

# Design as a Tool for Managing Risks and Vulnerabilities Regarding Artifacts of Public Safety

Walter F.M. Correia, Sérgio Ximenes da Silva, Fábio F.C. Campos,  
Marina L.N. Barros, and Marcelo Márcio Soares

Federal University of Pernambuco, Av. Prof. Moraes Rego, Center of Arts and  
Communication, Cidade Universitária, Recife – PE, Brazil  
ergonomia@me.com, {sergiouxim, fc2005, marinalnbarros}@gmail.com,  
marcelo2@nlink.com

**Abstract.** It is on man's interaction with the environment, taking into account all objects whether or not they are natural that design is focused. However, the relationship between the quantity and quality of what is produced and the creative processes of design do not always bring about the responses that the end user wants. This paper puts forward a proposal for designing a tool that may contribute to design methodologies for evaluating the safety of artifacts the use of which are restricted in the activity of Law Enforcement by Managing their Risks and Vulnerabilities. The paper sets out to include the knowledge of an expert in this subject area who is working on the risks and vulnerabilities that are present so as to obtain the most appropriate artifact possible for the demand proposed. The process of making such artifacts adequate and selecting them is permeated by such a large number of factors that they can only be matched, in amount, to the number of possible combinations between pieces of a chessboard. Hence the importance of producing a scale of values by using a rational and practical tool.

**Keywords:** Design, End User, Design methodologies, Safety of Artifacts, Public Safety, Risks, Vulnerabilities, Scale of Values.

## 1 Introduction

In general, when considering such methodologies as those of Cross, Roosenburg, Archer Jones, Gero, Lobach, Briggs and Burdek, one observes that their steps and design techniques are, at bottom, grouped into the following four main phases: Exploration of the Problem; Generating and Selecting Alternatives; Evaluating Artifacts; Presenting the Solution. (VASCONCELOS & NEVES, 2009).

The needs of people today are usually anchored on being consonant with their professional and private activities, family relationships, leisure, sports, i.e. not necessarily with issues of safety, warranty against direct and indirect attacks on their lives. This is because to guarantee this, there is the presence of the state, whose obligation it is to ensure that citizens have a dignified and safe life.

Article 1 of the Brazilian Constitution of 1988, in its sole paragraph, states: "all power emanates from the people, who exercise it through elected representatives or directly under this constitution". The article in question draws attention to the ownership of the exercise of power by exemplifying that the holder of power is the people. However, the exercise of that power occurs via the representatives of the people in the sense of formally establishing a Democratic State of Right and, therefore, of the sovereignty of the people.

It is precisely because of this, we have a set of different needs and aspirations to which great attention must be paid, namely that which comes from the Activity of Law Enforcement. This is because it is this which, nowadays, is responsible for upholding peace and resolving disputes, since this activity is directly engaged in life or death battles.

It is within this framework that the designer must serve by seeking to meet the most demanding needs arising from the Sector of Law Enforcement such that it may satisfy not only the large-scale production of artifacts that applies to all users and regards them as equal but also by bringing to the forefront concepts and procedures that enable the end user's increasingly specific needs to be externalized. This should be dealt with as being one and the same for everyone.

Hence a new need arises within the design process: using expert knowledge in the process of data collection in an attempt to list its main features, resulting in formulating a scale of values that should be prioritized so as to achieve results that are more specific and appropriate to the demand coming from the activity of Law Enforcement.

This research study seeks to obtain an aspect of the visual perception of the real space of Pernambuco/Brazil, concerning the items of equipment for individual use in the activity of public safety, the focus being on police vehicles. This will be done by working on the absence of a fit-for-purpose methodology of analysis for selecting, purchasing and distributing them. These will be analyzed from different perspectives by means of interviewing users directly and filming and photographing situations in which they are used. The vehicles are used in various operating environments that have the lowest and highest risk for the police. "Risk" is understood as a possibility that may occur from an event that may cause major or minor injury. Aspects such as ergonomics, usability and liability will be addressed.

## **2 Theoretical Background**

Design refers not only to the aesthetic appearance of products; it is geared towards well-being in people's lives.

There are very different specialties in the field of design: interior design, fashion, industrial design, etc. Another specialty which is very relevant is that of the Design of Vehicles, a concept presented by the Portuguese researchers Donato Nappo and Stefania Vairelli in their book "Design of Vehicles": "This is the study of the formal and aesthetic evolution of vehicles, from their origins to the present day. It is a chronological narration that precedes and crosses the world of wheeled transport that

ends up joining those who, with their ingenuity, managed to make history by determining the most significant developments and stages around the world".

Public safety, on the other hand is a concept linked to the legal provision of Safety, duly allocated in our Magna Carta, the Federal Constitution of 1988 in article 6 on social rights, together with education, health, work, housing, leisure, social security, the protection of motherhood and childhood as well as assistance to the destitute.

In the light of the principle of Human Dignity that guides the concept of public security, the renowned commentator on Law Rogerio Greco states: "Even the vilest, most hateful man, the cruellest and most cold-hearted criminal is a bearer of this value".

It is clear that in both concepts (design and public safety) there is a common factor: a plurality of disciplines and related issues that act as automatons on an assembly line, in which each of the concepts and disciplines is responsible for a portion of the whole and on which they have a direct influence on the final result should they be relegated to oblivion. That what they require is not special attention, but a just one to the correct degree that is applicable to each factor.

It is, in this diversity, that design is present as an element that creates, adapts and links artifacts to the specific needs of the users responsible for conducting the activity of public safety, and it is there that the Design of Public Safety is found.

Through the Designer of Public Safety, potentialities that were dormant because of the lack of dedication and knowledge will have been developed.

### **3 Research Methodology**

The Tool for Managing Risks and Vulnerabilities proposed starts with a specialist in the area in question making a direct evaluation (such as the end user, for example, policemen who constantly use vehicles in different situations).

First of all, the risks and vulnerabilities present must be listed. Then, they should be explained, put on a scale and subdivided into groups by functionality and relevance.

From then, the Likert scale and the GUT table are applied. At the end there should be a cross-check between the Likert Scale and the GUT Table and the most relevant markings applied on the Table of Scaled Values.

Hence there will be a Guideline by functionality of the aspects of risks and vulnerabilities considered the most important to be worked on. On using this Guideline, the main goal is achieved: that of obtaining an artifact that is best fitted for the demand initially proposed.

Questions about financial and time viability must be dealt with in a secondary analysis because they imply technical and administrative issues.

Some topics listed in the guidelines are specific to police cars and these alone, since they are the focus of this case study. The fact that the Tool for Managing Risks and Vulnerabilities can be used on any public safety artifact means that new risks and vulnerabilities present in these other artifacts be listed and that they need to be evaluated. This should be done by using the knowledge of another expert in the field

for that other object to be evaluated. The list of risks and vulnerabilities varies depending on the artifact to be evaluated. For example, if the object is a building such as the Arts and Communication Center of the Federal University of Pernambuco and the demand is for organic safety, by using the tool, the risks and vulnerabilities present using the knowledge of safety experts and end users, and in addition to determining what core values are to be worked out, they can be scaled and differentiated, for example, by finding out whether students are more at risk than teachers.

**3.1 Development of the Tool through the Case Study**

**Situation Map of Risks and Vulnerabilities.** On using police vehicles as a case study, the first step should be to list the risks and vulnerabilities and place them on a Situation Map of Risks and Vulnerabilities. Those listed must be related to the performance of the activity to be studied. They should be divided into groups by affinity, which is to be understood as those that have similar characteristics that a priori individualize the related risks and vulnerabilities and this may relate items precisely because they do not fit into any other existing group. The subdivision into groups allows for ease of observation and quantification when implementing the next steps of the tool. At this stage of application of the tool to the case study, six different groups were identified that have components which are interconnected by functionality such as protection against external threats or availability of an adequate place to allocate artifacts or the possibility of interference in the space so that to create room for moving around in it.

**Table 1.** The table with this step is available in the annex to the dissertation for the whole project. (Table 1 – Situation Map of Risks and Vulnerabilities Present in the Use of Vehicles. Source: The Author (2013)).

<b>Situation Map of Risks and Vulnerabilities Present in Use of Vehicles.</b>		
<b>Affinity groups</b>	<b>No. of needs order.</b>	<b>Risks and Vulnerabilities.</b>
Group 1	1	A lockable compartment with bars to transport detainees.
	2	Radio Communicators.

After drawing up the list of risks and vulnerabilities, all factors must be exemplified one by one as per the examples below:

(1) Lockable compartment with bars (fit for humans at the back of the vehicle) to transport detainees.

This is what is usually called in Portuguese the “jail-cage “in the car, only suitably adapted. Instead of transporting those arrested and detainees in the trunk of the vehicle or in the back seat without any structure to contain them except for hand-cuffs, they can be transported safely (both with regard to themselves and the police

officers who are escorting them). In one case in 2005, two policemen transported a prisoner in the back seat properly handcuffed behind his back when they stopped at a house to pick up his documents. While one officer was out of the car, the prisoner brought his hand-cuffed hands under his legs and grabbed the gun of the officer who was in front, in the driver's seat. After much struggle between the two of them, the police officer managed to retrieve his pistol and contained the prisoner. He almost lost his life. This is to make no mention of when the vehicle is involved in accidents, a time when a prisoner in the boot is likely to be severely injured.

**Likert Scale.** For this, we consider the risks and vulnerabilities related to a police vehicle, duly listed in the previous step of developing the tool. Each aspect will be evaluated according to what the user considers is more important or less important to safe-guard life. After quantifying this perception of importance what will be highlighted are the aspects considered as being the most significant ones to be worked on and as being indispensable in the daily routine. Such items scored at level 5 will be related to the scores given later from the GUT tool which will be developed in the next step for managing risks and vulnerabilities.

The table with this step is available in the annex to the dissertation for the whole project. (Table 7 - Grading the level of risk and vulnerability using the Likert Scale. Source: The Author (2013)).

**G.U.T. Tool.** Considering the levels of severity/ gravity (damage wreaked by the situation), urgency (minimizing the time to resolution) and trend, the GUT tool actions regarding the risks and vulnerabilities by priority level will be listed.

The table with this step is available in the annex to the dissertation for the whole project. (Table 13 - Requirements to be prioritized through the tool GUT Source: The Author (2013)).

**Data Analysis.** In this step a cross-check is made between the risks and vulnerabilities marked as most significant on the Likert Scale and GUT tool. Based on such cross-checking, there will be a real stratification of the aspects that are considered the most important ones which will enable values to be concentrated that result in a Guideline for scaling priority values when assessing the quality of a police car which will be worked on in the next step for managing risks and vulnerabilities.

The table with this step is available in the annex to the dissertation for the whole project. (Table 14 - Data Analysis. Source: The Author (2013)).

## 4 Results

### 4.1 Guideline for Scaling Priority Values When Assessing the Quality of a Police Car

If the methodology proposed is followed, the result will be a Guideline with a list of priority values when assessing the level of quality of a police vehicle (the object worked on as a case study). The result is realistic as to the needs of the object

demanded since it arises from observations made by an expert in the area and follows a logical process of gathering and correlating data. The proposed model is not restricted to police vehicles but can be used for other artifacts.

**Table 2.** The table with this step is available in the annex to the dissertation for the whole project. (Table 15 - Guide Line Scheduling Priority values when assessing the quality of a police car. Source: The Author (2013)).

<b>Guide Line for Scaling Priority values when assessing the quality of a police car.</b>		
<b>Affinity groups</b>	<b>No. of needs order.</b>	<b>Risks and Vulnerabilities.</b>
Group 1	1	A lockable compartment with bars to transport detainees.

Risks and vulnerabilities listed in the final guideline above, resulting from the application of the management tool, are the ones that should be considered when assessing the level of the fitness-for-purpose of a police vehicle for the desired activity. The final decision should be based on the response to the demand for police vehicles and serve as guides for defining the artifacts to be worked on as a priority as they were defined as most important ones founded on the knowledge of experts in the field.

## **5 Conclusion**

### **5.1 Initial Considerations**

No methodology for evaluating the effectiveness of restricted use equipment in the activity of public safety was found that takes into account the knowledge of experts in the data collection phase in the design process. To some extent, methodological submission to empiricism takes place.

It was not verified that there was a process of individualizing equipment with a view to adjusting them to the professional and thus reducing the possibility of failure in the performance of his/her activities.

### **5.2 Compliance with the Objectives of This Study**

Risks and vulnerabilities proved to be an efficient means of development for the applicability of the management tool for interventions in restricted-use artifacts in the activity of public safety, specifically in police vehicles.

The methodological processes of Design are benefited from the inclusion of expert knowledge in the development stage of the product, otherwise, a deficit in the safety of the end product might arise.

The transfer of knowledge from experts in the form of guidelines for the design process proved to be of paramount importance for the correct intervention of the designer, or at least for a more appropriate tweaking of the proto-design of artifacts.

### **5.3 Contributions to the Design**

Design methodologies usually do not put into the phase of collecting data, expert knowledge on the subject that one wishes to tackle.

Regarding police cars, the procedures allocated are arranged empirically, with studies and assessment processes being restricted to the methodologies of manufacturers which are geared to the average consumer. With the proposed tool, there is a strengthening to the designer for the process of creating and developing artifacts focused on the activity of public safety, thereby facilitating and strengthening the development of this professional activity.

### **5.4 Recommendations for Future Work**

Because the dynamics of the theme worked on, relevant aspects require further developments that may eventually become part of a differentiated whole, comprising important procedural changes in the activity of public safety.

Suggestions for what future research studies might tackle include aspects such as:

- Establishing a Standard (an NBR, the acronym in Portuguese for a Brazilian Regulatory Standard) about specific aspects in police cars such as the control of sirens, indicative lighting and radio.
- The creation of a specific methodology, focused on assessing artifacts for restricted use in the activity of public safety.
- Testing the tool on equipment that is not related to the activity of public safety.

### **5.5 Final Remarks**

Currently, there are investments in public safety in the State of Pernambuco/ Brazil in respect of purchasing the latest equipment such as a thermal camera for use in helicopters, the trucks of Integrated Control and Command Center used in the Confederations Cup in 2013 and later to be used during the World Cup football in 2014, the fully automated anti-bomb robot, special vehicles used in tactical units, boats and helicopters. However, as regards police vehicles, in general, submission to empiricism occurs regarding the necessary adjustments, which are not set out in a methodological tool for this purpose.

The tool proposed enables efforts and resources to be allocated more precisely, resulting in savings of time and fostering a better adaptation of artifacts to the user, as it should be, assuming an interaction where the user has to adapt him/herself to the minimum extent possible to the artifact in order to survive the hazards present in his/her working environment.

It was found that there are no in-depth studies on causes that led to incidents to do with public safety equipment.

For the activity of public safety, comfort and security are interdependent and the link is design. The process of selecting and making artifacts for a purpose is permeated by so many factors that can only be matched in number to the amount of possible combinations between pieces of a chessboard. Hence the importance of producing a scale of values using a rational and practical tool that will assist in developing safer artifacts.

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