Optimizing Public Service Delivery through Automated Stakeholder Interaction: Low-Code BPM Implementation

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Abstract. For years, public institutions have been characterized by a complex and specific structure that requires the applications of bureaucratic procedures that are in accordance with the law and the professional preparations of officials. Nowadays, public institutions have high requirements for implementing intelligent IT systems, which allow the handling of documents in electronic form and the automatic flow of the information that is contained in them. This article presents a set of business processes that have been implemented in a public institution (dealing with the implementation of tasks in agricultural and food markets) that was performed in the BPMN notation. In addition to a description of the system, the article presents the positive impact of the implementation on the work of the authority. The article presents how business-process modeling and simulation support an enterprise in creating an integrated information-processing system. It concludes with a presentation of the effects and changes that have occurred in the authority following the implementation of a business-process-management system.

1. INTRODUCTION

Increasingly, government organizations seek to optimize their operations by implementing a business-process-management system that allows them to quickly collect,

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process, and transfer data. The aim of public institutions is to replace the paper medium with electronic documents that are mainly used for interactions with stakeholders. This article describes a set of business processes that have been designed and implemented in a public institution, which were executed in BPMN notation. The implemented integrated-business processes increase the efficiency of the tasks that are performed thanks to streamlined workflows, improve the completeness of the data thanks to a centralized source of information, and enable the efficient management of resources while monitoring the course of actions from the management side. The solution, which was implemented in 2020, is based on business processes that were designed on the Aurea Low-code platform; this enabled the dynamic design of the company's business processes. The implemented business processes are still in use in 16 centers today (i.e., for more than four years), which has allowed the long-term monitoring and comprehensive evaluation of the achieved results. Process management is about systematically assessing their performance, maintaining their operation, and making adjustments when the achieved results deviate from the norm (van der Aalst et al., 2003; Oleś-Filiks & Waszkowski, 2024). The implementation of business processes based on the Aurea Low-code platform engine was a key step in the development of the selected public institution (Tecna, 2023). Low-code is a software-development strategy that uses little or no coding to create applications and processes (Tisi et al., 2019). For implementing the system, the Aurea low-code platform was chosen; it has the following features (as compared to other low-code systems):

– An innovative approach to building application components/modules – applications are built by using components that provide data based on any data source and make it available through an internal API. Any components that are created within one application can be easily transferred to other applications in the case of a duplication of functionality of both of the implemented systems.
– A high level of security – the authorization model that is used in the application is both simple and intuitive but has great capabilities – both in terms of making individual system components available to groups and users as well as defining access to records and individual data attributes (which is very important when implementing systems that store sensitive personal data).
– Unlimited possibilities for extending functionality and performance – the concept that is used allows for the use of databases with a table structure that corresponds to the respective domain; this significantly affects the performance capabilities of the platform, but it also allows for any extension of its business functionality. In the case of the need to implement advanced and highly customized views of the user interface, it is possible to use additional modules in the forms of micro-front-end applications, which can freely expand the way of visualizing the data.
– Many out-of-the-box integrations – basic integrations with LDAP and Active Directory services, mail servers, or monitoring systems are provided as part of the platform. There are also ready-to-use components for integrations with services such as National Node (login.gov.pl), KSeF, e-Delivery, EZD PUW, GUS TERYT, GUS REGON, PESEL Register, Google Maps, and many others. The platform also offers extensive integration capabilities with other systems through queuing systems, HTTP API services, database connections and flat files.

The overall goal of the system is to support process management while increasing the efficiency of an organization and optimizing its performed tasks. The use of a BPM-class system provides an opportunity for extensive user involvement in the process-description phase, the modeling, and the faster implementation (Oleś-Filiks, 2019; Waszkowski, 2019; Waszkowski et al., 2020). The purpose of this article is to provide the reader with an understanding of business-process modeling in the Aurea Low-code tool for workflow- and document-handling processes. BPMN notation (business process model and notation), which is used in Aurea Modeler (the business-process design module in Aurea Low-code), has been specifically designed to describe business processes and is the primary way of capturing them today (Nowicki et al., 2013; 2017; Waszkowski et al., 2017). Business models allow for a robust and graphical description of the steps that are involved with just a few elements (Nowicki et al., 2019; Waszkowski & Bocewicz, 2022; Waszkowski et al., 2018).

Low-code development platforms offer several key benefits for this type of institution. They accelerate application development through visual tools, thus reducing development time and speeding up the launches of new services. These platforms also contribute to cost reductions by minimizing the need for extensive coding and simplifying any maintenance (Alamin et al., 2023; Antunes & Mourão, 2011; Benac & Mohd, 2022). Furthermore, they enhance organizational agility by enabling rapid adaptations to changes and facilitating collaboration between IT and business teams. Low-code platforms empower the creations of user-friendly interfaces for citizens and farmers, thus improving service deliveries (Rybiński & Śmiałek, 2022; Rymer, 2017; Rymer & Koplowitz, 2019). Finally, they support data-driven decision-making by enabling easy data integration and analysis (Sahay et al., 2020). By leveraging these platforms, an institution can modernize its operations, improve its service delivery, and better serve the needs of the agricultural and food sectors.

2. CASE DESCRIPTION

The public institution in which the business-process-management system was implemented dealt with the implementation of tasks in the markets for agricultural and food products. These tasks were aimed at stabilizing the markets within the mechanisms of the Common Agricultural Policy. In addition, the unit carried out analyses of the agricultural and food markets and developed and disseminated information that was related to the implementation of the mechanisms of the Common Agricultural Policy as well as the conditions for participation in these mechanisms. Another pair of its tasks was to carry out promotional and information activities on agricultural and food products and to manage foreign trade in agricultural goods within the framework of the Common Agricultural Policy. The organization in question was a Polish public institution that supported the activities of the Polish state, society, and economic entities in undertakings that were related to the submissions of applications for co-financing and making payments under these applications as well as concluding contracts and handling reporting. The organization operated throughout the country – in 16 centers that were located in each voivodeship. Each center

had about ten employees. Previously, paper documents were processed manually – incoming letters, outgoing letters, transfers of cases between departments according to a pre-defined distribution list, and the archiving of documents. The expected result after implementing the business-process set was to automate, streamline, and simplify the handling of paper applications along with the possibility of automating the decision-making process (e.g., by using data-validation algorithms). The system needed to be reliable and enable better communication and data exchanges among the employees.

3. UNDERTAKEN ACTIONS

The scope of the project's first phase included the analysis, design, testing, and implementation of a set of processes for handling grant applications, payment requests, contracts, and the processing of basic and dictionary data. The scope of the second phase included the analysis, implementation, testing, and implementation of processes for handling final reports, statements of control orders, registers of control reports, and registers of financial recoveries. The solution, which was based on the Aurea Low-code system, enabled the design and implementation of processes for the processing of grant/payment applications and contract-handling processes as well as for reporting and monitoring within the organization.

The grant application process (Fig. 1) was started manually by the operator after selecting the "New Application" button. Once the process was started for the operator, a starter form was available for the operator to enter basic information about a grant application, which included the following:

- application number – number that identifies application;
- application date – date original application was received;
- sub-program – year;
- name and address of organization to which application was related.

The same operator who filled in the start form with the basic data was responsible for the processing of Task One. The operator downloaded the Task One application data edition from the list of tasks to be downloaded (where only applications that were launched by a specific user were visible). After downloading the task-edit-application data, the operator filled in the details of the application, attached scans of original documents, and approved the task.

Task Two (verifying an application) was performed by the verifier, who retrieved the task from the list of tasks to be downloaded. The verifier had read-only access to all application data. The verifier could not edit the application or its attachments; his/her task was to verify the form and content of the application. After verifying the application data, the verifier assigned the appropriate status on the form in the application-processing section:

- Verified – this was the default, positive path. Selecting this status and approving the task initiated the third application-processing task.
- To be corrected – this was selected if the verifier found an error and referred the application back to the operator to correct any errors in the application.

Task Three (processing the application) was handled by the approver. The approver retrieved the task from the list of tasks to be downloaded; he/she had the right to see all of the data in the request. The approver could not edit the request nor its attachments. The approver's task was to approve the request or send it back to the operator for correction if there were any errors.

When the approver approved the task, the contract process started automatically. The figure below (Fig. 2) shows the business process by which a contract was processed and claimants received the funds that were specified in the payment requests.

The figure below (Fig. 3) shows the business process for processing a payment request, which could only be processed for an organization once the contract had been successfully awarded.
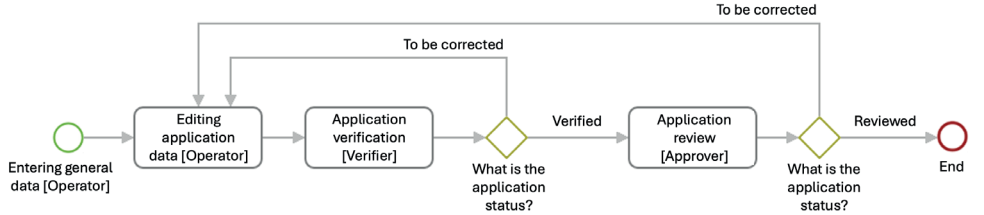

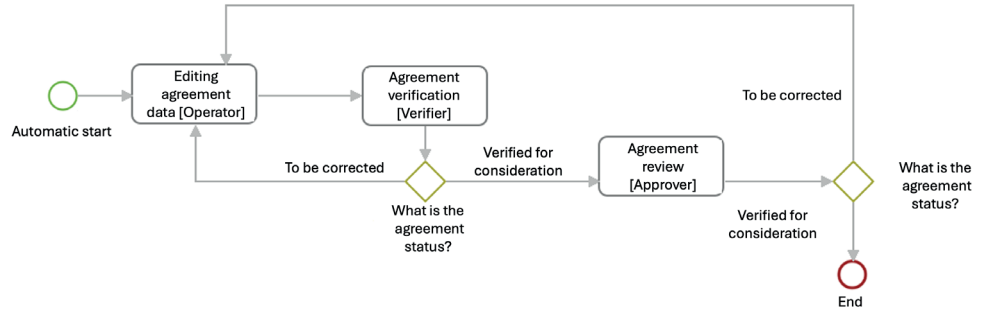**Fig. 1.** *Process for handling grant application*
Source: Tecna, 2023

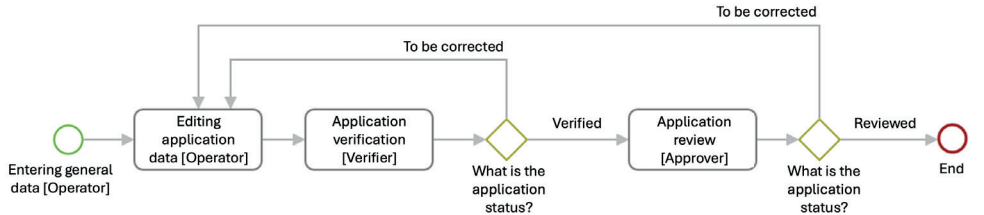**Fig. 2.** *Contract-handling process*
Source: Tecna, 2023

Fig. 3. *Payment-application process*
Source: Tecna, 2023

The business-process-management system was designed to support document handling, workflow management, and process control. Working with the system mainly involved the following:

- initiation of document-creation process by user who belonged to operator group;
- completion of application and contract form using data that was contained in dictionaries, original documents, and database by inserting them directly into document;
- use of data that was contained in traditional documents;
- verification of content and form of form;
- automatic validation of numerical values of document;
- use of grant-application register to complete contract value;
- verification and improvement of forms by authorized persons;
- exchange of information between users involved in creation of target document – consultation, escalation, and delegation of document;
- approved document and made it effective;
- storage of data in register dedicated to each application/agreement, with possibility of viewing it at each level of document processing (which was also determined by rights of given user);
- access to register for each document, where it was possible to see status of document (which made it possible to keep track of it);
- automatic updating of register data when each task was approved by user, allowing him/her to access most-recent data;
- record was kept of all actions performed during task process by users with appropriate rights – archived in graphical and textual history of process and specific task;
- recording in system on task form of scans of original documents produced in traditional form and their recording in document repository, which allowed direct access to original documents for authorized users.

The Aurea Low-code system enabled incoming documents to be recorded, reviewed, and approved. In addition, users who were working with electronic versions of documents had the ability to delegate, escalate, comment on, and view documents. Each document that was registered in the system was recorded on a dedicated register where the user could track the statuses of documents. The system allowed document templates to be added to the business processes so that the documentation could be generated automatically. In all of the implemented processes, complex validations were implemented, which allowed for checking the numerical values that were contained in the forms as well as calculating them automatically.

The implementation of the business-process-management system was aimed at optimizing the handling of the applications, the managing of their workflow, the controlling of the flow, and the use of data from existing databases in order to complete the necessary parts of the documents.

The user-rights module allowed one to easily control their access to the described system components and documents. Each user working in the Aurea Low-code system was assigned their own level of rights depending on their position in

the organization or their level of competence. Each role to which the users were assigned had specific rights that were different from the other roles. The roles that were responsible for initiating, reviewing, and approving the document-creation process were clearly distinguished in the system. In addition, the business process had a four-eyes rule so that the user who entered the data could not verify and approve it.

In the Aurea Low-code system, the process was described by using roles; it was only during the implementation phase that the physical users were assigned to specific roles. Several users could be assigned to a particular role. In the Aurea Low-code system, contractors were described by their roles, and the administrator was responsible for assigning specific people to the roles. This organization facilitated escalation, delegation, consultation, and setting up replacements. The assignments of individuals to specific roles was done during the implementation phase. By using roles rather than physical users in the business description of the process, any changes that affected specific individuals were made without disrupting the process.

There were several arguments for this:

– business case for process used breakdown of contractors by task, not by individual;
– no position was filled indefinitely, and project should have had sustainability features (so that project did not need to be changed with each change of personnel);
– roles could be filled by more than one person and vice versa – one person could fill more than one role.

Users that were assigned to a particular group automatically inherited the permissions that the group contained, so there was no need to define them for each user. The rights for a particular group were assigned by the administrator. The system had several utility functions, such as the following:

– document-database management;
– information retrieval;
– input and creation of documents;
– control;
– transmission of documents;
– system administration.

4. RESULTS

The implementation of a set of business processes in the Polish public institution enabled the automation of document and reported the handling and the development of the verification algorithms (which reduced the decision-making times and improved communications between the process participants). As a result of the implementation, the costs that were associated with paper handling and the archiving of documents were reduced, and the standards of the document processing were raised; it also facilitated communications with customers, thus eliminating any gaps in the company's documents and its internal and external correspondences.

The implementation of the system that was based on processes that were execut-ed in BPMN notation reduced routine and unnecessary formal operations in favor of increased automation. At the same time, users were given the opportunity to manage processes electronically, which allowed them to work remotely, thus facilitating the management and implementations of projects and increasing the efficiency of the work organization. The system that was implemented in the public institution made it possible to describe each document and show the path from its creation to its final entry in the register. The analysis that was carried out in the organization showed that several roles with different levels of competence were responsible for the creation of given documents in the institution. The assignment of roles to tasks and their re-sponsibilities was defined in the business-process model, which was then implemented in the Aurea Low-code system.

The use of the Aurea Low-code system to process electronic versions of applica-tions and contracts and to record them in special registers made it possible to analyze the processed documents and keep statistics on their processing. The system made it possible to generate various types of graphs to illustrate the data that was collect-ed considering the parameters that were set. The most frequently used items were graphs that showed the number of applications according to their statuses. The im-plementation of the system reduced the time that was taken to process applications, thus enabling the organization to process 5000 applications per month (as compared to 3000 previously).

5. THEORETICAL, PRACTICAL, AND SOCIAL IMPLICATIONS

The actions that are taken by individual user groups in executing business processes directly affect their related components and processes. Mutual communication, as part of the tasks performed, allows for the synchronization of work among depart-ments, continuous reporting on the progress of tasks, accelerated information flow, and improvements in the quality of service to beneficiaries. For managers, the system provides excellent access to management data and the ability to set key performance indicators as well as effective reporting to support management activities. Since the implementation of the system, searching for documents became much easier and fast-er, as it was no longer necessary to search for paper versions.

6. SUMMARY

The achievement of the implementation goal was possible thanks to the active in-volvement of the users in the planning phase, which made it possible to take the specifics of the industry and the requirements of the Polish public institution into account. It is worth noting that the planning of the implementation goals and the definition of the functional scope were the basis of every project and were steps that could not be omitted due to the flexibility of the implementation and the possibility of adapting the system.

Following the implementation of the business-process-management system, the following benefits were noted:

– better protection of document databases;
– more-efficient management of document access;
– tracking history of document flows and generating reports;
– efficient archiving of documents;
– standardization of document templates by using single predefined template;
– parallel creation of documents by single user for different organizations;
– automation and optimization of produced documents;
– consistency and uniformity of produced documents;
– use of validations that kept eye on user in action;
– faster use of more information, thus reducing document circulation times;
– increased security and reliability of produced documents;
– minimization of problems and document-circulation paths;
– ability to share documentation for individual users and groups to which they belonged;
– reduced volume of applications submitted while retaining necessary content, thus resulting in improved readability of applications;
– provision of single source of information and knowledge for data that was contained in claims and reports;
– acceleration of flow of information and improved quality of service to stakeholders;
– effective modeling and documentation of business processes;
– facilitation of training and onboarding of new employees;
– instant access to management information;
– reductions of decision-making times and improved communication between process participants by automating document handling;
– fast data-access and modification according to defined permissions.

At present, the system lacks a module for managing the components of funding (funding rates and their dependencies). It is planned to build such a module in the future after a detailed analysis.

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