

Business Challenges and Technological Innovations Applied in the ICT Platform for Occupational Activation of Senior Citizens

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Abstract: One of the key challenges for the next several years is to face, especially in highly developed countries, the problem of aging and its impact on the general quality of citizens' life. Due to this trend, the Authors have presented a concept of ICT platform aimed at increasing the activity of people at retirement age. It is dedicated to members of local communities, can be used to support entrepreneurship, self-fulfilment and activation in the field of independent social life. During the realization of the project, the Authors have noticed the different business requirements of senior citizens. They were described in the article together with respective technological innovations which were implemented in the ActGo-Gate platform as an answer to these challenges and requirements.

1 INTRODUCTION

The world's population is ageing in almost every country in the world. According to data from United Nations, the number of older persons — those aged 60 years or over — is expected to more than double by 2050 and to more than triple by 2100, rising from 962 million globally in 2017 to 2.1 billion in 2050 and 3.1 billion in 2100. Globally, population aged 60 or over is growing faster than all younger age groups (UN, 2017). This trend has become one of the most significant social transformation of the twenty-first century, with implications for nearly all sectors of society, including health, labour and financial markets, the demand for goods and services, such as housing, transportation and social protection, as well as family structures and intergenerational ties.

Therefore, different parties undertake various activities to allow seniors to live independently, in order to improve their quality of life and autonomy and reduce the cost of their care. One of the solution in this area is the ActGo-Gate project (Active Retiree and Golden Workers Gate, AGG). It focuses on the occupational activation of the elderly people with the use of modern technologies and includes a number of activities in the social, business and technological dimension. The aim of the platform developed within this project is the end-to-end support all involved parties, including senior end

users, intermediaries, service providers and employers. To provide them with immediate, short-term benefits in their daily lives or daily work operations, respectively, is key to motivate them to become part of the local marketplace (Osl, Österle, 2015). That is why the technical development was focused on enabling all the considered stakeholders the possibility of being an active part of the growing social e-marketplace for voluntary engagements and jobs. The primary end users i.e. volunteers and people in need of help get an ICT tool which enables to look for different kind of occupational opportunities (one-time services, long-term jobs etc.).

Those stakeholders with the given policies, strategies, processes, information identified at the early stage of the project as well as used technologies and existing business applications constitute a very challenging and heterogeneous technology ecosystem. During the research and development process, using the modern and innovative scientific and practical approaches (like design science method, agile approach etc.) a set of business challenges in that ecosystem was elicited. The designed, developed and implemented ICT platform face those challenges and provide the highest possible added value by introducing some technological innovations.

The aim of the paper is to present this ICT platform from technical perspective and especially

to emphasise its technological innovations, paired with respective business challenges.

2 THE ACTGO-GATE PROJECT OVERVIEW

The problems and opportunities mentioned in the previous section are addressed by the AGG project. Its vision is to create an ICT based marketplace supporting entrepreneurship, self-fulfilment and social participation for golden workers and active retirees. The model builds on local social marketplaces that serve as a basis and starting point for developing three occupational modules: “Serve the community”, “Flexible occupation” and “Get involved with organizations”, that start off in three different pilot regions. AGG is one of the first of its kind to provide a gate for a wide range of occupational possibilities. Thereby, market fragmentations as we see them nowadays can be transcended. AGG provides end users with easy access to this integrated gate and enable them to offer their skills to other community members.

To integrate the occupational modules with the existing local social marketplaces, a modular approach is targeted for the technical realization. It offers tools for efficient transactional occupational operations (appointments coordination, quality assurance, payment handling, reporting etc.); both for professional as well as informal activities.

3 ARCHITECTURAL OVERVIEW

The architecture of the ActGo-Gate platform involves 4 components (Lopacinski et al., 2017):

- Appointment Coordination System (ACS),
- Recruiting Service System (RSS),
- Gate Application (AGG),
- User Management & Identity System (UMIS).

Clients (ACS and RSS) are the systems constituting autonomous Internet services, which deal with specific forms of offerings and provide necessary functionalities such as the appointment coordination (in the case of ACS) or recruitment (in the case of RSS).

Gate Application (AGG) constitutes a single point of access for all user groups. It determines not only the visual branding of the integrated solution but also defines the general look and feel of the user interface for the main audience, service providers and employees of care-giving organizations. Within

the portals framework, the activities of users and the transactions executed via all the components of the platform are integrated and harmonized.

In the backend AGG makes its Application Programming Interface (API) available and itself uses the client's APIs to ensure the greatest possible homogeneity of data, functionality and secure access control. As far as the functional dimension is concerned, the most important task is to provide a tool for searching the offers and for the management of the user's publications. From a usability perspective, the portal provides the target group with an interface, adjusted to the perception of elderly people. Besides these functionalities a core objective of the Gate Application is to brand the solution in the market, explain it visually and in text and thus build up trust within the local community (Söllner et al., 2016). These objectives are mainly addressed by the use of a state of the art Content Management System (CMS). The administrator panel of CMS allows managing the integration settings, including necessary parameters, mapping of main entities etc.

The User Management and Identity System (UMIS) provides ICT tools which facilitate the user's registration and authentication, i.e. logging in users with Single Sign On (SSO) feature or providing information on the identity of the users to the services. SSO is a crucial property to ensure the integration of separate systems delivering the functionality of the marketplace (Kutera, Gryncewicz, 2016).

All described above components constitute a technically heterogeneous and organizationally distributed ICT platform dedicated to elderly users. During the research and development process, using the modern and innovative scientific and practical approaches, a set of business challenges was elicited. Those challenges, emerging from gathered requirements, were described in the next section of the paper paired with respective technological innovations which were implemented in the ActGo-Gate platform as an answer to these challenges.

4 REQUIREMENT CHALLENGES AND TECHNOLOGICAL INNOVATIONS

4.1 Heterogeneity of Elementary E-marketplace Platforms

E-marketplaces must adopt to various demands and

therefore consist out of various logical and technical modules (Schenkel et al., 2013). As a result, one of the core challenges is to include various existing or newly created services in order to ensure functional scalability and growth with user’s needs. This requirement asks for efficient, quick and adaptable technological solutions, especially in case of new service integration or increased loads on integrated web services or portal. Moreover, as integrated solutions usually are dedicated to a particular use case, and often are developed in different technologies, using various design patterns (Kutera, Gryncewicz, 2017) every portal solution has to deal with the specific character of each service in a standardized way. This clearly determines a generalized approach to building the meta application/portal, both in the data structure and business logic dimension. Consequently, a heterogeneous e-marketplace can have many access points with different user interfaces, APIs and user flows inside the particular applications. An integrated service e-marketplace addressing this means to organize and standardize the exchange of information among cooperating applications in a way that everyone can understand each other and functional synergies can be leveraged. What is more, these e-marketplaces should focus on the way of visual and procedural integration to keep entry barriers for users on low level.

Technological innovation: Application of Web-oriented Architecture with loose coupling paradigm

The software integration planned in the ActGo-Gate project includes a wide range of applications with their specific architectures, interfaces and APIs:

- client applications – ACS, developed in Python (Pylons Pyramid framework + Mako) and RSS, developed in Java (Liferay Portal),
- the gate application, built mainly on top of Laravel (PHP) and AngularJS (JavaScript) frameworks,
- UMIS with Connect2ID application for handling OpenID Connect protocol (Single Sign On) developed in Java.

All applications within the platform are built with the responsive web design paradigm, allowing users to use them on every device, from desktop computer to mobile devices using technologies like JSF, AngularJS, HTML5, Bootstrap and Sass.

The particular problem of integrating various relatively independent services was solved in the designed service e-marketplace, using Web-oriented Architecture (WOA) (Kutera, Gryncewicz, 2017). It

is the extension of the SOA (Service-oriented Architecture paradigm) to web-based applications emphasizing generality of user interfaces and Application Programming Interfaces (APIs) to achieve global network effects (Thies, Vossen, 2009). Allowing efficient communication between internal modules of the WOA-based network application as well as horizontal and vertical scalability are its core objectives (Kleinschmidt et al., 2017). These goals are reached thanks to using lightweight open standards such as REST (Representational State Transfer) or OpenID Connect (Pautasso, 2014) (Rauf, 2013).

The main principle of ActGo-Gate system is to build and deploy an application that is able to cooperate with different services owned by particular service providers while taking into account the lowest possible entry threshold. That is why the loose coupling paradigm and WOA (Web-oriented architecture) architectural style was chosen and adapted for project purposes. The concept of integration is illustrated at Figure 1.

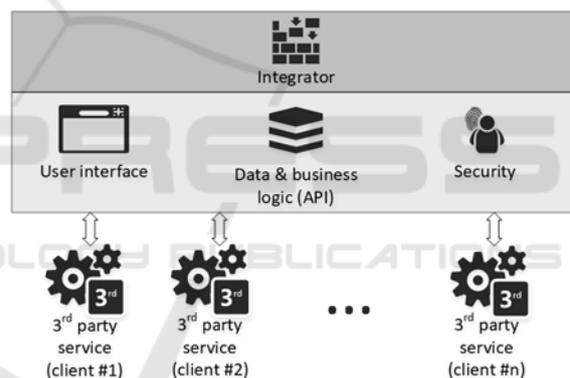


Figure 1: The high-level concept of integration. Source: (Kutera, Gryncewicz, 2017).

This concept indicates three main foundations for integration of service e-marketplaces (clients) under one system – the integrator (a role played by the gate application) (Kutera, Gryncewicz, 2017): user interface, data & business logic and security.

While the first level is related only to front-end adaptations within a particular system in compliance with the given standard, the two backend levels depend strongly on data exchange and communication between clients and the integrator (Maciaszek et al., 2017).

The communication integrator – 3rd party service within data and security integration should be based on WOA principles and loose coupling paradigm in order to keep all data consistent and synchronized.

The application was developed with WOA principles and uses the Vendor-based architecture to encapsulate the business logic responsible for every particular area of interest (like offer synchronization, user data exchange and authentication, data processing or site management). Two of them are cooperating directly with clients (Synchronization vendor and User vendor) through REST communication protocol and dedicated endpoints (each partner in the communication process is equipped with discovery API, a dictionary of all web services dedicated for communication within ActGo-Gate ecosystem).

The service e-marketplaces needs a set of endpoints connected with data & business logic as well as security. The first one concerns endpoints for each objective entity (like category or offer, where operations are defined by particular HTTP methods), while the second one – user endpoint and all supportive entities which help to authenticate him and grant proper privileges. Among those entities common structural elements should be defined and they should be treated as the basis for the integration.

4.2 Heterogeneity of Business Logic of Elementary E-marketplaces

The standalone e-marketplaces are very differentiated and varied as service suppliers offer to their customers more specialized services and concentrate on narrow customer segments. Therefore, there are significant differences between the business logic of each of them. Some of the modules require coordination of appointments (one-time services), the others use recruitment and evaluation process (recurrent or long-term services) (Maciaszek et al., 2017). That is why the process of ordering cannot be unified and be performed in a same way for every service. The integration of such heterogeneous processes is very challenging and requires a significant effort on the integrator's and the client's side and therefore constitutes an important barrier and high entry threshold, especially for the applying side.

Technological Innovation: APIs for Common Functionalities

In the ActGo-Gate case, transactional entities (like appointment, order, recruitment, event, project etc.) are fundamentally diversified in the various modules. This reality had to be accepted working on an integrated solution. That is why the decision was to let individual core processes to be performed only

in 3rd party services (and use the UI integration level for displaying 3rd party's view within the integrator UI), which are fully specialized in such processes (Kutera, Gryncewicz, 2017).

The ACS system contains a set of processes of appointment coordination, which can handle different scenarios of appointment coordination (dependent of the side initiating the process, the knowledge of identity of both sides of the appointment, the nature of the request etc. All elementary actions along the process are encapsulated into reusable web services (Kutera et al., 2017). The processes are taking into account very specific functional requirements like automation of dispatching process, performance confirmation or flexibility of pricing and price negotiations. They are required only in those processes and don't need to be integrated and available for other connected e-marketplaces (clients of the integrated solution).

On the other hand, the RSS module is focussing on mediation of organized and long-term volunteering work. In comparison to ACS it does not cover peer-to-peer activities and short-time scheduling of appointments. It's core functionalities and business logic are thus different and aren't covered nor duplicated in the portal application. Nevertheless, there are similarities not only concerning the module's general purpose but also concerning match-making process covered in the application. In AGG project common functionalities between modules have been identified and a reusable set of API-calls was identified.

4.3 Heterogeneity of Data Provided by Elementary E-Marketplaces

Different modules were designed with taking into account the domain knowledge on the specific field, which they are dedicated to. Having a different background, data structures developed for the application are different at various levels:

- namespace – the same entities can be named differently and there is a need to identify them properly and map them to respective entities required by the gate application,
- structure / relationships – between entities, dependent on context and business requirements, there could be 1:N or M:N relationships - the second type usually introduces additional data structures like pivot table in SQL,
- specific entities – entities specific only for the domain covered by the application.

It was one of the major challenge of the project to handle the diversity on the level of data structures and still provide the user a consistent UI level.

Technological Innovation: Metadata Model and Data Synchronization

Handling the data models, especially the feeds of published offers is one of the key features of the integrated e-marketplace in the ActGo-Gate project. The synchronization process was planned carefully to predict all possible scenarios of data exchange between the clients and the integrator for all CRUD (Create, Read, Update, Delete) operations. As always in synchronization deletion of offers was most difficult to handle – in both cases: when the client uses soft deletion of the record (setting the proper value for the particular record) or hard deletion (physical removal of the record). As a result all offers gathered from offer feeds sent by cooperating client applications are stored in a central repository after being processed by the dedicated vendors: Synchronization vendor and Data vendor.

The most important business rules for the central offer entity are following (Kutera, Gryncewicz, 2017):

- offer has to be assigned to at least one neighbourhood and category,
- offer has to be mapped with client offer index,
- offer has to be owned by one or more users,
- offer is obliged to have geographical coordinates set for displaying it on map,
- offer which don't have any active owner or assignment to an active category or neighbourhood has to be deleted.

The business process of the synchronization was modelled using the BPMN notation (Figure 2). The synchronization process itself is invoked automatically by using Linux CRON mechanisms at a certain schedule. One of the assumptions, arranged in the integration contract, is the focus on the continuous transmission of relatively small pieces of information to keep the consistency of the data within all systems. That is why the data flows

contain only information about recent changes (added as well as modified or deleted offers). The most important fact is that the relations are related to a certain sequence: E.g. before the direct request for an offer is sent, neighbourhoods and categories have to be synchronized.

The request for the offer synchronization is invoked automatically by CRON server tool. The request is sent via the routing API to the proper URI. Then the collection of offers is being built and converted to the JSON format. As the web service get the time limiter parameter every offer is checked whether timestamp of last update operation fits the requested period. If the collection is ready, the synchronization endpoint of the integrator receives it. It is being validated for syntax (expected structure and data types) and proper dependencies (neighbourhood, category, user). If any dependency is returning errors, the offer is omitted and such a fact is recorded in log files and optionally an alert is sent to the administrator. After a successful validation, the offer data is being processed by the decorator, which role is to convert data to the integrator-specific structure. Decorator is also adjusting the timestamps and checking the availability status of the offer. Log counters are also updated. All offers from the collections are checked within a multi-instance loop and if it ends the synchronization result is logged (Kutera, Gryncewicz, 2017). As a result the information about the offers is standardized and grouped into categories. The offers can be browsed in different views of catalogue (Rot et al., 2017).

The User Vendor resides in the gate application, which gathers, processes and synchronizes the user data with the central user repository. It supports the UMIS in keeping user data consistent with clients. This vendor is communicating with dedicated endpoints on client side (Registration and Update Endpoint) in case of the respective event (user is registering or user is modifying his/her user data). The communication with those endpoints ends with a success message from client side.

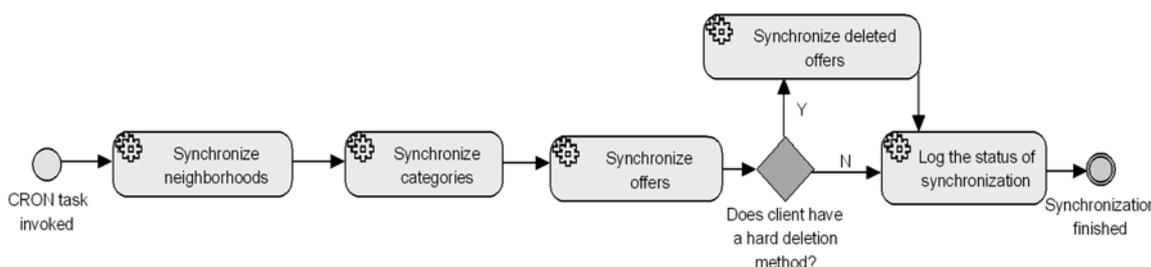


Figure 2. The high-level process of overall synchronization task. Source: (Kutera, Gryncewicz, 2017).

4.4 Various E-marketplace Applications with Various Access Control and Safety Policies

The applications like ACS and RSS functionally rely on authenticated users. Such services provide some public information to anonymous users, but the core functionality of any marketplace is related to reliable authentication and authorization as well as safety of personal data. As a result, the functionality of initial registration, login and user master data maintenance need to be available in all modules and therefore was identified as potential synergy of a comprehensive gate application. Furthermore, the topic of authentication, authorization and personal data is related to user acceptance, security and trust – which was an explicit domain of a comprehensive portal application (Phang et al., 2006) (Clercq, 2002) (Rot, 2016). The requirement to set up a central User Management and Identity System (UMIS) and Single-Sign-On (SSO) was clear – even if all modules came with its own dedicated and independent solution.

Technological Innovation: Central UMIS and SSO – One Account for All Integrated E-marketplace Applications

The result of integration in the field of security and access control is obvious: users are able to get an access to a wide range of services with just one profile. Their access data is securely managed on the ActGo-Gate site (in the mentioned separated module – the UMIS module). With such an account, user gets access to offers in various areas, without having to remember multiple passwords and mail addresses combinations to protect data. Whether they want to use or provide a service, they simply create or search for an offer through their account and agree on the details. The application ensures one access, safe and convenient.

The choice of the protocol was made among three solutions: OAuth 2.0, OpenID Connect and SAML. The choice was difficult as they are in some way complementary but different in their basis. Finally OpenID Connect (OIDC) was chosen as it satisfied all the requirements and therefore should ensure full SSO property by cooperating with the common user directory (Kutera, Gryniewicz, 2016). The particular solution chosen for implementing OIDC was Connect2id (as Identity Provider) with an OpenDJ LDAP user directory – it is a solution natively prepared for OIDC handling as well as ready for communication with AGG, ACS and RSS

APIs, thanks to additional extensions written by the author of the core server application.

What constitutes an unquestionable advantage of the chosen architecture with a separate component UMIS is a considerable degree of separation of the user data and of the processes related to the management thereof from the other IT systems. This results in a data security improvement. Furthermore, the centralization of the user management makes the platform very interoperable and therefore it is easily extendable by new clients, whose task is to provide complementary services to the platform's current offer. The choice was made also to create the innovative brand of the integrated e-marketplace and build trust among the users, as well as to ensure a good user experience with a single sign on.

4.5 Elderly People Use the Digital Technology Differently

Many adult people have the basic skills in usage of the interactive devices, and thus, are more likely to already be familiar with computers, mobile devices, and related technology. The system is designed to support them in their search for additional employment and/or help to improve their quality of life by offering them a single access to online services provided by professional organizations or private persons. Pilots showed that access to applications needs to be very low-threshold from a usability perspective.

The real challenge is how to entice elderly people to request services, where many people could possibly be afraid of utilizing ICTs in their day-to-day operations. They require to get user-friendly interfaces and very clear and simple procedures with contextual support.

Technological Innovation: Responsive Interface with Additional Adjustments Dedicated for People with Sight Disabilities

In general, the development of the frontend part of the applications was performed in compliance with Web Content Accessibility Guidelines (WCAG) 2.0 (W3C Consortium, 2008). Its aim is to make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these. Special attention was put on visualization to create friendly and clear interface with intuitive text formatting and clear icons to simplify the cognition process among the site content. The navigation

schema is intuitive and easy, supported by additional explanations at every stage of navigating through the site. The error handling policy is also well developed by equipping the active interface elements with validation rules on the frontend and with clear explanations about the nature of the error. The gate application is also offering an adjustment tool that allows for resizing text content up to 22 pts and change the original layout on the simplified, high-contrast one (Rot et al., 2017). As it was already mentioned, the application can adapt to any display size so even on mobile device the content is easy accessible for elderly people - in mobile views most operations can be accessed via the dedicated intuitive mobile menu.

5 CONCLUSIONS

The key challenges in this project were mostly related to various aspects of a technically heterogeneous and organizationally distributed setup as well as specific business requirements coming from the heterogenous market. Most of its technological innovations addressed the various aspects of integration – in a technical but also organizational sense. Distribution, heterogeneity, and complexity only could be handled due to a strong domain-driven thinking, a modular, black box-approach relying on common but relatively simple APIs and of course the use of open standards at any interface. Applying an agile approach and involving the user on a regular basis as well as automated deployment and testing allowed to deliver and improve an integrated solution step by step (AGG Consortium, 2018).

The Authors are aware of the fact, that such a modular solution has some limitations and the most noticeable one is the difference of the particular UIs. Such fact leads to worse user experience, when users need to learn and use the similar, but not the same graphical, structural and navigation schema in particular client application. Applying common style guidelines and standard behaviour could cause that marketplace may be treated by the user as homogenous one, as various apps on a smartphone with its operating system providing all the shared styling and base functionality.

Weak awareness of the advantages of buying and selling services among elderly people and a limited general trust to online markets is still a problem. The developed platform provides relatively simple transactional workflow for each kind of supported activity and support of the intermediary at the

crucial levels of the process, however the results from pilot implementations still show that the barriers have not been overcome completely despite many organic activities like presentations and trainings. Such problems have to be taken into consideration in the evolution of the current implementation and the corresponding business model.

The technological achievements of the project have been evaluated in real-life pilots both by regular users and service providers as well as social organizations that supports elderly users in their social activation. The results in general show that users are willing to be supported by such ICT platform in their occupational activation, they see the advantages of such a support and have a positive opinion of having one hub for many offers and one accounts to access them easily. Those areas, that still need to be improved, were clearly identified and potential solutions were discussed with all the stakeholders and all of them will be the basis for the further research work of the authors.

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