User-Centred Design for QR Store: a Case Study

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ABSTRACT

This work describes the user centred design process of one of the first QR stores in Italy. Users related concerns in QR use and m-shopping experience have been surveyed, eliciting users' expectations and needs for the effective and satisfactory use of the QR store to be designed. This has been achieved combining human factors reference data with studies on consumers behaviour buying in shopping malls and in m-commerce stores. Being the QR shopping a consumer experience happening in a multidimensional environment, multiple aspects of physical shops and environment, as well as of QR store app have been addressed during the design stage of the project, aiming at delivering: a) mobile interface of e-commerce service able to support effective and satisfactory buying tasks in public/crowded spaces, b) exhibition paths that match requirements of safety, security and trust in the m-commerce service and that, at the same time, represent an attraction element in environment, c) billboards for goods displaying, supporting ease of vision and information usability by both generic pedestrian flows and motivated customers. The paper also discusses the usability test in real environment to be conducted once the installation will be completed.

Keywords: Mobile Shopping, Environmental Ergonomics, Retail Spaces, Consumer Behaviour, User Requirements

INTRODUCTION

This paper presents the design and development of a QR shop based on principles of User Centred Design. The workgroup has been appointed to design posters and paths for an m-commerce shop using QR codes, to be settled in a shopping mall in Rome (Italy), with the final scope to assure users' satisfaction towards the service and the overall success of the business. The study provided the opportunity apply ergonomic principles for the integrated design of all components of an m-commerce service: posters goods displaying; m-shop interface for mobile devices; physical space exhibition routes and environmental features. To deliver final result, human factors reference data have been combined with studies on consumers behaviour buying in shopping malls and in m-commerce stores.

E-shopping based on QR codes is an emerging market, with good perspectives: At the end of 2011, Tesco supermarkets put posters of its products with QR codes in the Seoul subway, allowing users to make purchases directly from their smartphone and receive at-home delivery on the same day; as result, online sales were up 130% and the company saw a 75% increase in the number of customers. This success history has arisen growing interest in

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many sellers from different countries. This work describes the user centred design process of one of the first QR stores in Italy. Starting from literature review, success stories and users related concerns in QR use and m-shopping experience have been surveyed, eliciting users' expectations and needs for the effective and satisfactory use of the QR store to be designed. After that, user centred requirements based have been designed for any component of the QR store service, namely:

- for billboards, to assure attractiveness, ease of vision and detection by both commercial pedestrian flows and users involving in purchasing tasks.
- for mobile interface of the m-commerce service, to provide a quick and easy shopping experience, considering environmental effects on people purchasing in public/moving spaces
- exhibition paths: to match requirements of safety, security and trust in the m-commerce service, and to enhance attractiveness in complex spatial layouts

Installation of billboards is now completed and usability tests with real users in real environment are going to be conducted, in order to validate the QR shopping system delivered.

SHOPPING EXPERIENCE AND USER CENTRED DESIGN

Several tangible and intangible aspects of shopping environment affect buying behaviour of a potential customer, in both real and virtual shopping experience. Being the QR shopping a consumer experience happening in a multidimensional environment, a review of main aspects to be considered for physical shops and spaces, as well as in mobile e-stores has been conducted.

Consumer behaviour in real shops

An interesting study on factors influencing people during purchasing in shopping malls highlights three basic behaviours (Underhill, 1999):

- customers are attracted by crowded shops, but at the same time crowd is a determent. Therefore, crowd enhance traffic in shops and pushes customer to get in but is discouraging in the final purchase decision;
- lines at cashes exert a sort of pressure, so that customers prefer to spend their time only in shops considered really matching their needs;
- probability that customers put in their cart a "vicious" product increases if they have already put in a virtuous or necessary one.

Hui and colleagues (2009) collected these results matching data from receipts and cash counters with data coming from GPS devices (pathtracker) installed on carts in a big shopping mall, sending their position each 5 seconds.

On the other hand, anthropological studies suppose that people has an innate need to organize in their mind an environment and the surrounding (Lynch and Rivkin, 1959). Then the way in which customers represent a shop in their mind can produce relevant effect on how they arrange their paths.

Many studies show the relevance of controlling environmental stimuli on customer's behaviour (Turley and Milliman, 2000; d'Astous, 2000), being purchasing attitude strongly affected by characteristics and environmental image of the shop.

People behaviour in public spaces

Dynamics of movements for pedestrian groups with individual goals, destinations and preferences, appears as chaotic but are actually rather regular and are surprisingly predictable, in both urban spaces and shopping malls (Helbing et al. 2001). Studies based on video recordings show that pedestrians go around freely only in scarcely

crowded areas, in the other cases their movement is influenced by several factors such:

- repulsive interactions with other pedestrians and/or obstacles, so that people put in practice self-organizing phenomena;
- footprints on soft ground (as in green areas) are attracting factors, and other pedestrian will try to retrace the path drawn by footprints;
- pedestrians show a strong repulsion towards deviations or turning out movements from intended direction, even if the direct way is crowded;
- pedestrians prefer a linear direction, delaying as far as possible the change of direction, unless the alternative path isn't more attractive (i.e. less noisy, more illuminated, etc.)
- pedestrians keep a walking pace comfortable to them, until an acceleration is needed to get to the destination on time. Walking speed of pedestrian crowd follows a Gaussian trend, with a mean value of 1,34 meter/ second-1 and a standard deviation of 0,26 m/s-1;
- pedestrians prefer to keep distance from other pedestrians and any general obstacle; the chosen distance decreases in case of rush or highly crowded spaces.

Persons distribution on a possible surfaces depends on their knowledge: a better knowledge determines a smaller surface occupation. Increasing pedestrian density, interpersonal distances decreases in places are particularly interesting. Individuals which know each other often behave as only one person, as they were just one pedestrian.

One of recurring results is the pedestrian tendency to turn right at a cross or multidirectional point of choice (Melton, 1972; Serrell, 1997; Underhill, 1999). According this model, pedestrian self-arrangement can be used to obtain more efficient crowd flows in smaller surfaces. (Bitgood and Dukes, 2005) . Empirical observations show that pedestrians have a preferred side, in Germany and USA pedestrians prefer walking on right side, and the same can be assumed for Italy, given cultural similarities. Bitgood reviewed conflicting literature and deduced that right turn is preferred in case of lack of powerful directional factors; this study is based on movement economy as empirical approach to understand how pedestrians move in the environment.

It seems also difficult to understand why pedestrians rarely turn from right side of aisles to the left or from left side turn to right, being crowding and destination considered weak motivations. Movement economy is a strategy to minimize walking costs (time and fatigue), and reducing cost advantages are maximized. Therefore, a dramatically reduction of efforts in environment navigation will increase benefits. This principle can be applied also to signage and labels, for which few words and good readability are preferred to an interesting content and design lettering.

Consumers' behaviour in m-stores

e-shopping environment must be rich under cognitive and aesthetic point of view, providing an augmented shopping experience if compared to the traditional one. Easy navigation and prices competitiveness in an electronic environment for examining products are important predictors for online shopping attitude (Childers et al., 2001).

Features to be controlled in mobile e-shop services are (Vietri and Castelli, 2012):

- HMI: prefer a dashboard style interface, immediately comprehensible by the majority of users. To be presented in dashboard: cart, product sheet, purchasing terms, purchasing process, who we are, FAQ, reviews.
- Product sheet: necessary fields are product picture, name, description. Price, m-commerce discount, variations, delivery times, delivery hours, payment method, cart, social share, reseller ratings, add to favourite, tell a friend, product reviews
- Cart: basic information for the purchase process to be completed in maximum 3 navigation steps from dashboard: price, quantity, payment method selection, purchase finalization (payment)
- Delivery datasheet: delivery day and time, delivery contacts, modify/delete, send.

Readability in the format *portrait* e *landscape* (smartphone and tablet) must be assured.

Influence of the colours

Colours play a crucial role in human perceptions. As the result of several studies it is interesting how we can utilize the visual stimulation caused by the colours in order to promote and improve the product sales, continuing the communicational objectives, that can result in a purchase which is pleasant and comfortable in order to ergonomic guidelines.

In all forms of non-verbal communications, the colour gives an immediate impact to convey the message and meaning (Eiseman 2000), in fact at times it is called "silent vendor". It instantly attracts the eyes of the client, and it must create his interest and curiosity for the product and an ideal messenger of the description.

Certain colours or combinations of the colours transmit actual universal significances, for example, in workplace safety: the use of black on a yellow background for the road signs, because the high contrast ensures excellent clarity of the message, such as the red signal hazard used to identify fire protection equipment and emergency stop buttons in hazardous machinery.

The impressions and meanings of the colours change over time and space, some scholars suggest that the differences in gender and age can provide interesting information and highlight the differences, it is also not to underestimate the influence exerted by trends and changes related to social awareness (Feisner, 2000, Sable and Akcay, 2010). For example, a specific study on shopping centres has identified the preference of French Canadians to the rooms decorated with warm colours and the Anglo-Canadian for those characterized by cool shades (Chebat and Morrin, 2007).

Several studies have shown differences in colour perception between people whose exposure to sunlight changes to the geographic location and even economic development may be affected. The people who live near the equator have a reduced perception of blue compared to populations in northern latitudes who have developed a more refined colour vision. People from different cultures have different preferences, but the blue shades are the colour generally more appreciated despite some cultural barriers (Sable and Akcay, 2010). The blue in many cultures it is the expression of reliability.

Briefly, we can report that the studies show that the combination black and white is synonymous with authority and truth, "black and white", and the contrast ensures decisive clarity, the grey is neither positive nor negative and leads to confusion, loss of distinction, "a grey area". The red, one of the colours from the most ancient name, is the first to be seen in a rainbow and that is the greater emotional impact, the orange is the colour of happiness and warmth, yellow is highly visible, with the highest brightness rating after the white is visible before any other colours when it is associated to black, and its positive connotations (joy, happiness, vitality, hope, optimism) outweigh the negative ones. Purple is the colour shades which are more difficult to distinguish for the human eye, is the colour of spirituality and mystery, mourning and death (Kleynhans, 2007).

In addition to shade other factors must be considered. In general colours with high saturation and brightness tend to be preferred and considered more pleasant. The object has a greater impact, especially if it is placed in the foreground. Blue is the colour with the highest preference, also compared to the levels of saturation and brightness (Camgöz, 2002).

Warm colours such as red, orange and yellow are considered to be stimulating and exciting, while cool colours like blue and green are calm and relaxing (Bellizzi et al, 1983; Wisenblit and Grossman, 1999). Bellizzi found that the warm colours in the commercial areas attract more attention than the cool colours, although the cool shades tend to be favoured when customers are facing tough decisions to select.

USERS RELATED ISSUES IN QR SHOPS DESIGN

QR shops

The QR codes were initially used in Japan in the automotive industry, but are rapidly spreading due to the superior storage capacity compared to barcodes (7,089 numeric characters or 4,296 alphanumeric characters, versus 128), but mostly thanks to the growing popularity of smartphones and tablets that provide fast access to a website from anywhere to make a purchase. The QR code follow a standard reference to international standards ISO 18004.

According to a study prepared by ScanLife, in the first quarter of 2012, the codes were scanned 13 million times, with an increase of 157% over the previous year. The majority of users were men (63% vs. 37% women) aged between 25 and 34 years old. According to a study multimedia CBS / Kantar, four out of six European users say they have heard of QR code.

One of the most important commercial uses of QR code is a supermarket chain Tesco, which at the end of 2011 they installed posters of their products with QR codes in the subway in Seoul to make purchases directly from the smartphone with home delivery within a day. Result: online sales increased by 130% and 75% increase in the number of customers.

Some characteristics of the QR code:

- Consists of square shaped symbols in three corners and black markings arranged within a frame. The three squares in the corners represent the feature graphics more easily visible. With these 3 squares the user can easily navigate and decode the information contained therein;
- Has a redundancy of information that allows possible damage to the QR code up to 30% to be legible.
- Not as cost consuming compared to the normal printing of the posters;
- Easy to use with mobile phones and smartphones and is also readable with 2D scanner and webcam;
- The recommended minimum size 9x9mm (depending on the contrast and the amount of information);
- Can be made in different colours with sufficient contrast within the QR code and can be integrated into a logo.

The critical issues regarding the project QR Shop:

- For use with some models of mobile phones an application still needs to be downloaded but many manufacturers are now incorporating the function devices;
- Differences in speed of response;
- Creativity is essential to ensure a quick and easy identifiability of the QR code, and their use;
- Less effective in crowded places.

The positioning and sizing respect to the environment and to users of the QR code on the posters should be studied more carefully.

QR SHOPPING USERS' EXPERIENCE

Characteristics and behaviors of users

The list below shows the personal characteristics of the users and their behaviour with respect to the use of QR code and e-shopping in relation to the Italian market.

Table 1: Favourable and unfavourable conditions for QR shopping in Italy.

Positive conditions	Negative conditions

- Aged between 25-44 years - Male gender - Resides in Lombardy - Owns iphone - Have a QR reader installed - Habit to shop online - Possession of Paypal account / prepaid card - Willingness to spend time to understand the characteristics of the product and / or compare prices	- The majority of smartphone owners recognize a QR code but does not know what it is or what to do with it - Difficulty of precision in the use of the touch screen - Impatience - Hands busy - Poor or no previous experience of online shopping

Characteristics of the environment

The list below shows the main environmental parameters that determine favourable or unfavourable attitude for purchasing task in a QR Store.

Table 2: Favourable and unfavourable environmental conditions for QR shopping.

Positive conditions	Negative conditions
- Not overcrowded, which leaves personal space protected and allows one to pay attention to the task of purchasing - Absence of direct light and reflections that hinder legibility of the phone screen - Adequate lighting on the display surface - Stable signal of mobile data or wi-fi - Low-noise in the surroundings	- Crowd - People covering parts of the QR store - High noise environment - The user is amidst intense flows of people - The QR store is located in a marginal area, potentially perceived as isolated/unsafe

Service Features

The list below outlines the characteristics of the commerce, the concept of the store and the key features of the app QR shopping that can encourage or discourage the purchasing activity.

Table 3: Favourable and unfavourable features of mobile interface for QR shopping app.

Positive conditions	Negative conditions
- Easy availability of delivery information - Clarity of contact info and recognition of the seller - Overall usability of the interface of the phone, in particular small number of navigation levels (compared to the desktop version), size of text and images , and size of areas to be covered. - Federated login - Size of text and images legible from the distance to which the users are located	- Need to download the application - The need to create accounts - Impact of the costs of shipping - Delivery time - Need to use the credit card in non-optimal position (eg on the street , among others)

- Accuracy of the description of the product
- Discount given exclusively to purchases from QR store
- A chance to try / touch the product
- Option to save your cart and complete the purchase from a desktop pc

QR SHOP USER REQUIREMENTS: DESIGNING A MULTI LEVEL INTERACTION EXPERIENCE

QR marketing needs to integrate an marketing requirement and ergonomic instances , the application of which is intended to create a more convenient purchase and to meet the needs of the customers . The ergonomist working group will proceed to design in consideration of the evidence reported in behavioural studies and colours.

Physical space

The installation will take place in shopping centres, display must be attractive and effective at the same time , provide a proper analysis of the information to the passers-by, and for any subsequent scan. The area must be of high-traffic but not located in the immediate vicinity of the major supermarket , as the crowd could be a deterrent . For the most effective promotion, the most attractive, important products are to be displayed separately from other less significant items, in the most visible positions and settings.

Elements to attract attentions used are: grazing lights , lettering and arrows on the floor, banners , independent exhibitors. The letters and arrows on the floor and freestanding display structures will also be used as elements of behavioural conditioning of the pedestrian flow . Display racks with products will instead be placed on the wall.

Display racks and billboards

The top section is too high for an easy scan of the QR, so it is advisable to be used for directions, information, corporate image of the QR shop.

The optimal distance for purchase in a public space is between 50 and 80 cm, the diagram below shows the vertical field of view for 5% of the women and 95% of the male.

Important point, both for the ease of the task of buying, and for the attractiveness of the exhibition, is the correct font size. The following tables provide a guideline for people with normal visual acuity.

Tables 4a and 4b: Parameters for billboards fonts readability..

Font sizes for advertising posters

Type of **text**	**Font size**	**Details**
Title	150+ pt	Legible at a great distance (at the far end of a very large room)
Heading	48pt	Easily legible header from those who are walking in the vicinity
Subheading	36pt	Legible by more than 1.5 m
Body text	32pt	Comfortable Reading from about 1.5 m
Notes / captions	24 – 32pt	Use only if necessary, for a distance of about 1.5 m m

Reading distance	Font size for comfortable reading	Details
0.35 m	8 pt (minimum)	Typical distance for reading a book. The majority of the people prefer, for this distance, 10,11 or 12 points
0.7 m	16 pt	Font size for optimal read a large poster at the closest distance
1.5 m	32 pt	In public places this is the minimum distance at which you are able to bring to a Poster, as a result not only of people but also alter the height at which the writing can be
7.5 m	160 pt	This is the distance from which you would expect to be read a billboard in a public place.

Attention has to be paid to the contrast information / background:

- ensuring the highest possible contrast, which is given by a yellow background + text + purple or yellow background Black text. However, they are to consider the needs of commercial and attractiveness of the product. Considering that technology products will be on display, warm, bright colours are more associated with low-end computer gadgets, while for products of higher purchase cost tend to be associated with more refined, sophisticated tones such as dark blue and white, which combination also represent an adequate contrast

- using a light background for the pictures, not overlay text on images, saturate as much as possible the image of the product.

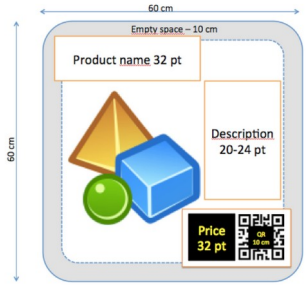
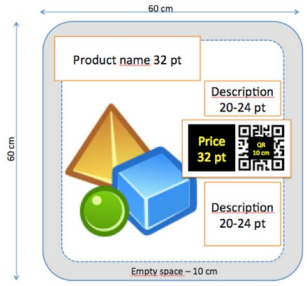
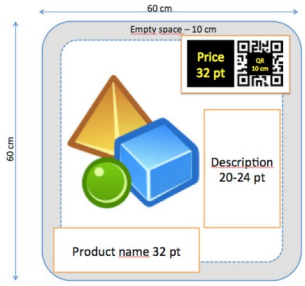
- avoiding overcrowding with too much written information, will be sufficient: price, product name, short description requirement product

The products must be presented each in a well-determined grid, clearly indicating the price and QR code associated, as in the pictures. The squares structured according to the following areas: central image (margins of 10 cm), area price, area info, QR code (10x10cm).

Table 5: Design specifications defined for aall displays layout.

Range	Height	Using
Top level	60 cm	Explanation of the usage
II Top half, centred	60 cm	Products of the most significant, suitable for men The QR Code is placed at about 175 cm above the ground
III Lower centre	60 cm	Products of the most significant, suitable for women. The QR Code is placed at about 135 cm above the ground
IV Lower level	60 cm 45 from the floor	Products of lesser commercial interest, is less ergonomic level, commercially suitable for products intended for children. The QR code is placed about 95 cm above the ground

Table 5: Design specifications defined for aall displays layout.

Good displaying frameworks	Position in billboard
	II Top half, centred - The QR Code is placed at about 175 cm above the ground
	III Lower centre - The QR Code is placed at about 135 cm above the ground
	IV Lower level - The QR code is placed about 95 cm above the ground

Service

Use of the virtual store environment in public is appropriate in redeveloping of the '3 clicks rule' to reach the desired content, so that in order to make a purchase it is a simple '3 steps to screen' home-dashboard; cart; delivery data . Only in the case of vision of the 'product details' it will take 4 steps, or more if you want to go to other icons.

To finalize the purchase in the vicinity of the QR Store is important to encourage payment through Paypal, or by recording your credit card, or cash on delivery if necessary. Payments by bank transfer increase the likelihood of a delay.

Therefore, the process behind the service must follow the following steps

- Dashboard (after scanning)
- Cart (choice)
- Data delivery / payment (your choice)
- E-mail notification (automatic)
- Thank you (automatic)

Facilitators

Ergonomics In Design, Usability & Special Populations III

The facilitator's task is to support users to enable them to understand the workings of the QR code and purchasing. In this project, the commercial functions of this figure are assistance of the visitors and evaluation of the project. Through questionnaires and checklists will be specially built examined comprehensively, objectively and critically the appropriateness of the objectives and the quality of the actions taken in relation to the results, the effects caused to the needs and prefixes. This activity will be supported by the creation of videos for the observation of user behaviour.

USABILITY TEST OF THE QR STORE SERVICE

The project for the development of the QR store prototype here presented includes a step of usability testing but, given the present stage of development of the project, usability tests have not yet been conducted. Here will be provided an overview of the planned work. The QR shopping experiences is characterized by the strong intersection of features of shopping mall spaces, QR boards and QR shopping app; therefore the usability test will address all the above factors as single service component and as a service in the whole. Tasks needed to complete the purchasing process with the QR store service will be defined, starting from the QR boards approach to the payment via the QR store app. For each of these tasks, usability metrics will be identified in order to understand users' effectiveness (quantitative metrics), efficiency and satisfaction (qualitative metrics) during actions execution. The test will be conducted with not intrusive techniques, basically creating a check list supporting over the shoulder and environmental observations.

CONCLUSIONS

The case study of User-Centred Design for QR Store was conducted with the intent to demonstrate the importance of the methodology and application of ergonomic principles in the context of marketing, being also a valuable support to the business improvement thanks to the correct consideration of users needs and expectations. The design team has defined and adopted ergonomic guidelines in order to achieve the commercial objectives of the store by delivering a pleasant purchase experience for the user. The project has addressed also a further objective, that is applying ergonomics in a "multi-objects" project, since user centred principles have been addressed in the analysis and design of the aisles, exhibitors, posters, mobile app interface and, finally, are going to be validated with real world usability test.

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