



# Forensic Police's Work Simulation to Support Product Development in Times of Pandemic

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**Abstract.** Work simulation is a strategy to integrate work knowledge into the design process. Although it a recurrent approach among ergonomists, few paper present information on simulation preparation and the material used. This paper presents a work simulation planning to support forensic ballistics packaging for evidence collected in the crime scene. The study was conducted with the forensic police department of a statue Brazilian Civil police. Because of the COVID-19 pandemic restrictions, the ergonomist had to restrict their interaction with workers to remote meetings. Based on the initial field study interrupted by the pandemic and remote discussions on work constraints, the ergonomist team develop a design for ballistic evidence packaging and prepared a simulation to test it. The simulation plan presented englobes different materials, intermediary objects designed, workgroup composition. Also is shown the general dynamics, including rules, points of interest, and typical action situations selected for work simulation.

**Keywords:** Work simulation · Activity · Intermediary object · Participatory ergonomics

## 1 Introduction

Ergonomists have been using various participatory methods to integrate users into the design process of workspaces, equipment and other elements of the work system. These simulations technics generate benefits such as focusing on user needs, thus improving solutions and increasing project acceptability [1]. Several authors use work simulation methods to integrate knowledge from work activity [2–5]. These simulation methods involve users' participation, but the ergonomist must plan these meetings and select the intermediary objects [6] to organize participatory dynamics. Despite of some author proposes frameworks for simulations and presents details on the material used (see for example [7, 8]; usually, these subjects are not well described in articles.

This text report part of a project related on developing packaging for forensic police department in Brazil. Police officers use these packaging to protect, manipulate and control the evidence collected in crime scenes during all custody chains. When these forensic packagings are poorly designed, they can interfere in these police officers' work

activity. This paper will present and discuss the simulation planning for testing forensic ballistics packaging developed based on the discussion on these police officers' work conditions.

The activity analysis stage is essential for the Ergonomic Work Analysis [9]. However, the project reported here had analysis restrictions due to work-related safety issues and limitations imposed by the pandemic. To overcome these limitations, three ergonomists' design team worked with a forensic group to develop forensic evidence packaging. The group reported difficulties related to work situations, discussed usage particularities and design propositions to support various evidence packaging development. The design team organized work simulations with forensic police officers who manipulate this material during the chain of custody in more advanced stages. The simulation was planned to test the design proposals and allow the design team to analyze better these work situations that were previously only discussed.

## 2 Method

We conducted a case study with a police forensic department, where a team of three ergonomists organized a participatory approach in the project of new forensic evidence packaging. The team worked on the project for one year, analyzing work procedures, legal and technical requirements, and forensic police officers' work situation to collect and precede analysis on evidence collected on crime scenes and/or on civilians involved in the investigation. The project's purpose was to develop forensic packaging for different departments related to computer crimes, ballistics, forensic medicine, among others. The purpose of the study presented in this paper is to analyze the planning on simulations held to test one of the packing developed for ballistics. This ballistic packing is used to collect ammunition and projectiles on crime scenes.

Authors conduct this study as a case study [10], a methodological approach suitable to investigate phenomenal in their environment. Work simulation is a methodological tool used in the design process, where people's dynamics interfere in the design results. Besides, case studies are applied in a situation outside experimental control, such as the social interactions, reactions, and discussions during the design process.

The project was developed based on the Ergonomic Work Analysis [9]. The ergonomist team started the project by visiting all laboratories that analyze evidence collected in crime scenes, discussing with officers difficulties related to manipulating evidence. Access to crime scenes to follow the evidence collecting was not possible due to legal and security restrictions. Subsequently, due to the Covid-19 pandemic, the design team need to stop the work analysis on police laboratories. The strategy for gathering information on the work situations was changed, centered on meetings with a forensic police officer and forensic technician. They also consulted other colleagues specialized in other departments. Although this approach limited the study, it was the possible strategy to keep the study without exposing the design team and the police officers in forensic laboratories.

Based on these remote interactions with forensic officers and laboratory technicians, the design team proposed several design solutions for forensic packing and laboratory material to manipulate and preserve evidence. To test the design propositions, the

ergonomists prepared prototypes very close to the proposed materials and respecting their real scale. The objective was to conduct simulations focused on the work activity based on selected typical action situations [2, 3, 11]. This way, the ergonomist could observe how forensic officers would use the proposed material. This was a strategy to compensate the limited access to work activity. Because of restriction related to the COVID-19 pandemic, this paper will focus on simulation planning since it was not yet possible to conduct these tests on the police premises.

This study's data was collected from planning prepared by the ergonomist and its summary presented to the directress of the forensic police unit. This plan was prepared in two stages, an executive summary presentation to the directress and an extensive plan submitted to the remote support team composed of forensic officers who work with the ergonomist team.

### 3 Results

The simulation was planned to allow observing a simulated work activity, trying to maintain the temporal continuity of collecting ammunition on the floor in some scenarios prepared by the ergonomist team. To better organize the results, the planning will be present in three different items.

#### 3.1 Simulation Structure

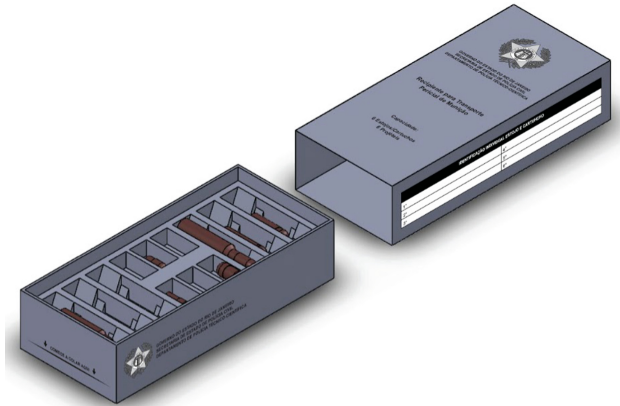
The first element is the team composition. Because we have the interest to observe a simulated work activity, it's necessary to include who actually collect and manipulate this kind of evidence. The proposition was to include three forensic offices and one police officer. Because both professionals can collect evidence, it is essential to have both points of view. The meeting would also involve the three ergonomists in the project and forensic offices who worked remotely with the design team. This composition would totalize nine people with different backgrounds and points of view on the manipulation process.

A second element of the planning is the simulation place. The proposition is to hold a simulation on the ballistic laboratory. The selection has two motivations: first, hold the simulation meeting in a place where users know well and feel comfortable. Secondly, inside the ballistic laboratory, extra material can be used in the tests if the ergonomist team's initial material is not enough. This includes ammunition material that cannot be moved from places to be used on the tests.

#### 3.2 Simulation Material and Intermediary Objects

To conduct the simulation as planned, a series of materials is necessary. First, to test collecting ammunition, it necessary to have the disposal of ammunition. For safety reasons, all ammunition used for the test are inert, which means they have inside material removed to not work on weapons anymore. All the shells prepared for the test is provided and inerted by the police. For the test it was select a variety of calibers so packing could be tested with the more common ammunition for pistol, revolvers and rifles.

The primary material for this simulation is the ballistic packaging. They are the intermediary objects that represent the design developed. Although it was not possible to prepare a packaging with the same material specified, dimension and resources are functions on the prototype. The packaging comprises three parts (Fig. 1): a plastic piece to put the ammunition individually, a paper casing to protect the ammunition on the plastic piece, and an adhesive seal to block the packing and to allow officers to write information regarding the collection. The two last elements have material very close to real on the prototype. The plastic piece, on the other side, is made with 3D printing.



**Fig. 1.** Different elements from the ballistic packing

The packing was designed in two different sizes for different ammunition quantities. Because there is no pattern to how many ammunition police officers can find in a crime scene, the two sizes were conceived to give more flexibility to organize the collected material. Also, as the selection of size packing is an item of interest for the simulation, it was necessary to plan equivalent quantities for both sizes.

A second intermediary object is a variation for the adhesive seal. On the seal, the collector officer will describe information relative to the evidence, such as the officer responsible for the collection, date and summary description. The information selection related to the custody chain and its organization on the label was discussed with the remote workgroup. However, during the simulation, it is possible to have a new discussion on the material, conducting to new propositions. The variant adhesive seal intermediary object is simply the label dimensioned without written information (except for organizational identification). Rather grid lines so they could rewrite a new proposition with reference to the label size to avoid inputting too much information.

A third object is a piece of chalk. Because we will be presented some “simulated crime scenes,” to help the officer doing the task proposed, it will be drawn on the floor three “bodies” to use as references for the ammunition collection. The mark on the floor will remain the same during all “simulated crime scenes”; their role is only to mark situational with multiple shooters and multiple points of ammunition collection.

Lastly, the equipment for simulation recording. For these simulations, ergonomists planned to use three cameras: one for continuous video recording, one for photographs, and one in case of need. The discussion will also be audio recorded to guarantee the discussion continuity and easier editing for further analysis.

### 3.3 Simulation Dynamics

The ergonomist team programmed the simulation meeting to occur in three hours and it is structured in four phases. The first phase consist on dynamics introduction. Explain that participants will perform some collections using the packing. Also, they will be asked to explicit their thinking process during the use so other participants can understand how he is using the material and explain that the packing is developed to support his fieldwork and process control during the custody chain. Therefore, it is important to explicit his difficulties related to his real problems and strategies. It will also be presented the recording material and explicated that all videos will be used for the study propose and their anonymity will be preserved.

The second phase is to perform the typical action situations selected with the remote support team. The third phase will be centered on discussing their opinions on the material developed and possible propositions. The fourth phase will be to thank everyone for their availability and inform that all participants will receive a summary presentation on the most important results from the simulation and the modification of the material.

To perform the simulated work activity, it was selected some typical work situations, all of them with prior interest of analysis. Four of the typical action situations are related to the “crime scene” organization:

- (1) collection of small amount of low caliber ammunition around one body mark and one shooter;
- (2) collection of small amount of hight caliber ammunition with around two body marks and two shooter;
- (3) collection of large amount of different caliber ammunition around three body mark and multiple shooter;
- (4) collection of large amount of different caliber ammunition with one body and new shooting risk imminent.

Each of the selected situations will create an opportunity to observe characteristics of possible work activity. For example, some point of interest is related to how officer moves around the crime scene, how simple is to handle the packing during collection, how the collector officer uses the spaces inside de plastic piece to organize ammunition collected, among other elements. The last situation with a shooting risk imminent is to evaluate the possibilities of a sad situation that police officers often meet: do the collection under pressure due to risk involved on the local.

After each collection, the officer will be asked to perform a new situation: seal the packing and fill in the information regarding the crime scene. They will then simulate to deliver the evidence material to the forensic ballistic laboratory to finally reach the forensic who will open the analysis’s packing. Simulate the “processing of the process” to register in the packaging’s label all department the evidence passed before getting to

analysis. Each responsible will fill the label. This way, it will be possible to evaluate if the label helps the control during the process.

## 4 Discussion

This work highlights some aspects: first, the importance of collaboration with professionals in the field. Without constant meetings with the work team, developing the evidence packaging proposal for the situation's specificities would not be possible.

Second, ergonomists designed the simulation dynamics aiming also to simulate work temporality. Not every simulation and not every simulation support allows this type of use. The ergonomist aim was to test the product in a simulated work situation to test the product in real-time. Also, to observe a work activity (even if simulated) that could not be observed in real conditional for safety and biosafety reasons.

Third, the dynamics is not centered in validating a design proposal, but to discuss design solution with the workgroup and edit the project during the meeting. Although the simulated task's performance is sent to be central, during the next moment, that participant will have the opportunity to present new ideas and new work strategies that could lead to further modification of the design. In this sense, modifying the design after the meeting will not be a sign of design failure but a sign of the dynamic's success.

This work presents the limitation on access to work activity analyses due to the restrictions caused by the COVID-19 pandemic restrictions. The strategy to discuss work situations and design solutions remotely is not optimal but rather a resource for this particular situation. Also, the simulation was not yet realized. Even with the planning, the simulation is subjected to work variability not anticipated and new aspects that can emerge during the discussion.

## 5 Conclusion

Work simulation is a methodological resource to ergonomist integrate knowledge on work activity. A well-defined plan, procedure, intermediary objects, and selection of material can play a role in the dynamic's success. This paper presents elements from this planning, helping other ergonomists prepare similar simulations during other projects. An important factor is to prepare situations to induce discussions on work activity, their variabilities, and strategies to overcome these situations. Based on this reference, an ergonomist will have better conditional to reevaluate the design proposal and address new design solutions to support better work strategies.

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