

## CareProfSys - Scientific Report Phase II - Executive Summary

The **CareProfSys** project (<http://careprofsys.upb.ro/>) aims to develop, test, and validate an intelligent career profile system by implementing it in an observant environment, the Career Counselling Center at the National University of Science and Technology POLITEHNICA Bucharest. The created system will be able to offer career counselling using advanced analyses of user profiles, automatically extracted from various data sources. CareProfSys users will receive professional occupation recommendations based on these data, using ontological inferences from the "Classification of Occupations in Romania" (COR) ontology (developed in the project), aligned with the European list of qualifications and specific machine learning classification algorithms. A conversational agent will provide personalized advice about the recommended occupations and necessary steps for the future, while 3D virtual scenes will help users visualize activities connected with a recommended profession. The project has **three phases**: (1) System design and COR ontology development – in 2022, (2) System development and testing – in 2023, (3) Implementation of the CareProfSys in the UPB-CCOC centre – in 2024. **The second phase** is "System Development and Testing". This stage has a single but extremely important activity for the success of the project, "Development, Testing, and Optimization of the CareProfSys", with five specific tasks described below.

The CareProfSys has a layered architecture. **Data extraction** necessary for the system is performed through the web interface, with data being pulled from multiple sources following user authentication: Europass CVs, social media accounts, and responses to a questionnaire. A special category of data is that required for creating a user account. Logins are managed using SpringBoot and Spring Security. All user information is stored in a MongoDB database. **Data processing** involved: removing contradictory information from different data sources; identifying abilities and interests useful for the recommendation process, according to the COR ontology; mapping data from natural language into structured data. **The development of system services** consisted of developing profession recommendation services, access to Web-based virtual reality scenarios (WebVR), and the CareerBot conversational/chatbot agent. Currently, the recommendation mechanism includes two methods: **ontological inference and recommendation through the application of a machine learning algorithm**. Professions recommended by both algorithms are offered in top positions, then, to allow users to explore as many careers as possible, all other recommendations from either method are offered. Each time a user utilizes CareProfSys, answers questions, and has an electronic profile attached in the system, an individual is instantiated within the COR ontology, who, with the help of the Hermit reasoner, will be classified as belonging to a class representing a profession in the COR ontology, meaning that profession suits the user. Additionally, using the K-Nearest Neighbors (KNN) algorithm from the sklearn Python library, a machine learning model was trained to recommend professions, based on 8 characteristics extracted from the user's completion of the form. Since **developing animated 3D scenarios** is not easy, we chose to develop scenarios only for six professions, within the project, to exemplify **the concept of representing recommended professions through VR**, all featuring many gamification elements: network engineer, civil engineer, web and multimedia systems designer, chemical engineer, university professor and similar, project manager. For the development of a virtual reality application that can be run directly from a web browser, we used the Unity Engine game engine along with specific packages such as WebXR or VRTK Tilia. **The chatbot**, virtual career advisor, was developed using the Pandorabots platform and AIML language, based on tags. **The web platform** represents the user's access point to the CareProfSys system. For the frontend part, technologies such as HTML, CSS, Bootstrap, React were used. In implementing the backend, a Maven project was created in which technologies such as Spring Boot, Apache Jena, OWL API were installed. During development, we applied **modular testing** by developers, alpha and beta **functional testing**. The system was also tested by 48 university students and a group of 27 high school students from across the country, participants in a summer school organized by POLITEHNICA Bucharest. The feedback provided by participants was obtained through questionnaires and constituted the starting point in the system optimization activities. In the second phase, **1 deliverable** was produced: "Technical implementation and testing report of the system". **The project results were disseminated through 5 articles presented at international conferences** (4 ISI), **1 presentation at a conference in the USA**, **1 updated ISI journal article from phase I**, **5 new journal articles** (1 ISI Q2, 2 ISI, 2 BDI), **1 media outreach intervention**, by updating the project **website**, creating and populating the **Facebook page** of the project, publishing relevant information on LinkedIn, and participating in two relevant educational fairs.