MODERN PENSION TRACKING SYSTEM
– THE CASE OF SLOVAK ORANGE ENVELOPE PLATFORM

Daniela Danková[1]
Ján Šebo[2]
Ivan Králik[3]

Abstract: *European Commission has a long-term objective of tackling the demographic issues of EU member states by creating a network of national pension tracking systems. The initiative launched in 2021 aims to present good practices in building modern pension tracking systems. The paper examines key aspects of a modern, consumer-driven non-governmental platform providing users with the features of pension entitlements across all pension pillars in Slovakia. The methodology is built on the case-study where governance, research, front-end and data management issues are elaborated. The paper presents in-depth steps and robustness of microsimulation model applied for the pension tracking platform. The results could serve for other countries and modern PensionTech providers as a good practice and a guideline to create a comprehensive integrated pension tracking system with minimum development and operational costs and extremely short time-to-market duration.*

Keywords: *Pension entitlements, Pension projections, PensionTech, Microsimulation, European tracking system.*

1. INTRODUCTION

Development of FinTech solutions intensively intervenes into the complex public policies, among which the pension systems are the dominant ones. Pension institutions are deemed to be one of the oldest institutions, where communication with participants uses old paper means. However, there is undoubtedly a shift towards digital communication.

More and more pension providers use web portals to give general information and build personal web environments for participants to see their entitlements and make pension calculations. However, fragmentation of provided information on expected pension benefits by particular pension providers organized as a form of public-private mix causes sub-optimal decisions of savers on their pension arrangements. Current trends and EU policies intensify the pressure on pension scheme providers to periodically provide information which allows individuals to make informed decisions. Even this trend is unstoppable, the provided information is in many cases retrospectively oriented and highly fragmented.

Only a few countries have grown to the level, where the information requirements are oriented on the provision of forward-looking information on expected pension benefits. Some pension providers also provide apps so that information is accessible to their participants on tablets and phones. Among them, only a few provide modern pension tracking systems allowing users to access their pension accounts to track their pension entitlements and evaluate the appropriate-

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[1]   Orange Envelope, non-profit university spin-off, Závada 48, 99121 Závada, Slovakia
[2]   Faculty of Economics, Matej Bel University, Tajovskeho 10, 97590 Banská Bystrica, Slovakia
[3]   Faculty of Economics, Matej Bel University, Tajovskeho 10, 97590 Banská Bystrica, Slovakia

ness of accumulated pension entitlements and assets. Pension tracking services in The Netherlands, Denmark, Norway and Sweden show overall positive user statistics both in terms of usage and satisfaction of service provided. Most existing tracking services continuously expand functionality. In a few countries where no national tracking service is yet in place, plans for creating one are (e.g. Ireland, United Kingdom) gaining greater momentum.

Pension providers are becoming faster to respond to trend changes and are better tuned to the users' needs. One limitation for pension providers is, however, that they have a restricted view on the financial situation of their participants. For pension providers of occupational schemes, for example, the information they have on the entitlements of their participants usually does not extend beyond the entitlements of the pension scheme they provide. Recent developments and technological advances have given rise to a new type of PensionTech companies that put on fast track technological superiority and the ability to develop applications that serve the consumer needs also in the area of pension entitlements. Modern PensionTech tracking services have an advantage here, being able to give a better overview across more providers and in some cases across several pillars with consumer centric approach and lean development and operations that are built on scalable software-as-a-service (SaaS) principle.

Our paper aims to bring more insight into the process of building a modern Pension tracking service as a case study. The paper is organized as follows. The introductory part has provided key insight into the development trends in the area of pension tracking systems. The second part focuses on key aspects that should be considered when designing and implementing the modern Pension tracking system as recommended by several EIOPA reports and evaluates the analyzed Orange Envelope platform. The third part presents key information on the robust microsimulation model employed by the Slovak pension tracking system – Orange Envelope platform. The part devoted to the future research directions discusses results from user-testing and presents some findings on development trends of analyzed pension tracking system based on agile development and consumer demand. The conclusion part summarized key findings and recommendations for other countries and PensionTech companies wishing to implement low-cost modern and agile pension tracking service.

2.   EIOPA PRINCIPLES AND RECOMMENDATIONS ON BUILDING PENSION TRACKING SYSTEMS AND PENSION BENEFIT STATEMENTS PLATFORMS

The heterogeneity of pension systems and fragmentation of pension providers combined with the complexity of personal financial need and the interplay between economic considerations and individual aspirations make the problem of personal finance one of the most challenging in economics. As pointed out by Medova et al. (2008), all current solutions used in practice ignore one or more of the features of the full dynamic solution to make the problem easier. The impact of each of the incremental complexities involved is very poorly understood by practitioners and is often dismissed as unnecessary without hard evidence. Dempster (2016) argues that financial planning for the benefit of individuals is based on a variety of approaches internationally. These range from simple heuristic approaches for selecting portfolios to those incorporating the joint stochastic optimization of asset allocation, contributions to different savings vehicles and setting flexible saving and withdrawal rates. As affordable computing power and bandwidth continue to increase and the solution efficiency of large stochastic optimization problems expand, ever more complex financial planning tools are emerging. As we enter the age of big data,

this trend will surely continue. Building a successful pension tracking system requires a unique multidisciplinary approach that bridges the newest research on pension modelling with high-tech ICT and should involve not only researchers and IT developers, but other stakeholders both from the side of regulators as well as providers and users. Consumer-centric approach serves as a bridging principle.

European Commission in its Request to EIOPA (2020) seeks to develop best practices for the set-up of national tracking systems that facilitate access to individualized pension information. Current knowledge and recommendations on building a successful pension tracking system (EIOPA, 2020; TTYPE, 2015) recognizes four areas that needs to be scrutinized in detail. These areas include purpose and functionality, front-end and design, back-end and technical aspects of projections and platform, and governance and operational aspect of the platform.

Below we compare the recommended approach with the findings on the Slovak pension tracking system – the Orange Envelope platform (https://www.oranzovaobalka.sk/web/en/).

1. **Purpose and functionality aspects of the pension tracking system.**
   a. Recommendation: Pension tracking system should have a clear scope/coverage, targeted audience and users, type of information offered, type of functionalities developed in order to provide comprehensive and easy to understand information.
   b. Orange Envelope Platform: The platform has a clear scope of providing personalized pension projections across the entire pension system in Slovakia. The audience represents the working population with mandatory and voluntary participation in pension pillars (1st PAYG pillar organized by governmental Social Insurance Company, 1bis pillar provided by Pension Asset Management Companies, 3rd pillar provided by Supplementary Pension Asset Management companies, 4th pillar provided by Investment companies). Users are allowed to open an account and connect their providers via personalized security login credentials. The platform provides key functionalities on tracking existing pension entitlements, downloading and storing personalized pension records and provides personalized pension projections. Pension projections include recommended scenarios, while the scenarios are probability weighted (see more information on microsimulation model and pension projection part below).

2. **Front-end/design aspects.**
   a. Recommendation: Pension tracking system should adopt the recognized principle of layering information (EIOPA, 2013), user experience and testing with a periodical assessment of the platform scoring from the users´ view and present comprehensive information on the financial situation and expected pension benefits.
   b. Orange Envelope platform: When pension data from providers are synchronized, users are presented with 3 layers of information on expected pension income based on 4 subgoals defined by EIOPA (2018). The initial layer contains broad information on overall pension income and expected replacement ratio supported by evaluation of the expected financial situation using Pension Traffic Light (https://www.oranzovaobalka.sk/index.html#!/16/pension/overview). Second layer provides detailed information on current pension entitlements and expected pension benefits from each pension pillar. Each section is organized in form of the questions a typical user asks, such as: "What Pension can I expect?", "How is the pension calculated?" and "How to improve my situation?". For each section, these key questions are presented in a multimodal way to support the under-

standability of information. Each year, users are tested by platform supporters to identify the overall success score of the platform and to identify bottlenecks and improvements. Standard testing is based on usability testing methods (Barnum, 2010). New functionalities are tested before implemented on the platform on a special focus group of users. Existing functionalities are reviewed once a year on a broader scale of platform users.

3. Back-end and technical aspects of the platform.

a. Recommendation: The platform should employ digital identification tools, data standards for data transmission with other pension providers, stochastic pension projections techniques allowing for uncertainty and protocols for data exchange and data quality (e.g. record-keeping). When designing the back-end, there should be centralized (many-to-one) or decentralized (many-to-many) database and model of data transmission (data exchange) employed (see Figure 1).

b. Orange Envelope platform: The platform has been initially built on the "many-to-one" principle, where the platform integrates pension reports pulled-out from partial pension providers. Later on, as broader cooperation with pension providers and other stakeholders has been developing, the platform has started to change the principle to "many-to-many" and started to provide aggregated data for other platforms as part of the business model. For example, pension providers found added value of the platform and ability to retrieve pension data of their clients including the clients´ pension projections and present the projections within providers´ platforms. Employers, who contribute the data on their employees into the platform retrieve reports and other data on the efficiency and costs of sponsored pension plans for managerial usage (see Figure 2 for the model of data transmission and exchange).
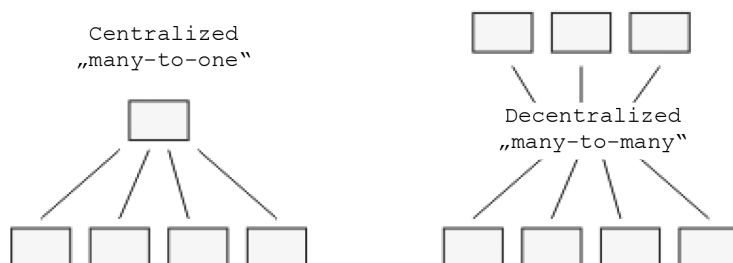
Figure 1. Database and data exchange model in Pension Tracking System
Source: Own elaboration
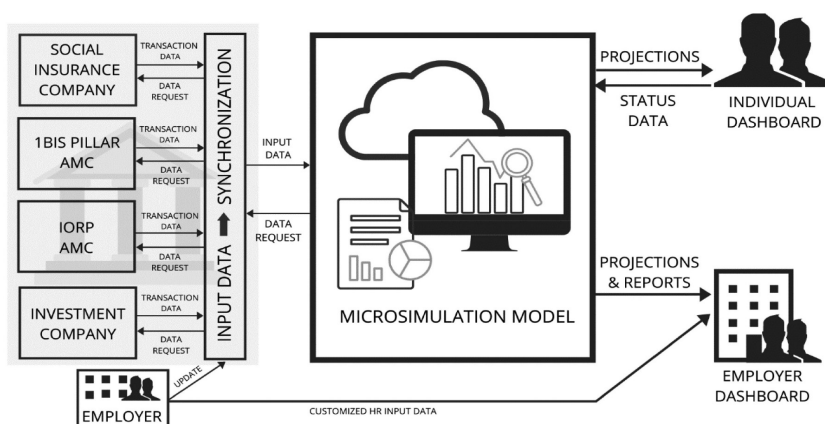
Figure 2. Orange Envelope architecture and data transmission
Source: Orange Envelope Technical Documentation, 2020

The data to other stakeholders are provided based on dedicated or open API protocols, where individual requests are examined on both sides of data transmission and data exchange. The flexibility of the platform allows for various communication protocols and dedicated API configuration based on the needs of stakeholders.

4. **Governance and operational aspects.**
   a. Recommendation: Pension tracking system/platform should have a clear business model of financing, partnership with basic pension data providers, clear rules on compliance/due diligence, cyber-security and personal data protection rules.
   b. Orange Envelope platform: The platform is provided by non-profit organization backed by university researchers, who devoted their state-of-the-art pension system microsimulation model to the platform and adjusted its functionalities to provide individualized pension projections. As a non-profit organization, the financing is based on multi-sourcing, where research grants, donors, revenues from pension providers for pension projections, payments from employers for provided pension reports for their employees and plans, as well as payments from end-users are used to cover the operating costs of the platform. Study on European Tracking System (TTYPE, 2016) estimates the operating costs of existing tracking services between € 0,15 and € 0,30. Orange Envelope platform should be able to operate at the cost of € 0,12 per economically active citizen per year as the development and implementation costs have been already accrued by the financing institutions within the initial 2 years of operation. The platform continues to create strategic partnerships with pension and long-term savings providers, ministries and other governmental bodies. Additional cooperation is active with research agencies and universities, consumer organizations and employers. The data protection and security are built on the GDPR rules, where the provision of initial status data is given based on the consent of the end-user. Using his login credentials, the platform retrieves raw data from pension providers using a secured connection and removes the login credentials from the server memory. Retrieved data are then synchronized within the database. The last step is the division of personal data and pension data. The data are encrypted and stored separately using a secure key to decrypt the connection between the personal data of a user and respective pension/financial data stored by the platform. When the user is securely identified (using login credentials at the platform or face-ID when using a mobile phone/tablet), the data are paired for the session.

3. MICROSIMULATION MODEL AND PENSION PROJECTIONS WITHIN THE "ORANGE ENVELOPE" PLATFORM

Current recommendations on building robust projection models for pension tracking systems (EIOPA, 2018) include stochastic assumptions on key macroeconomic variables (inflation, labor productivity, asset returns, interest rates, volatility, correlation among asset classes) as well as individual factors (life-cycle income) for modelling.

The Orange Envelope microsimulation model is an open, cohort based, stochastic model with a dynamically aging population that generates simulations based on moving-block bootstrapping technique (resampling). It connects key modules: demographic, macroeconomic, pension policy, individual micro-model and moves the population forward by a year. The details on the microsimulation model architecture are provided in Figure 3.
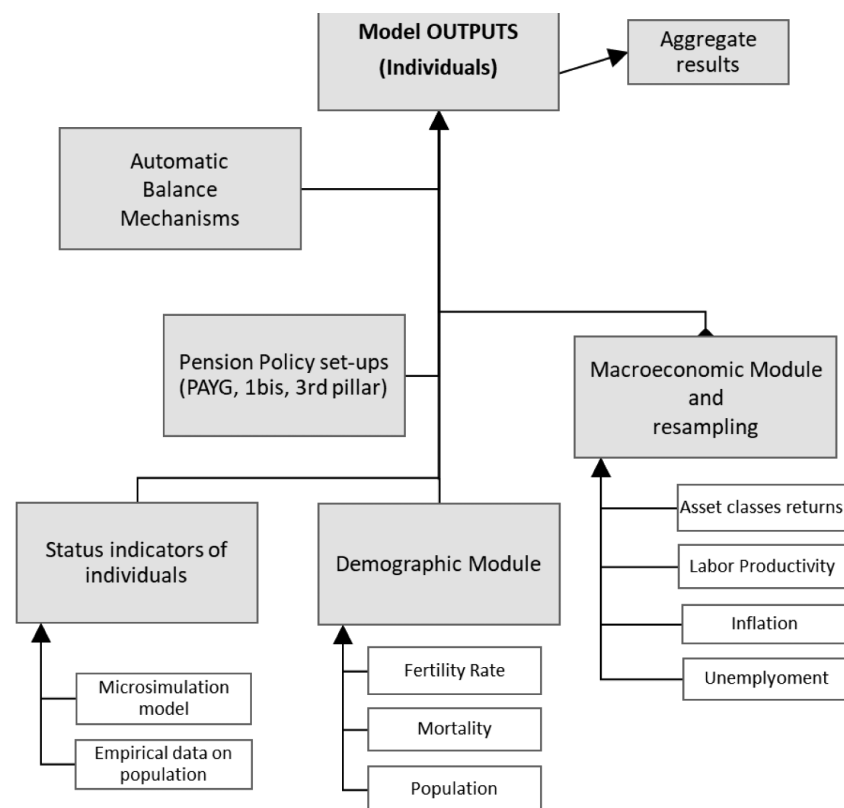
Figure 3. Orange Envelope stochastic microsimulation model architecture
Source: Orange Envelope Technical Documentation, 2020

The model generates a considerable size of the data when the entire population is covered (around 1.5 TB data), which significantly limits the direct connection of the model to the web application. Computational simplification was invented where the results are sorted into the data-cubes that include quantifiable measures (values) for attributes (indicators) across dimensions (scenarios) that prove to be statistically reliable while enabling the usage in a real-time environment (on-demand). By solving the relationships of data-cubes generated, the whole process was simplified and automatized for the web application. Created data-cubes (aggregated and individualized) containing the changes in pension policy and individual pension set-ups. The result will be a multidimensional data-cube system of individualized and aggregated variables, attributes, and dimensions. The system of model data-cubes is presented in Figure 4.

Maintaining relationships between macro variables allows their linking to individualized data provided by users.

In order to keep the whole system updated and to innovate user functionalities, the agile management based on RDD (research-develop-deploy) technique is implemented (Katz, D. S., McHenry, K., Reinking, C., & Haines, R., 2019). The research team receives the request from the consumer relations officer, who sets the priorities for the research based on consumer-centric approach. The research team immediately starts their tasks and as soon as the problem is solved, it is transferred to the IT development department, which takes over the management of the task. As soon as the coding/programming tasks are finished, consumer relation officer deploys the focus group to test new functionalities. Based on the consumer testing results, the solution is deployed to the platform or further improvements are suggested. The second alternative starts the new cycle. If the solution is successfully deployed, it is automatically involved in the periodical testing.
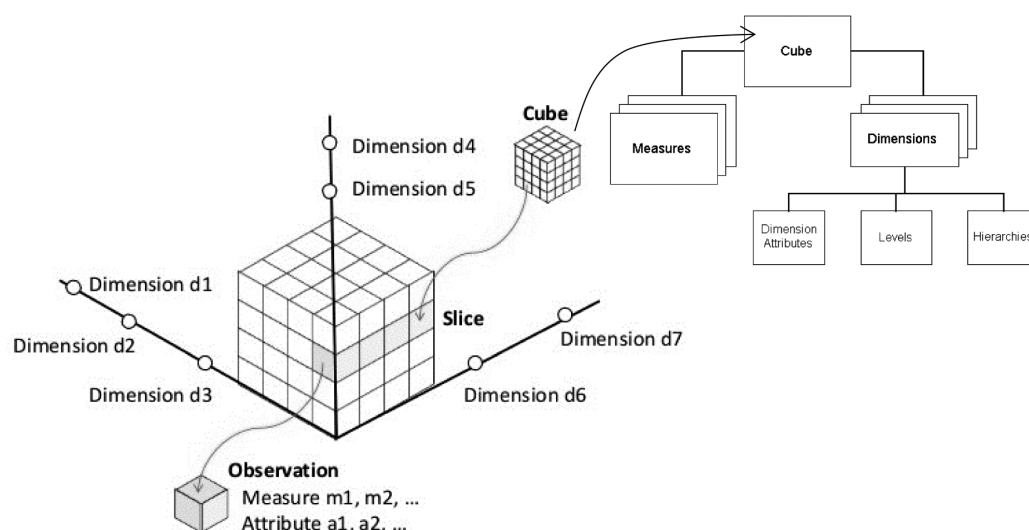
Figure 4. Multidimensional data-cube system of pension model
Source: Orange Envelope Technical Documentation, 20*20*

4.   FUTURE RESEARCH DIRECTIONS

Our paper shows, that linking research and value-added applications to a wider range of actors allows for the fast development of complex pension tracking system at minimum cost and time. We see the potential of gathering additional funding and development of functionalities, which would drive further development of traditionally centralized governmental solutions in the area of pension information provision. This allows the non-profit platform to grow faster and increase innovation, build digital public administration, digitize industry in ancillary services and create a new PensionTech industry, while providing integrated high value-added information in isolation pension entitlements across the pension system in the Slovak Republic.

In addition, the application is scalable in the part of defined contribution schemes, which opens up the possibility of wider use and the connection to the European tracking system.

Further development can be seen in opening new undiscovered area of complex financial planning tools, where the pension information are supplemented by private sector financial products such as investments, credits, insurance products or value of real-estate. This could lead to the new research area of individual asset-liability modelling.

We see the limitation of research in lower support from the dominant player in the market, the Social Insurance Agency, which restricts access to anonymized data to refine the microsimulation model for estimating the development of individuals' income and thus expected pension entitlements from the first pillar. Subsequent development and research should aim at improving the interconnection of providers' database systems in order to unify the way data is shared without the need to exchange sensitive personal data.

5.   CONCLUSION

The objective of the paper was to present as a case study a new way of developing a complex pension tracking system at a low cost without the intervention of state agencies. We have examined an existing non-profit pension tracking platform operated in Slovakia, that has been built

and operated by a group of researchers. We have examined the key aspects as recommended by EIOPA and critically evaluated strong and weak areas of the platform. At the same time, the article uncovers critical aspects of the development and operation of pension tracking platforms that are forced to provide an innovative and consumer-centric approach. We claim that the uncertainty of the funding leads to the sensitivity of the platform provider to the consumer requests that increases the innovation and lowers the time-to-market for new functionalities. The platform could be used as a good practice for other countries or research teams that want to provide pension projections to the users while significantly lowers the development costs and time.

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