The Quality of Building Design Between Aesthetics and Usability: a Case Study on Underground Stations

Gabriella Duca

Department of Architecture - LEAS Laboratory
University of Naples Federico II
Naples, Italy

ABSTRACT

This paper presents a research on railway station usability, where Usability Performances Areas (UPA) and Usability Performances Indicators (UPI) have been defined in order to understand the gap between intended design quality and actual quality as perceived by end-users of the building. According with the ISO 9241/11 standard, the definition of usability metrics has been based on the observation of users and tasks in the railway station, resulting in 13 clusters of users, with characterizing behaviours and needs, involved in 15 elementary tasks. UPAs express the general usability requirements common to all tasks, which have been successively elicited in a set of corresponding usability indicators, specifically addressing each task. The full list of UPIs has been applied for the assessment of an underground station of Naples (Italy), belonging to an underground stations network created with the joint work of world-class architects and artists. Usability critical points related to architectural plan, architectural detailing and outfitting which result from poor consideration of end-users in building design process are discussed, together with implications for the effective integration of ergonomic skills in the design process.

Keywords: users' needs, task analysis, usability assessment, architectural design, technical solutions

INTRODUCTION

For a building, the quality of the design may assume many different meanings according the buildings' lifecycle stage, the intended stakeholder, the urban and social context where the building is set (Attaianese and Duca, 2005). A way becoming more and more popular for local administrations to express care for citizens' life quality and for revitalizing urban areas is promoting buildings with a high image value, delivered by the so-called archistar firms. This strategy is based on the assumption that playful, high-tech, evocative buildings bring values in terms of urban quality for citizens and visitors (Hall and Robertson, 2001). But, as end-users of a building often experience, an overall aesthetic quality does not assure effective, efficient and satisfactory accomplishment of their intended goals, so that perceived building quality dramatically decreases once people become actors rather than spectators (La Cecla, 2012; Baird and Penwell, 2012). Therefore, an usability question for building designers arises: how to control design process in order to assure that architectural project will be able to deliver expected quality also under the users' perspective? Buildings usability is concerned with the effectiveness, efficiency and satisfaction of tasks performed by users in built environment (Jensø, Hansen and Haugen, 2004; Alexander, 2007). This means that

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building usability represents the suitability of a building for a specific use, that is the ability of the building to help users in achieving their goals in a fully satisfying way ((Maier, Fadel, and Battisto, 2009; Duca, 2012). Therefore, under the users' point of view, architectural quality actually delivered depend on the extent of designers understanding and consideration of users' characteristics and expectations (Attaianese and Duca, 2012).

DEFINING USABILITY METRICS FOR RAILWAYS STATIONS

Users and task analysis

Under the ISO 9241/11 context of use framework, buildings are the environment whose usability must be assessed considering users, tasks and equipment. For the case of railway station, it has to be considered that passengers do not use tools (as ticketing machines, turnstile or gates usability do not properly pertain to the architectural design, and should be assessed as itself) but they use personal belongings to do actions not functional for the travel scope. Therefore, these items and related actions were considered as an attribute of users. Station users include people with a big variety of scopes, such railway personnel, accessorial services personnel, security and maintenance staff; the presented research focused on passengers and not travelling accompanying persons.

In a first research step, users were observed looking at reasons for their presence in the station, their physical and sensory-cognitive abilities relevant to built environment fruition, assuming that they have different spatial needs to be satisfied (NetworkRail, 2011; CABE, 2001). This analysis lead to 13 users clusters, as reported in Figure 1.

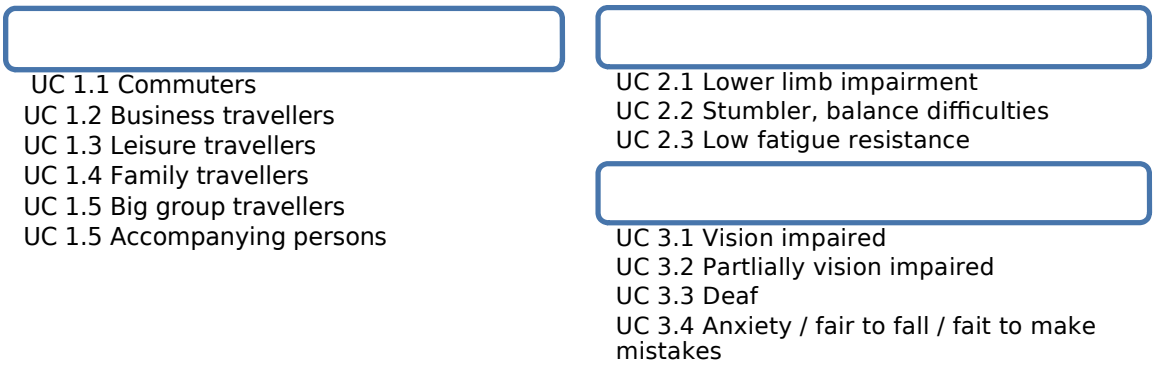

Figure 1: The 13 clusters of users.

Users clusters were characterized looking at how they use the building, in terms of prevailing behaviours and personal activities not directly concerned with the travel. This allowed to elicit needs characterizing the examined cluster, as shown in Table 1. Since a railway station might be used by all or just some users clusters, the list of users' needs to be matched by designers may vary accordingly.

Table 1: Example of needs elicitation for each users cluster.

C1 Reasons for using the station	Style/type of use of the station	Characterizing not functional activities	Characterizing needs
UC 1.1 Commuters	High familiarity with the place	Working	Optimization of journey times
	Short using time	Napping	Real time information on service delays or malfunctioning
	Reduced use of main services (ticket counter, waiting lounge) and accessorial services (coffee shops, ATM, etc)	Reading (digital/paper)	Real time information on other connected transport services
		Watching/hearing from	

	Use of the station in connection with other short distance transport services and/or and personal transportation means	personal devices Making personal phone calls	Direct access to the platform Expeditiousness of pedestrian flows

Together with the users analysis, a hierarchical task analysis was drafted, breaking down the two macro-tasks (A) "Take the train", describing the task flow from the entrance to the boarding, and (B) "Leave the station", describing the task flow from getting off the train and starting the next part of the travel to the final destination. A total of 6 tasks and 15 sub-tasks were identified.

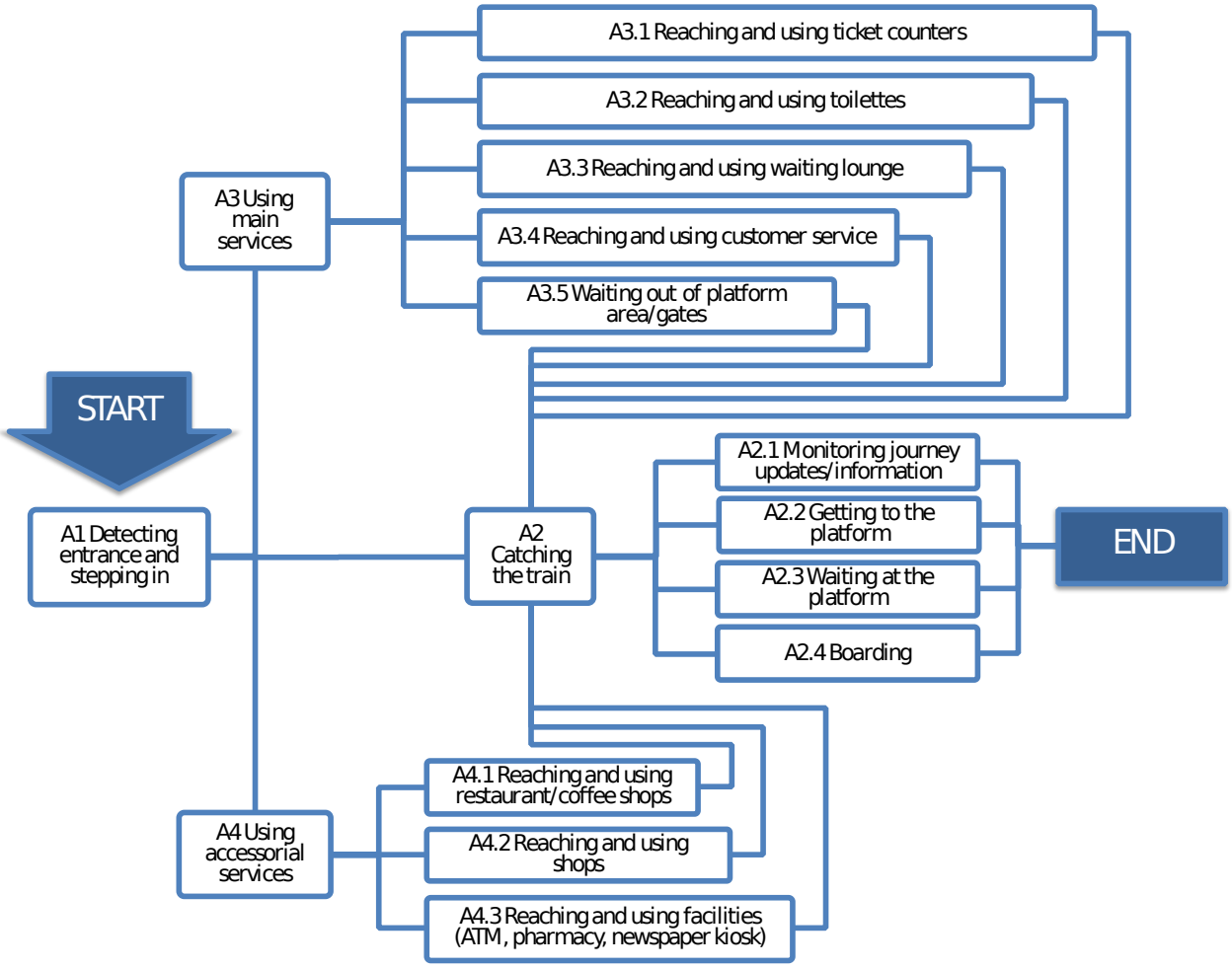

Figure 2: Task analysis of the macro-task (A)"Take the train".

Metrics for usability assessment

Starting from the whole of users' needs identified in the previous stage of the study, a set of 7 Usability Performance Areas (UPA) was defined, with the aim to set the framework of overall building characteristics to be assured for any users' cluster, during any task it might execute in the station (Page, 1960; Afacan and Erbug, 2009; Vischer, 2008; Hedge, 1999; Bluyssen, 2010; ISO, 2011; Haruna, et al., 2011; Kaya, 2004; Stanton et al., 2013). After that, for each of identified sub-tasks, Usability Performances Indicators (UPI) were elicited as further detailing of UPAs (Ahasan et al., 2001; Abdul-Samad and Macmillan, 2004; Sailer et al., 2008; Imrie, 2012; Lehman, 2011; Boomsma and Steg, 2012; Sonmez Turel, Malkoc Yigit and Altug, 2007; Bitgood and Dukes, 2005; Benfield et al., 2014; d'Astous, 2000; Clive et al., 2002; Doku and Erkip, 2000; Howarth, 2006). In both UPAs and UPIs there is no

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explicit reference to accessibility, since users' needs were formulated under the inclusive design approach, and accessibility was considered as an implicit and transversal requirement. UPIs refer to both technical (materials, technical solutions, etc) and spatial (layout, shapes, lighting, etc.) characteristics of the building.

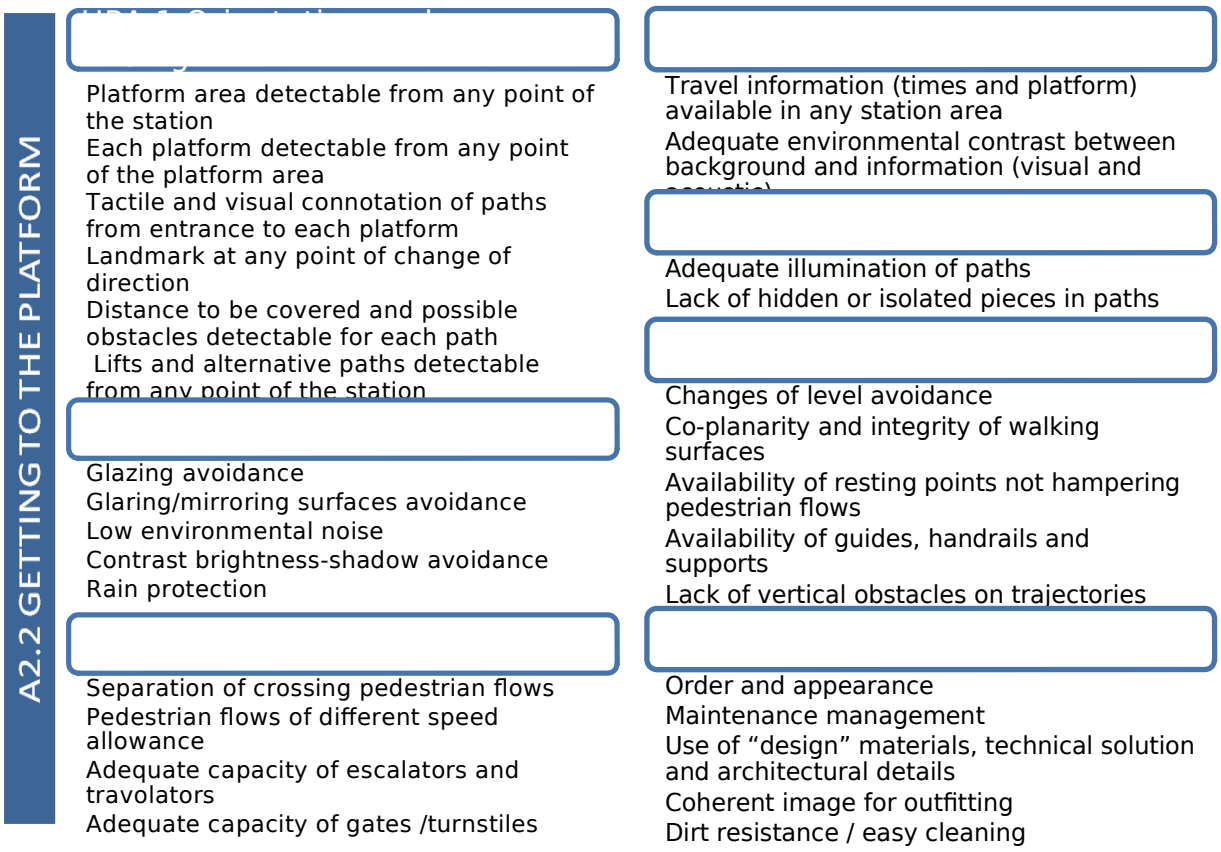


Figure 3: Usability Performance Indicators for the sub-task A2.2 - Getting to the platform.

ASSESSMENT OF AN UNDERGROUND STATION WITH THE UPA & UPI METHOD

The Dante station and its users

The station chosen for the experiment is the Dante underground station of Naples (Italy). It was designed, together with the homonymous square restyling, in 1999 by the famous Italian "archistar" Gae Aulenti. The station is part of the "Stazioni dell'Arte" (Stations of Art) project, involving 9 stations of the Naples underground network. These stations host more than 200 works by 100 of the world major contemporary artists and were designed by some of most famous contemporary architects, with the aim to increase attractiveness of public transport bringing contemporary art to passengers and renovating important areas in the city (Cascetta, 2005). Therefore, the Dante station was designed with the explicit aim to deliver high architectural quality to passengers and general public, and represents the ideal case study for understanding if a good architectural project under the architects' perspective matches implicit and explicit quality expectations by actual users.

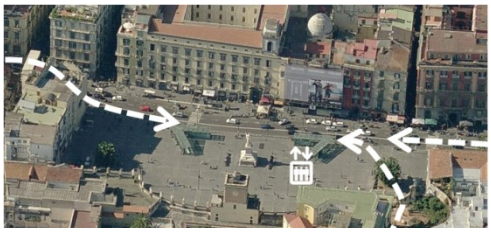
The station serves a very rich urban area, with schools, university, a hospital, a theatre and many nightlife venues, offices and residences. Moreover, being the access station to the historical centre, the station is used by tourists; it is also located at the end of a bike lane, and then represents a small multimodal hub. For the above reasons, the Dante

station includes all the users clusters previously defined, involved in short-medium distance travels for the whole day timeframe.

Conduct of the usability assessment

The usability assessment was conducted examining inside and outside features of the station for each single sub-task with its usability indicators. Therefore a sort of multilayered assessment made of 16 separated inspections (one for the 15 sub-tasks + the "A1 Detecting entrance and stepping in" task), was carried out, obtaining a list of technical solutions and other conditions that were found inadequate for the considered UPIs. Table 2 reports an example of usability investigation results for the "A1 Detecting entrance and stepping in" task.

Table 2: Usability assessment for the "A1 Detecting entrance and stepping in" task.

UPA	Usability conerns	
Orientation and way-finding	Elevator is not detectable by people, unless they enter the square deviating from the main approaching directions	
Environmental comfort	The station is in an empty wide square with black stone flooring, which creates a heat isle during the hottest summer hours, with consequent heat stress for users reaching the entrances	
Capacity	The main staircase crosses the way-out elevator. In rush hours walking out people blocks entering people Width of walkway part between "M" signage and elevator does not allow a wheelchair passage with a walking person aside/crossing Lack of bike stalls	
Travel information	Lack of travel information on interchanging lines	

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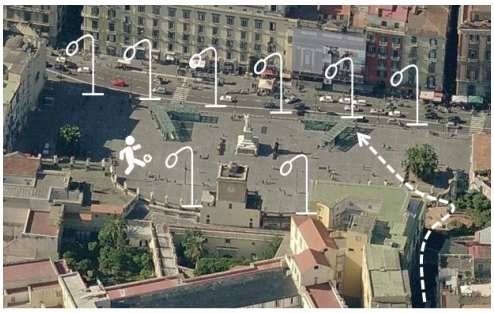
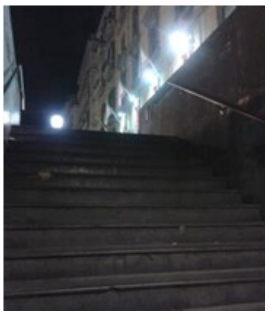
UPA	Usability conerns	
Security	The pedestrian square is used as playground by children: station users can be hit by balls/bikes/skates etc. One of the path to the entrances is under-illuminated because of the streetlamp layout	
Safety	Shops lights on Via Tarsia entrance create a too high luminance contrast with the stairs, so that black stone steps are not visible during shops afternoon opening hours Entrance staircases are illuminated with small radius spot, so that some steps remain in the dark Step edges are damaged Slide on walkways are textured for tactile information, but they are not visually contrasted because they are in black rough stone as the normal flooring. Decorative use of texture for flooring material produces optical effects which make visible an inexistent floor guide. People with partially impaired vision might be erroneously guided against a column	  
Aesthetic and cleaning	Glass walls surrounding stairs are soiled by writers and flyers Top boards covering stairs are damaged by water seepages	

Findings from usability assessment

The assessment of the Dante underground station with the Usability Performances Areas and Usability Performances Indicators highlighted usability issues related to all the design scales, from general architectural layout to technological solutions and final outfitting. For what concerns the layout, it has been observed that the plan causes some problems for safety and expeditiousness of pedestrian flows, as well as in accessing external elevator. Technical solutions for walking surfaces and light systems affect either safety, because they produce conditions

increasing slip and trip probability, either comfort, since there are inside and outside paths were users suffer too hot and/or too dark environmental conditions; moreover, wall and floor technical details cannot be easily cleaned. Main critical points concerning outfitting are linked to way-finding problems for all services in the ticket hall, the lack of information about the underground connected lines and travel directions, the lack of information for the right exit to choose according the outside final destination, and, finally, insufficient sitting places and acoustic discomfort at platforms. Some more usability problems come from poor maintenance management, which should be more effective against vandalism. As overall assessment result it can be said that major usability issues have been found for all UPAs, whilst all UPIs, when not highly critical, offer not optimal solutions under the users' expectations perspective.

CONCLUSIONS

The paper has presented an usability case study on a building of high architectural quality. One of the main considerations resulting from this study is that building usability is a crosscutting issue, that can be fully achieved only if usability principles are applied since the earliest design stage, when the whole image and plan are set-up, and continue feeding the design process at all the scales, from technical solutions to architectural details and final outfitting.

It can also be said that the majority of usability problems come from architectural design choices rather than station management or use, since main usability problems originate from the concept of the station in its whole as well as from its technical details. This means that putting in practice usability improvements would require expensive interventions or even a total renovation; only in few cases, reasonable improvements are possible as, for instance, changing the type of light bulbs or advertisement and information boards.

Therefore, a better integration of ergonomics skills in the building design process is needed to avoid the gap between intended building quality and actual quality brought to users, due to the poor consideration of their characteristics and tasks by architects. This can be considered either a problem of design team composition, since rarely ergonomists join architectural design teams, (Dul et al., 2012), either a problem of architects' education, since human factors competencies are generally disregarded in university courses (Olguntürk and Demirkan, 2009).

For what concerns the usability assessment method formulated in this study, it has to be considered that Usability Performance Areas and Indicators reflect the "key performance" approach, widely used in many technical fields. In this case, the UPIs approach requires that ergonomist in charge of the usability assessment is able to recognize and describe all the architectural aspects involved in a given usability condition, or, on the opposite, that architect in charge of the assessment is aware about any possible effect of built environment on users. Therefore, again, it is clear the need of a specific education topic addressing human – built environment interaction issues, for both designers and ergonomists (Barrett, Barrett and Davies, 2013).

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