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ICT as a Contribution to the Dissemination of Information to E-Consumers

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Abstract: *Currently, most organizations rely on Information Systems and Information and Communication Technologies to disseminate information in various contexts. Conversely, consumer rights are enshrined in the Constitution of the Portuguese Republic and Law no. 24/96, of July 31, emphasizing the right to consumer information. The underlying problem lies in the difficulty of accessing information on consumer rights and duties. The project aims to create a Web Application to simplify information retrieval, avoid time wastage across different platforms, enhance data access and sharing speed, and increase data availability and connectivity. It seeks to empower citizens as consumers and enable organizations to access and disseminate information more efficiently. The application, developed using the Design Science Research methodology, facilitates quick access to consumer rights information, allows user registration and authentication, and offers account management features. Overall, it adds value to consumers' lives by promoting awareness of responsible consumption.*

1. INTRODUCTION

The project called HUB E-CONSUMER aims to create a Web Application to simplify the search for information, avoiding wasting time using different applications and sources, increasing the speed of data access and sharing, and also increasing the scale of available data and connectivity. According to a study carried out in March 2019 on Consumer Protection Policy in Portugal, available on the website of the Directorate-General for Consumer Affairs (Consumidor, 2019), it was found that 30.2% of respondents say they do not know consumer rights and duties, 39.9% say they know, but little, 28.4% say they know, but reasonably, and only 1.2% say they have a lot of knowledge. The aim is therefore not only to empower citizens in their role as consumers but also to enable the organizations involved to access and disseminate information more easily, creating a tool that enhances this objective, with the potential for adaptability and enabling decisions to be made more proactively and less reactively. Based on the objectives, in short, the aim is to increase knowledge of consumers' rights and duties. The Design Science Research (DSR) methodology was used to develop this application.

2. THEORETICAL FRAMEWORK

This section presents the theoretical framework underlying the project, particularly information modeling, requirements analysis, programming, and software quality. Data modeling *is the process of diagramming data flows. When creating a new or alternative database structure, the designer starts with a diagram of how the data will flow into and out of the database. This flow diagram is used to define the characteristics of the data formats, structures and database handling*

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functions to effectively support the data flow requirements. After the database has been built and implemented, the data model remains the documentation and justification for the existence of the database and how the data flows have been designed (SAP, 2023). Types of Data Modeling - Regarding data modeling, there are essentially three types of data: Relational, Dimensional and Entity-Relationship Models. In the first case, *Although with an 'older' approach, the most common database model still used today is the relational one, which stores data in fixed format records and organizes them in tables with rows and columns (SAP, 2023).* In the second case, *less rigid and structured, the dimensional approach favors a data structure that is more related to the use or business context. This database structure is optimized for online queries and data storage tools. Critical data elements, such as the quantity of a transaction, for example, are called "facts" and are accompanied by reference information called "dimensions", be the product ID, the unit price or the date of the transaction. A fact table is a primary table in a dimensional model. Retrieval can be fast and efficient - with data for a specific type of activity stored together - but the lack of links between relationships can complicate analytical retrieval and use of the data. Since the data structure is linked to the business function that produces and uses the data, combining data produced by different systems (in a data warehouse, for example) can be problematic (SAP, 2023).* Finally, the Entity Relationship Model (ER Model) is *an E-R model that represents a business data structure in graphical form, containing boxes of various shapes to represent activities, functions or "entities" and lines to represent associations, dependencies, or "relationships". The E-R model is then used to create a relational database in which each row represents an entity and the fields in that row contain attributes. As in all relational databases, 'key' data elements are used to link the tables together. (SAP, 2023)* It is therefore considered that, given the specific nature of the project, the ER Model was adopted. Regarding data abstraction, there are three levels of data abstraction: *Conceptual data model, Logical data model and Physical data model. The Conceptual data model, characterized by being a "general" model, "represents the overall structure and content, but not the detail of the data plan. It is the typical starting point for data modelling, identifying the various data sets and the flow of data through the organization. This conceptual model is the high-level blueprint for developing the logical and physical models and is an important part of the data architecture documentation. The second level of detail is the Logical data model. It is more closely related to the general definition of "data model" in that it describes the flow of data and the contents of the database. The Logical model adds detail to the overall structure of the conceptual model, but does not include specifications for the database itself, since the model can be applied to various database technologies and products. (Note that there may not be a conceptual model if the project relates to a single application or other limited system) (SAP, 2023).*

Finally, *the physical model of the database describes the details of how the logical model will be realized. It should contain enough detail to allow technicians to create the actual structure of the database in hardware and software to support the applications that will use it. The physical data model is specific to a particular database software system. There can be several physical models derived from a single logical model if different database systems are used (SAP, 2023).* This process has evolved, with the emergence of Artificial Intelligence (AI). There are currently several applications that support this process, such as Tableau; Microsoft Power BI; SAP BusinessObjects; MySQL Workbench. These applications help with data modeling, which is a fundamental process in data analysis, database creation and other processes. In short, data modeling aims to structure data into a visual representation, such as diagrams or databases, which allows it to be analyzed from a better perspective. Another aspect to consider involves requirements analysis. This *is an important aspect of project management and is responsible for collecting the indispensable, necessary data that the user needs to solve a problem and achieve their objectives. As well*

as determining a user's expectations for a given product (Fernandes, 2015). To carry out a successful analysis, it is necessary to identify the following requirements in a project: functional and non-functional requirements. The functional requirement consists of *Statements that describe actions that the system should or should not do. These actions are usually associated with functionalities and behaviors and are specified as how the system reacts when faced with a certain input, how it behaves when faced with an error and what to do when faced with specific scenarios. These types of requirements can take on different levels of specificity and detail, depending on the situation being reported and the expected behavior of the system concerning that relationship. For example, a user should be able to search the agenda for all clinics; the system should generate each day, for each clinic, the list of patients for that day's appointments; each member of staff using the system should be identified only by their eight-digit number. Non-functional requirements correspond to restrictions on the services or functionalities offered by the system, such as security and time restrictions. In addition, non-functional requirements define system properties such as reliability and storage space, for example. Also known as quality requirements, they are generally more difficult to express measurably, making the analysis process more complex (Sommerville, 2011).* There are several non-functional requirements, shown in Figure 1.

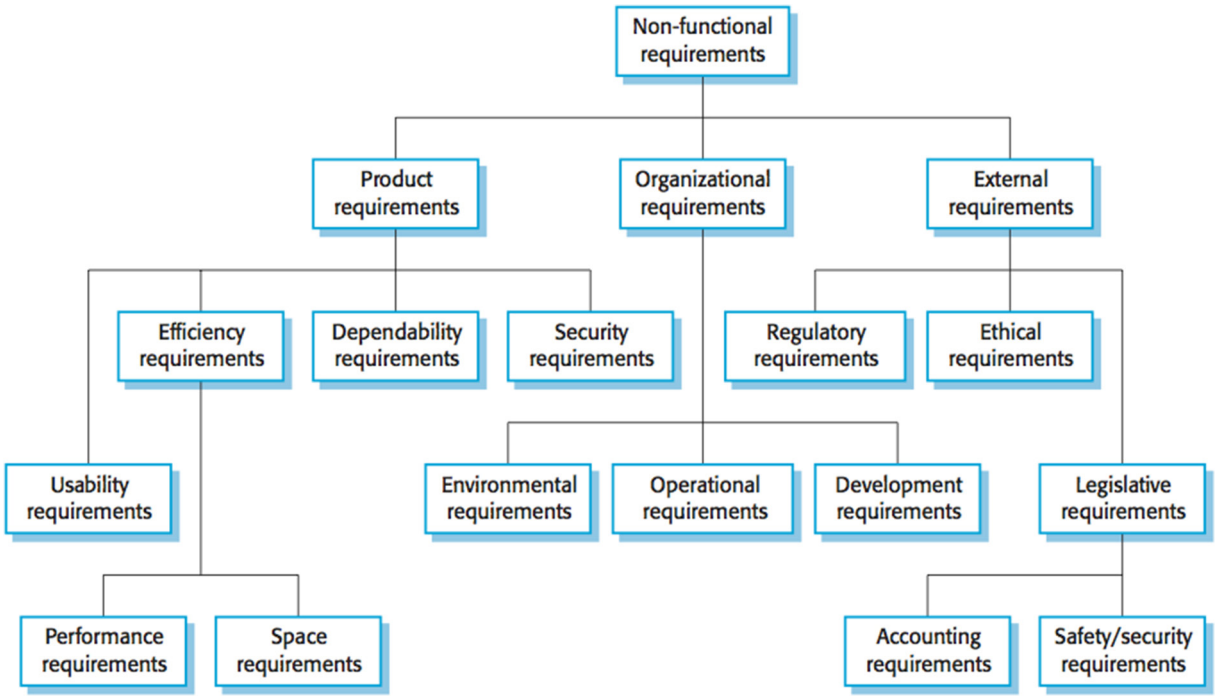

Figure 1. Types of Non-Functional Requirements

Source: Sommerville, 2011

According to Figure 1, non-functional requirements are subdivided into product, organizational and external requirements. In this sense, requirements analysis aims to identify the client's needs (requirements) for the realization of a project. Programming is the act of communicating instructions to a computer. To do this, it is necessary to adopt programming languages so that the computer can interpret the same instructions, thus building algorithms, such as the C# programming language. *C# is a modern, object-oriented programming language. C# allows programmers to build many types of secure and robust applications that run on .NET. C# (Microsoft, 2022).* An object can be defined as, for example, a car, in which it has variables such as license plate, color, model, make, among other identifiable variables in this object. In short, Object-Oriented Programming (OOP) *is a paradigm that interprets a problem as a collection of interacting objects. It is*

based on code reuse and the ability to represent the system much closer to what we would see in the real world (Coutinho, 2021). Software quality *is the conformity of explicitly stated functional and performance requirements to clearly documented development standards and the implicit characteristics that are expected of all professionally developed software (Pressman, 2019)*. In consulting, this phase is considered crucial for software to have the quality desired by the project's stakeholders. It is therefore important to carry out tests after the development phase in order to check that all the requirements mentioned above are met. The main levels of software testing are: Unit, Integration, System, Acceptance and Regression Testing and Unit Testing *aims to explore the smallest unit of the project, looking for faults caused by logic and implementation defects in each module separately. The target universe for this type of test is the methods of objects or even small pieces of code." The Integration Testing (Neto, 2016)* Aims to provoke faults associated with the interfaces between modules when they are integrated to build the software structure that was established in the design phase. *System Testing "Evaluates the software for faults by using it, as if it were a final use.* I*n this way, the tests are carried out in the same environments, with the same conditions and with the same input data that a user would use in their day-to-day manipulation of the software. It verifies that the product meets its requirements*: *Acceptance Testing implies that it is "generally carried out by a restricted group of end users of the system. They simulate routine system operations in order to check that the system behaves as requested.* Finally, *"Regression testing does not correspond to a level of testing, but is an important strategy for reducing "side effects". It consists of applying, with each new version of the software or each cycle, all the tests that have already been applied in previous versions or test cycles of the system. It can be applied at any test level (Neto, 2016).* It is therefore considered imperative to implement this phase, carrying out the previously identified tests, in software development, because without it, it becomes difficult to know the maturity of the development carried out, which could lead to poorly completed software, not meeting the client's expectations.

3. METHODOLOGY

The methodology used to develop the HUB E-CONSUMER project was Design Science Research (DSR), characterized by being *a research methodology that is suited to the field of Information Systems in the creation of an artifact (Peffers et al., 2017)*. The methodology consists of six stages: (i) Identification of the problem; (ii) Identification of the solution and its objectives; (iii) Development and design of the artifact; (iv) Demonstration; (v) Evaluation; (vi) Communication. The development of the application was based on the methodological assumption of using DSR. Regarding the problem identification stage, meetings were held with the project's stakeholders to identify the underlying problem, after which the project's objectives were identified with the stakeholders. After this stage, the design and development of the project began. Throughout the development, meetings were held with the stakeholders to demonstrate progress and provide feedback. Following these phases, scientific dissemination was carried out. This research methodology was adopted because it aims to study, research and investigate a particular problem. Based on this study, a solution is identified, which is then developed to mitigate the problem.

4. WEB APPLICATION DEVELOPMENT

Based on the problems identified, in coordination with the stakeholders, the need arose to create an aggregating web application, to simplify the search for information on consumer rights and duties, avoid wasting time using different applications and sources, increase the speed of data access and sharing, and increasing the scale of the data available and connectivity. The aim is also to

empower citizens in their role as consumers by creating a tool that integrates all the others, with the potential for adaptability and which allows them to make decisions more proactively and less reactively. In turn, the organizations involved are also empowered to access and disseminate information that meets consumer requirements, on the one hand, and adapt their communication to needs, on the other more easily. It is considered that this will be a tool that has the potential to contribute to the transformation of the age of consumerism, in other words, to help the transition from excessive materialism to responsible citizenship in the market for goods and services. *Consumerism is a movement that is characterized by citizen action within the context of the market through the creation of or adherence to movements or organizations that defend and promote the rights and duties of consumers with the aim of fighting (refusing from a negative perspective) or encouraging the act of purchasing (negotiating from a positive perspective), through the politicization of conscious and responsible consumption, based on values that privilege ethical, ecological and equitable purchasing, in search of quality of life and consumer self-determination (Silva, 2018).* The web application aims to centralize information on consumer rights (Law no. 24/96, of 31 July - Consumer Protection Law), as well as presenting it clearly and objectively to the following target audiences: (i) consumer associations, (ii) General Directorate for Consumers (DGC), (iii) general consumers, (iv) technicians from Consumer Information Centers, (v) academic researchers, (vi) teachers in the field, (vii) companies and (viii) non-profit organizations. The Web Application focuses on presenting information from the following sources: official gazette (Diário da República), Portuguese consumer associations (Associação Portuguesa para a Defesa do Consumidor (DECO), Associação dos Consumidores da Região Açores (ACRA), Associação de Consumidores de Portugal (ACOP), among others) - ANACOM (National Communications Authority), ECC-Net - European Consumer Center Portugal, Consumer Protection Service - Madeira (Regional Secretariat for Inclusion and Social Affairs of the Autonomous Region of Madeira) and Direção-Geral do Consumidor - Consumer Portal. The web application will have to achieve key objectives: guaranteeing quick access to information on consumer laws and rights, simplifying the presentation of the information in question, increasing the connectivity of the information, increasing the scale of the data available and, finally, reducing the time wasted in accessing the information. After identifying the problem, data modeling was carried out, starting by interviewing the stakeholders involved in the project, carrying out the following points in chronological order: (i) identification of the actors and their objectives as users, (ii) carrying out the requirements survey, (iii) identifying functional and non-functional requirements and the applications and components needed for development and (iv) based on the requirements, a data model was designed, using MySQL to build the Entity Relational Model (ER Model). The Web Application has eight Functional Requirements defined: Information Availability, Registration System, Information Filtering System, Help System, Authentication System, Actor Profile System, Management System and Logout System.

5. RESULTS AND DISCUSSION

Given the problem under study, it was possible to identify that consumers generally have gaps in their knowledge of consumer protection laws. All the tests passed the maturity assessment and were reported to the project's stakeholders via video conferences, which they approved. This project received several approvals during its development, undergoing various functional tests. All the stakeholders involved in this project had their say in the evaluation process and were present at meetings, thus approving this project and guaranteeing the objectives identified and established in the planning phase. After this phase, the results obtained in the project were scientifically disseminated. It is also considered that the development of this project should have a positive impact on the lives of consumers, helping to transform the era of consumerism into the

era of consumerism. It is believed that the application has a solid basis on which to build a more complete version, considering all the features developed. It should also be emphasized that, in view of the study's problem, the development of the application is considered to have systematized the search for information, thus optimizing the time spent searching in various sources (Lopes, 2023; Lopes et al., 2023).

6. CONCLUSION

Based on the results of the study presented, it is possible to identify that Portuguese consumers have little knowledge of consumer protection laws, which points to a current need that can be filled by the potential of technology. In view of this problem, the project aimed to develop a web application to aggregate and simplify the search for information on consumer rights and duties, speeding up the search for reliable and up-to-date data in different applications and sources of information. We believe that the development of this project will have a positive impact on the lives of consumers, transforming its users into responsible players in the market. It is believed that the application has a solid basis for a more complete version, considering all the features developed. It is also seen as adding value, as well as contributing to the field of literacy, by optimizing the use of different sources of information already available on the internet, thus increasing sharing and connectivity and enabling consumers to make more informed decisions.

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