S) MODEL TO REPRESENT THE RANGE OF ISSUES WHICH NEED TO BE CONSIDERED IN DESIGNING TRANSPORT SERVICES FROM A USER PRESPECTIVE

The Hexagon –Spindle model [1 and 2] is an example of a user centric ergonomics model, which places the focus of attention on the transport user (see figures 1 and 2). It provides a means of visualizing the wide range of factors which contribute to user satisfaction or experience of transport services, such as the design of the infrastructure, management of services, design of vehicles and personal characteristics. As such, the model provides a structure for the systematic consideration of human factors whether these relate to design of specific parts of the service (e.g. ticket machines) or the quality or service. It also recognizes that a particular system does not sit in isolation. It may be influenced by cultural and political factors. In the case of transport these factors are of especial importance. For example, the sustainability agenda is prioritizing the use of public transport, whilst at the same time austerity measures may be reducing service coverage to those who need it most;. greater recognition of the rights of disabled people to have access to mobility have increased recognition of discriminatory practices which limit the mobility of certain groups of people.

The H-S model recognized that just presenting one instance of a user's interaction with a system was insufficient. A user interacts with many parts of the system over time, each of which needs to be optimized. Hence, the concept of the whole journey experience and the need to optimize each part of the journey, from transport planning through to arrival at the final destination. If public transport falls below levels of satisfaction, alternative journeys may be planned (see fig2)

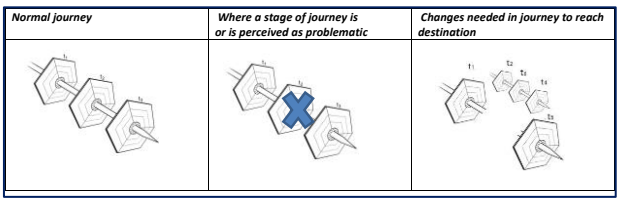


*Figure 2: The consequences of not optimising each stage of the journey for the end user*

The concept of the 'whole journey' involves recognition and measurement of each stage of the journey – from planning, through to movement to the first transport gateway, ticket purchase, negotiating to the vehicle, travel on the vehicle, negotiating movements from the vehicle to other transport modes or the destination. A multitude of factors are of potential and significant importance. For example, poor street design or street aggression may have a significant effect on mobility, unreliable and overcrowded services may make public transport less attractive.

## 3. CAPTURING USER REQUIREMENTS AND LEVELS OF SATISFACTION OF TRANSPORT SERVICES

Having the H-S model as a fundamental building block enables an understanding of the complexity of factors which influence a person's interaction with the transport system to be

built up. Different types of passengers have different requirements, or have different requirements in different circumstances (e.g., as a commuter I may not need directional information, when I become a tourist, my needs change). A passenger with a disability may need advanced information of station layout and the ability to book assistance and information may need to be presented in different formats to compensate for perceptual and communication difficulties. For ergonomists, a central belief is that if you optimize the quality of experience for those with the most challenging needs, everyone will benefit. For example, all passengers could benefit from knowledge of the design of a station to ease their movement through it, or the presentation of essential information in a clear manner in different modes. Additionally, passenger requirements may change during the course of the journey as travellers become tired, hot or anxious, or let down by poor experiences earlier in their journey.

Such a model can be used to design research measurements to capture user requirements in a systematic way, about particular aspects of the service. Once the pertinent variables are known these can be mapped on to appropriate research instruments to aid in, for example, the collection of information regarding requirements and the quality of service.

Ergonomists and designers have been instrumental in shaping new, more inclusive ways of gathering data from potential service users from concept design through to evaluation through to post implementation /customer satisfaction surveys. The user centred design process is outlined in ISO 13407, and relates to 4 stages, understanding the context of use, specifying requirements, creating design solutions and evaluating design. Design is based on an explicit understanding of users, tasks, and environments; is driven and refined by user-centered evaluation; and addresses the whole user experience. The process involves users throughout the design and development process and it is iterative. Models such as the H-S model, enable the areas of interest to be sketched out, which may form the basis of dedicated research tools.

Although ISO 13407 does not stipulate the research instruments to be used, taking a user centred approach requires the proactive engagement of users at all stages of work. In the past public engagement could be categorized as tokenistic especially in the development of city wide initiatives, with meetings poorly organized and attended, poor record keeping, sample bias and little evidence that the issues raised by users influenced decision making. New more inclusive, qualitative methods have been developed to ensure that the user voice is heard. These range from focus groups to more participatory (real and virtual) forms of engagement using co-design and co-creation workshops (e.g. [5]) and methodologies promoted in Living Labs [6].

The FP7 project, METPEX [7] aimed to produce tools to capture passenger experience of the whole journey. This provides an example of 1) the need to look at variables associated with all stages of the journey; 2) for all types of passenger; 3) for different transport modes. Mindful of the need to consult with different types of users, the project used targeted focus groups to reach passengers who might not have otherwise been sampled during the data gathering period, and whose voice needs to be heard by operators, transport planners and authorities. Such groups included, women, those with mobility problems and communication difficulties, travelers with dependents and children, young people, older

people, those living in rural areas and on low incomes. It is not surprising that in some cases the level of service that they received fell short of that received by other groups.

Informed by the H-S model , a comprehensive set of variables were created (in general, and for each user group, journey stage and mode of transport), from which research instruments were developed in the form of on-line and real time surveys, a game, retrospective surveys and focus groups. These were trailed in 8 cities for one month in 2013 [7]. The data was used to compile a set of Key Performance Indicators (KPIs) which could be used to measure the quality of public transport in a reliable way.

## 4. KEY PERFORMANCE INDICATORS

In order to improve transport services, vehicle design and transport infrastructure (including pedestrian and cycle routes) it is important to know how existing services are perceived by passengers and their current and future expectations in order that the journeys be faster, more convenient, safer, comfortable and enjoyable. Measuring the gap in service quality has proved an important means of enhancing service provision in a number of domains. Figure 3 shows a view of the top level quality indicators derived from the METPEX project. Under each of these headings are a set of variables statistically related to the quality indicator. Similar sets of KPIs exist for different forms of transport and user groups.


*Figure3: Example of Key Performance Indicators for Quality Components Derived from METPEX [4]*

## 5. INCENTIVES TO ADDRESS SERVICE INEQUALITIES AND POOR SERVICES

Understanding customers' needs, and building designs or services that match those needs, that excite and delight customers has been shown to be beneficial to all businesses. Involving users at the start of the process is more likely to result in products and services, that match their needs, that are attractive useful and usable. Early user involvement will build a market place for services, a client base and a reputation that the customers are put at the heart of the business. Satisfied customers remain loyal, and make recommendations. Product testing of early concepts may reduce the need to make changes when they are more

expensive later on in the development cycle. It has also been shown that inclusive, and universal design principles benefit all the user population, not just those with disabilities.

The same principles relate to transport and city design. If user centred design is placed at the heart of transport system development - whether it is in relation to vehicle and station design, design of ticket machines, timetables, or customer service, or the provision of active forms of transport – if the needs of the users are considered the resultant service will be more inclusive, accessible and satisfying to travellers. If this is the case, more people will be attracted on to public transport.

## 6. CONCLUSIONS

The paper has outlined the way in which ergonomics/human factors can be applied at various stages of transport planning and city design. At the heart of all activities is the need for inclusivity and user centred design, where ALL users are put at the heart of decision making, policy, strategies and design. It only through the recognition of all citizens' needs that we can create a humane city.

## 8. ACKNOWLEDGEMENTS

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