Abstract — This project created a mobile application for claim notification, and at this moment supports the agreed statement of facts on motor vehicles (ASOF), where various information on the accident report, made from a mobile application installed on an Android device will be inserted. The current paper based process is slow, complicated and confusing due to the large number of elements required to complete and having to use multiple documents for the respective filling. In a digital age, a mobile application for claim notification is an alternative to using the ASOF on paper. With great focus on user experience and we designed this application for situations where the user may be affected psychologically due to the occurrence of an accident. On the other hand, it is important to note that the application may function as a showcase for the products of insurance business. The application allows to populate several data automatically, capture and attach accident images, know the user’s location, contact roadside assistance, search for points of interest, allows interoperability with the computer system of the insurer and can transmit information between devices with the same application. Usability surveys and tests were performed. The results show that the solution achieves a performance in completing the mobile application 2.1 times faster than filling the ASOF on paper. Users also preferred to fill the ASOF in the mobile application instead of filling the ASOF in paper.

Keywords— Mobile App, Android, Insurance, Agreed statement of facts on motor vehicle accident, Usability

I. INTRODUCTION

The Agreed Statement Of Facts on motor vehicles (ASOF) is used in the participation of an automobile accident, in order to report the accident directly to the insurer and to ensure a quicker analysis of the circumstances in which the accident occurred. This should be sent to the insurer within eight days following the event and everyone involved in the accident must keep a copy.

Despite the ASOF having the purpose of assisting drivers in occasions often associated with stressful and sensitive situations, it is normal for victims to have several questions when filling out the declaration, which may lead to an incomplete ASOF, or not properly state all the information necessary to start the claim notification process in the insurers. These are some of the main problems that drivers encounter when filling the ASOF declaration (see VI).

The Instituto de Seguros de Portugal (ISP), pursuant to and in accordance with Decree-Law No. 83/2006, of 3 May [1] set the ASOF model to make a claim to the insurer and fixed the structure of registration by insurance companies in terms of reported claims settlement processes, as well as the timing and manner in which this information will be provided [2]. In the same decree, it is stated that "the participation of a claim can be made both in a form, provided by the insurance company, according to the form approved by ISP, such as through the use of other media", as long that it is written or recorded [1].

Because there is an alternative to the paper based ASOF through other communication channels, without the usual printed form, it is logical to propose a solution that will minimize the main problems through the use of a mobile application for claims notification. The solution brings some possibilities that were not feasible before, like bringing together all the accident information in one document, information of the victims can be automatically loaded, creating a system that allows interoperability between customer devices and insurers and send the ASOF from the very place where the accident occurred.

The application explicitly works with ASOF, but from the beginning there was the concern of making an universal application. The application is prepared to add other types of notifications besides vehicle accidents, such as personal accident, fire, house and health. Concern about the application extensibility goes beyond the notification of other accident types, as it is also prepared to support the victim through a connection with services such as repair workshops, fire departments and tows. In short the application aims to reduce existing problems and reduce some of the usual filling gaps in the printed form.

Currently traffic is a major problem for those who live in cities directly affecting time management. When an accident happens, drivers want to solve the situation as fast as possible. However, filling the accident report of an automobile accident on paper is slow. Regarding this problem, it is proposed the development of the mobile application for claims notification, which is not yet implemented in Portugal and other countries. The primary audience for this solution is all the drivers of private or commercial vehicles and that in the case of an accident may use the ASOF.

Mobile Application for Claims Notification

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Two key issues to solve are: firstly reduce the average time of completion of the ASOF, and secondly create an interface providing excellent user experience, which can be understood by the largest possible number of users and devices. Both problems are intended to be further assessed by tests and users tests to ascertain that the objectives were achieved. We also propose in this paper to analyze existing applications, by identifying the main weaknesses and advantages of such systems, and build a mobile application with an interface that brings together some of the information that were previously acquired from those various systems and has better performance than the ASOF on paper.

II. State Of The Art

Mobile applications are triggering a complete change in the way people approach technology and use their mobile devices. Currently much of the population has a mobile device and wants to have constant access to information. This made programmers and software companies bet in the mobile market. The concept of “workstation” or even “desktop” is now insufficient. An individual requires immediate access to professional or personal applications, and the ability to make decisions anytime or anywhere with maximum flexibility. These requirements make it clear that a major contributor to the development and growth of software companies today is mobility. It is shown that companies, by making their tools mobile, enhance their visibility in the market, while familiarizing users in their daily tasks with their products [3].

According with Jakob Nielsen, a consumer on a regular mobile application spends more time interacting with a dedicated application than the corresponding mobile site. A mobile site is good, but a mobile application is even better [4]. Of course it’s more expensive for a company to build a specific mobile application, because it has to work with different systems on the market. However, a study conducted by Nielsen Norman Group measured a success rate of 76% when people used mobile applications, which is much higher than the 64% success rate reported for specific mobile sites [5].

A. User Interface (UI) Design Pattern

User Interface is the visual part of a computer application through which a user interacts with software. It determines how commands are given and how information is displayed on the screen. The UI is well known to be responsible for a considerable part of the development effort in interactive systems. Yet, we still lack a standard, or at least commonly accepted, notation to express technical representations of UI patterns that convey the solution in an abstract way that can be applied in many different design situations [6,7].

The idea of applying patterns in Human-Machine Interaction goes back to the work of Norman [7] and Apple’s Human-Interface Guidelines [9]. UI patterns are a very important step towards promoting consistency. UI design is becoming a more complex and demanding task with the advent of multiple information appliances [10, 11]. Therefore, the capability of identifying UI patterns, and expressing the solution in an abstract way that is independent of a particular design or implementation is ultimately important.

B. Usability evaluation

Nowadays, with the growing omnipresence and dependence to interactive systems, usability is an increasingly important issue. Small usability issues can escalate and lead to economic and social consequences [12].

We can analyse UI through analysis techniques, computerized procedures, empirical methods and heuristic methods [13, 14]. One of the best ways to evaluate an interface is to consider alternatives still in the design phase, through heuristic evaluation, analysing if certain rules (heuristics) are contemplated in the solution and to what degree. The Nielsen heuristics are the most used in these type of evaluations, although others exist.

Jakob Nielsen defined a set of 10 Heuristics [13]: Visibility of system status; Match between system and the real world; User control and freedom; Consistency and standards; Error prevention; Recognition rather than recall; Flexibility and efficiency of use; Aesthetic and minimalist design; Help users recognize, diagnose, and recover from errors; Help and documentation.

C. Agreed Statement of Facts (ASOF)

The ASOF consist of two parts: the ASOF itself (Fig. 1) and the Motor Accident Report. The ASOF contains 15 fields, with general information such as date, time, and place of accident, information about policyholders, vehicles, insurance companies and drivers. This work aims to develop a proof of concept application that replicates the ASOF.

![Fig. 1. ASOF Document.](image-url)
D. Mobile applications for claims notification

This section describes existing applications for claims notification. Seven different applications that work on the Android operating system were analyzed (Fig. 2): eCliente Allianz Portugal, AAMI Claim Assist, Shannons Claim Assistant, Direct, My AXA, AxiKit Accident Report Kit and Accident Report.

At an international level there are still very few applications properly designed for claims notification and at the national level stands out two applications, Direct and eCliente Allianz Portugal, which lets you notify a claim. Despite being attached to an insurer, most of these applications still appear to be a prototype, as it is the case of the application eCliente Allianz Portugal, My AXA and Accident Report.

In all applications have been studied 14 features. We extrapolated from the study of the several products:
1. Add Space, for advertising insurance products;
2. Offer other features beyond claim notification;
3. Allows to make notification of other types of accidents beyond the ASOF;
4. Allows that two users using the same application in any way can exchange data between devices;
5. Access to the insurer database. The client can load relevant information to help filling of the ASOF;
6. Enables to call emergency service (indicating the location where the user is / on a map);
7. Enables to call a tow service (indicating the location where the user is / on a map);
8. Find the address nearest to where the accident took place;
9. Similar to the ASOF;
10. Allows the user to complete a notification even without internet access;
11. You can select a workshop to send the vehicle to for repairs;
12. Once completed, the accident report is presented to the user for review;
13. Send an e-mail to the insurer with the claim notification;
14. Create a XML or other type of file with the extracted data from the ASOF, for a more proficient integration with the insurer.

Table 1 compares all claim notification products examined.

<table>
<thead>
<tr>
<th>Feature</th>
<th>eCliente Allianz Portugal</th>
<th>AAMI Claim Assist</th>
<th>Shannons Claim Assistant</th>
<th>Direct</th>
<th>My AXA</th>
<th>AxiKit Accident Report Kit</th>
<th>Accident Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2.</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>3.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>4.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>5.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>6.</td>
<td>Yes (No/No)</td>
<td>Yes (No/No)</td>
<td>Yes (No/No)</td>
<td>Yes (No/No)</td>
<td>Yes (No/Yes)</td>
<td>No (Yes/No)</td>
<td>No (Yes/No)</td>
</tr>
<tr>
<td>7.</td>
<td>Yes (No/No)</td>
<td>Yes (Yes/Yes)</td>
<td>Yes (Yes/Yes)</td>
<td>Yes (Yes/Yes)</td>
<td>Yes (Yes/Yes)</td>
<td>Yes (Yes/Yes)</td>
<td>Yes (Yes/Yes)</td>
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<tr>
<td>8.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>9.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<td>No</td>
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<td>11.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>12.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>13.</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>14.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 1. Comparison of some claim notification applications on the market.

In conclusion, most applications that have a list of useful contacts (emergency towing, police, etc.), usually only allow notification of the ASOF, no application has a mechanism that allows the interaction of the same application from another user, few solutions are similar to the ASOF, access to the insurer database, through the internet, is not a feature used with all the potential that could have and five of the seven applications can make a claim notification without Internet access.

Based on Table 1, one can conclude that no application is very good in general, but all appear to be good in some specific fields. Thus, there is the challenge of integrating with good levels of usability, such as making the notification with no Internet connection, get the user location, indicate a workshop near the client, preparing the application to serve as a "showcase" advertising, access and integration of the mobile application with the insurance information systems and create a mechanism that is able to transfer information between clients.
III. REQUIREMENTS

Functional requirements and mockups were used for defining the functional design, because:

- Mockups, are an effective method into demonstrate what is expected to be the functionalities and interactions with the final system, giving the possibility to who develops the project to convey their interpretation of it, before the effort to implement occurs;

- The survey and requirements prioritization are crucial in defining the features that the system concerned should include.

A. Functional prototypes

In a project of this kind the interface is a requirement of the utmost importance, because the ease of use will determine the satisfaction of the product final users.

Some of the working prototypes created are now introduced (Fig. 3). This demonstrates the system in terms of its functionalities, enables a better understanding of it, and allows to detect serious usability errors, missing features, display specifications and describe in more detail the various prototypes.

This prototyping phase (functional prototypes) and test with users was made in the design and implementation phase, in order to detect errors as early as possible, when these are easier to fix.

![Fig. 3. Examples of some Mockups.](image)

B. Requirements Analysis

Through the prototypes analysis it was possible to detail what were the features that the system should have and complete the functional requirements. At this stage the non-functional requirements were also identified. All requirements are classified with different priorities since there are some more important to the resolution of the problem and project success than others. Hence it established a scale of priorities according to the MoSCoW method [15] (Table 2).

<table>
<thead>
<tr>
<th>Priority</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must</td>
<td>High priority requirement to the project. Must be implemented.</td>
</tr>
<tr>
<td>Should</td>
<td>Medium priority requirement important to the project. However failing to implement this requirement does not compromise the project's success.</td>
</tr>
<tr>
<td>Could</td>
<td>Low priority requirement. Adds value to the project, but should only be implemented if the budget is sufficient.</td>
</tr>
<tr>
<td>Won’t</td>
<td>Very low priority requirement, is a future recommendation.</td>
</tr>
</tbody>
</table>

Table 2. Requirements priority according to MoSCoW method.

In table 3 the identified functional requirements for the mobile application proof of concept, are detailed with the categories Must (M) and Should (S).

<table>
<thead>
<tr>
<th>(Priority) Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(M) Authenticate and gather information from clients</td>
<td>The client needs to enter email and password when accessing the application, in order to identity and access customer database.</td>
</tr>
<tr>
<td>(M) Confirm submitted information</td>
<td>Data should be validated as much as possible by the application.</td>
</tr>
<tr>
<td>(M) Create server</td>
<td>Between the insurer and the customer must be a server that allows authentication and data transmission to the mobile application.</td>
</tr>
<tr>
<td>(M) Autocomplete location</td>
<td>Using the Google API is expected to automatically fill in the address of the accident location.</td>
</tr>
<tr>
<td>(M) Photographic vehicles damage</td>
<td>When an accident occurs, it will be possible, by calling Android system features, to run the device's camera application.</td>
</tr>
<tr>
<td>(M) Autocomplete some information of ASOF form</td>
<td>Filling out some form fields is done automatically, due to having access to insurance customer database.</td>
</tr>
<tr>
<td>(S) Information exchange between devices</td>
<td>Exchange information (ASOF form), if people involved in the accident have the same application on their devices.</td>
</tr>
<tr>
<td>(M) Display emergency contact</td>
<td>In the event of a claim the application should question the user if an ambulance will be needed and indicate the location (coordinates and address) and automatically call the emergency contact through the claim notification application.</td>
</tr>
<tr>
<td>(M) Tow contact</td>
<td>Allow the user to have access to the tow contact.</td>
</tr>
<tr>
<td>(S) Access pending notifications</td>
<td>If there is an incomplete notification, the user has the opportunity to access it directly without the need to create a new notification.</td>
</tr>
<tr>
<td>(S) Create similar insurance database</td>
<td>The user retrieves his information this database.</td>
</tr>
<tr>
<td>(M) Create report with all information filled</td>
<td>Before the notification is sent to the insurance company a report document is created for the user to review all the information filled.</td>
</tr>
</tbody>
</table>

Table 3. Analysis of functional requirements.

IV. ARCHITECTURE SOLUTION

A simple architecture with three main modules allows to implement the claim notification application proof of concept. Figure 4 illustrates the communication system suggested, constituted by three modules, a mobile application, a database and a server.

![Fig. 4. Solution Architecture diagram.](image)

A. Server

The server function is to receive and send information requested by the application, allowing multiple users to access resources related to their data through the retrieve of information from the database. The solution used involves...
integrate server and mobile application through a Web Service.

1) **Data Transfer Methodology**

SOAP introduces a significant overhead to the web services, which may be problematic for mobile devices, and currently Android does not provide any kind of official SOAP library. Taking into account that REST architecture offers a simple solution and is easier to develop, REST was chosen to transfer data between the mobile application and the server.

2) **Business architecture**

The server allows the insurance company to change advertising and information without the user needing to upgrade the system. Updating an activity at runtime enables the application to have an available business component to the insurer as it is possible to change the products displayed in the application at any time by changing some parameters in a simple JSON file present on the server.

**B. Store information in mobile application**

1) **Authentication procedure with the mobile application**

After authentication, the user receives information about fields that can be automatically filled in the ASOF. These fields refer to the following sections of the ASOF: Insured/policyholder; Vehicle; Insurance Company; Driver.

This information is stored on the Android device and information can be accessed later even if there is no access to the internet.

2) **Mechanism for storing information**

There are two main possibilities for saving information in an Android device: **SQLite**, which stores large amounts of structured data and the reading from the database is slower compared to the other option, and **SharedPreferences**, which allows to store information using the primitive data type of key-value pairs and has better performance compared to **SQLite**. The data of the mobile application will be stored using the second option, because the application will only need to store some values and be quick to respond.

**C. Acquisition of Points of Interest (POI) and localization**

The Android system allows you to include maps, through **Google Maps**. This application can show the user's location on the map or set routes. Thus, you can tell the user of the claim notification application his/her location, or a route to a POI to choose from a list of useful contacts.

To obtain the geographic coordinates **Google Maps API v2** Android library and the **LocationManager** class can be used, the first to retrieve the user localization from two "suppliers", a **Network Provider** and **GPS Provider** or a combination of both. To obtain the nearest address from the input of local coordinates, the **Geocoder** class can be used. This class lets you convert a geographic location into an address, a process called reverse geocoding.

**D. Interoperability in communicating with insurers**

The mobile application is prepared for the interoperability with the insurer IT system. This is achieved by an **XML file** that contains all the information filled in the claim. The information contained in the XML file is the same as that available in the ASOF on paper. This file is attached to the claim notification email, which will be sent to the insurer. In addition to the written fields of the ASOF images of the initial impact point, vehicles damage and accident scheme are also stored in the file. All pictures are encoded in base64.

The use of an XML schema allows easy integration with any insurance company IT system. As the fields present in the ASOF in the mobile application are the same as the current ASOF on paper. The integration is very straightforward.

**E. Exchange forms between victims**

The application allows exchanging most of ASOF vehicle form information using Bluetooth technology. This model maintains the privacy of the victims during the filling of data of other drivers (point 6 to 9 of the ASOF), because the users need never to hand over their mobile device to other victims involved in the accident (Fig. 5). There is no need to manually fill in all the data from the other driver, which would delay the claim filling process, thus eliminating the bottleneck present in the solution, because it is the activity with more mandatory information to complete.

**F. Signature Model**

Point 15 of the ASOF refers to the signatures of drivers, where both drivers agree with all the information present in the ASOF. Each driver gets a copy of the same ASOF. So if one of the drivers tries to change some information the other can repudiate it.

What is the problem of not having signatures? The problem arises when there is the possibility of one of the drivers changing the information after both reviewed the ASOF. The document can be changed before reaching the insurer without the consent of one of the drivers, i.e., message integrity is called into question and the accuracy of the information as well.

Figure 6 shows a scheme that illustrates the problem, where Driver 2 (C2) changes some data of the ASOF without Driver 1 (C1) knowledge. The ASOF that reach D2 Insurance is different from the ASOF reaching D1 Insurer. This situation is bad for insurers because the ASOF documents are different and Driver 2 has harmed Driver 1.
Fig. 6. Scheme that exemplifies the tampering of the ASOF by Driver 2.

The entities in this model are D1, D2, the respective insurance 1 (S1) and 2 (S2) and a repository (where insurers can get the private keys of their customers). The proposed model works if both drivers have a mobile device with the claim notification application. Figure 7 presents a model that ensures the integrity of the ASOF when arriving in the insurer.

1. D1 and D2 drivers exchange between them the accident report, plus the Hash of the ASOF encrypted with the public key of the driver that sends it. The hash function ensures that, if the information is equal to the value given by this function, there is no change in any way; a completely different value is produced by the Hash function.

2. The mobile application automatically compares the ASOF of D1 to D2 and indicates if they are equal, if they are not the fields should be modified until both ASOF be equal.

3. The message sent to insurance companies contains the ASOF plus the Hash of the ASOF encrypted with the public key of the other driver. For example, D1 sends to S1 its ASOF, plus the hash of ASOF of C2 encrypted with the public key C2. D1 may not modify the content of this part of the message as it has no access to the private key of D2.

4. The insurer seeks the private key of D2 in the repository, decrypts the contents of the second part of the message and compares the D2 hash with the Hash de D1. If the values are the same it means D1 did not change the ASOF.

Fig. 7. Scheme that exemplifies the integrity of the ASOF for both drivers.

This model has two advantages: drivers exchange the ASOF, which allows checking whether there are differences in the documents, and ensure that the claims submitted to insurance are equal.

V. IMPLEMENTATION OF THE SOLUTION

A. Server and Database

The server for the mobile application was implemented in a free hosting online server, because this allows the application to be fully used and tested everywhere with internet access. PHP language was used to implement a REST Web Service in the server. The Web Service is responsible for receiving the credentials from the mobile application and return the information available on the database. The server also contains a JSON file with the information that will populate information and images in the business area in the main menu. This file is responsible for providing information about the “showcase” advertisement view in the main menu of the mobile application (Fig. 8a).

The database was developed in MySQL, which is managed by phpMyAdmin, which is a web application for Administration of MySQL over the Internet. Some fictional information was inserted into the database through this system in order to test the mobile application.

B. Final Mockups

The implementation of claims notification application plus the screens of the final prototypes are now going to be introduced. These resulted from evaluations that the functional
prototypes suffered based on tests conducted with users as the solution was developed.

Figure 8a represents the menu that allows the user to access the main features of the application: report an incident, consult the user's profile, look for points of interest and call tow or emergency. At the top of the main menu the section corresponding to the business area is visible. This area shows five images, with different advertising, that change periodically, or by sliding a finger over the image.

Figure 9a represents the Emergency menu. In this activity key information which may influence emergency arrival time is present. It is possible to observe on the map the current user location, geographic coordinates (latitude and longitude) and the nearest address. This address and contact details will then be sent to the emergency number via SMS, but there is also the possibility for the user to contact this service directly.

The activity “Call Tow” present in Figure 8a is similar to emergency. However, the Call Emergency and Send SMS location button will be directed to the insurance company assistance number.

After the user presses Make Claim button (Fig. 8b) he/she is directed to Type of accident menu (Fig 9b). The size of the icons and the words used to indicate the type of damage is relatively large. This is intended for an accident situation, where the victim/user may be psychologically affected, to allow a rapid perception of information by the user.

Figure 10a shows an activity similar to Type of accident menu. This activity is responsible for choosing what type of claim the user wishes to communicate, within the claims related to the automobile.

Figure 9b shows all necessary elements for completing a ASOF:
- General Information (1-5 fields of the ASOF);
- Vehicle A/B form (6-9 fields of the ASOF);
- Initial impact point of vehicle A/B (field number 10 of the ASOF);
- Visible damage (field number 11 of the ASOF);
- Accident circumstances (12-14 fields of the ASOF);

Note that the various elements listed in figure 10b follow the same order of the ASOF on paper and there is also a concern about the colours. While the activities concerned with vehicle A are in blue, the activities of the vehicle B are in yellow, as in the ASOF on paper.

As the user completes the various elements of the ASOF, the symbol on the right side of the screen will display a green check symbol, which informs the user that that element is complete. The same goes for the element Submit Notification, it can only be accessed when all the mandatory information has been filled.

All these details provide some advantages. For example, if the user has already seen or filled an ASOF, it will be familiar to fulfill the ASOF in a mobile application, because the accident report on the application follows the same points (1-14) and color scheme of the paper form. These similarities with the ASOF paper not only allow a user to become more comfortable and confident with the completion of the ASOF in a mobile application, as they also allow an easier integration with the IT department of the insurance companies because those systems have exactly the same fields that are filled in the mobile application.
Figure 11a shows part of the General information menu. Here the address can be found automatically, for mutually exclusive questions radio buttons are used and with regard to witnesses a table was set up to store names, phone numbers and addresses.

Figure 11b shows part of the vehicle form menu. This menu consists of the ASOF vehicle form (fields 6-9) and several options with the intent to simplify the notification process (get user information automatically from the insurance database, upload vehicle information, select driver, save form and send information to other users through Bluetooth).

Figure 12a shows the Vehicle Point of initial Impact. After clicking an arrow appears on the screen. The arrow is movable and allows the user to indicate more precisely the point of initial impact. It is possible to select three types of vehicles: Automobile, Motorbike and Truck.

Figure 12b shows the Visible Damage menu, where the user can link photos to the claim notification.

Figure 13a represents the Accident circumstances menu. Here the same circumstances of the ASOF on paper are present. It is possible, through this menu, to draw the plan of the accident and record information like audio remarks.

Figure 13b shows the the menu Select Workshop. This is an extra feature intended to send a car to a workshop selected by the user. Three options are available:
- Find recommended workshops: this option allows the user to see the recommended workshops from a map view perspective;
- Workshop indicated on user profile;
- Input the workshop address manually;

Finally, Figure 14a shows the Submit Claim menu. In this menu you can send a notification to the insurance company, but only after reviewing the document.

In Figure 14b you can see the first page of the document created from a sample ASOF. This document is about 15 pages and has the objective of centralizing in one place all the information selected in the ASOF.

Figure 15c shows the email which will be sent to the insurer. This email contains the following files attached: photographs of the visible damage, images from the initial impact point for both vehicles, the plan of the accident at the time of collision, the audio recording, a pdf document and an xml file with all the information from the accident to integrate with the insurance company more easily.
VI. SOLUTION EVALUATION

Figure 15 represents the time obtained in the user tests of the ASOF filling on paper and in the mobile application. Figure 16 represents the number of errors and hesitations that occurred when filling in the ASOF on paper and in the mobile application. Measurement of time was done in pairs and errors and hesitations count was recorded individually.

![Graph showing time completion of ASOF](image)

**Fig. 15. Time completing ASOF on paper and in the mobile application.**

![Graph showing number of errors in ASOF](image)

**Fig. 16. Number of errors in the ASOF on paper and in the mobile application.**

The average time in the completion of the ASOF is of 25.4 minutes on paper and 12 minutes on the mobile application. The performance of the mobile application is 2.1 times faster compared to the respective filling of the ASOF on paper. Thus, it may be concluded that the filling the ASOF on paper is slower than the respective filling on the mobile application.

The number of average errors of the ASOF is 2.8 on paper and 1.4 on the mobile application. Therefore it can be concluded that the number of errors that occurred while filling the ASOF on paper format is precisely the double of the mobile application. From the number of errors that occurred filling the ASOF, it is possible to conclude that in general the majority of participants made more mistakes on paper compared to the mobile application.

Some of the major mistakes that happen and that the claim notification application helps to decrease are for example: lack of space in various fields of the ASOF; no erasures; find information in the documents, particularly in the green card and driving license, which are documents that users usually are not used to see or are hard to find. Access to the insurer’s database helps a lot on retrieving information that are present in these documents, but otherwise would be difficult to find.

A. User survey

At the end of the tests users were asked some questions regarding the satisfaction of filling the ASOF individually. These questions are intended to be a subjective evaluation of how users feel about the mobile application system. The user satisfaction is one of the most important factors that will influence their decision regarding the approval of the mobile application. In questions 1 to 3 we used a quantitative scale with 5 values: 1 (very bad) 2 (bad) 3 (poor), 4 (good) and 5 (very good) and questions 4 and 5 were yes or no questions.

The list of questions was:

1. What did you think of the GUI?
2. What did you think of the ease of use?
3. What do you think in general about the application?
4. Do you think this system would bring an added value to an insurance company?
5. Would you use this system instead of the ASOF on paper?

Table 4 shows the average value of the responses given in the survey by the participants.

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<th>4</th>
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<td>4</td>
<td>4</td>
<td>5</td>
<td>10 yes</td>
</tr>
</tbody>
</table>

The tests carried out demonstrate that the completion of the ASOF in the mobile application is faster than on paper. The number of errors is also lower in the mobile application than on paper. These results allow us to infer that in situations where the user is mentally affected, recourse to the mobile application can minimize mistakes and reduce time in a negative situation.

VII. CONCLUSIONS AND FUTURE WORK

The focus of the development of this work is to achieve a fundamental goal, to create a mobile application allowing the submission of insurance claim notifications, focused on ASOF. The main objective is for the mobile app to become an alternative to the current model of filling out paper ASOF.

Multiple meetings with stakeholders involved in this project were held and an effort was made to obtain the viewpoint of multiple people during the execution of this project. Debating hypothetic problems and its solutions in a timely-manner can be explained by the need to adjust and prevent likely problems in a timely-fashion way and to understand the intended features of the application. This strategy was used throughout the implementation phase, parallel to research and testing of other Claim Notification applications available on the market, and allowed the development of an application with better capabilities than the other applications reviewed.

In order to demonstrate that the proof-of-concept offers a viable alternative and a tangible advantage to insurance companies and their clients, a system with three fundamental blocks was created: a database, a server and an Android mobile app. This system allows the testing the mobile app just as if the user was connected to an insurance company. Thus, it is possible to perform usability testing in order to measure the solution’s performance and analyze customer satisfaction.
This evaluation produced excellent results, since the tests demonstrate that the mobile app is approximately two times faster than filling out the traditional ASOF. Also, results on the number of mistakes made during the form filling process show that the number of errors is reduced approximately by half when using the mobile app. Customer Satisfaction was inferred through the questionnaires filled out by the users, which showed pretty good results. Users found the graphical interface and ease-of-use to be good and claim that they would use the mobile app to fill out ASOF instead of the traditional paper counterpart.

Hence, it is possible to say that the built proof-of-concept (database, server and Android mobile application) presents a viable alternative to the filling out of paper Car Accident Mutual Statements. In an age where mobile app usage is increasing, an insurance company implementing this system will certainly reduce costs and increase customer satisfaction while, at the same time, strengthening its position as innovators.

A. Future Work

Since it can be improved in many ways, the work achieved so far is just the beginning. All the conclusions drawn from the work developed in this project are the beginning of an idea that can, in the future, inspire the development of a mobile application for Claim Notification.

Some topics that can be approached in a future work are:

- Allow the notification of claims other than ASOF;
- The task of allowing some predefined drawings in the design of the accident schematic (topic 13), for example car A, car B and traffic lights. The user would only need to drag-and-drop these elements to the main screen and place them accordingly in order to better represent the way the accident happened;
- Send the information between the victims using NFC technology;
- Allow the user to have multiple vehicles or a fleet and choose the vehicle that was involved in the accident;
- The mobile app should also serve as an insurance green card which means that the app would be required to store all the information currently available on an insurance green card certificate in a way it could also be confirmed by the police. The user would only need to send the information to a device carried by the police using short-range wireless technologies (Bluetooth or NFC);
- Implementation of a self-service area personalized to the customer;
- Porting the application to iOS and Windows Phone;

REFERENCES

https://www.apseguadores.pt/


