INFORMATION SYSTEM FOR OPERATIONS IN AN AVIATION COMPANY

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Abstract. The work deals with the design and implementation of an information system for the needs of an aviation company based on its requirements as an integral part of its digitization process. In the first part, the authors examine the current trends, but also the development possibilities, of these systems in areas using computerized collection, processing, storage, distribution, as well as display of information for the needs of personnel in an organization operating in the air transport sector. In the second part, the authors discuss the design and implementation of an information system for a company involved in the air transport process. They are based on predefined requirements of the organization. The result is functional online customizable software based on web technologies in accordance with the functional as well as non-functional requirements of the organization, usable not only in air transport.

Keywords: Transportation; Aviation; Technology; Computer System; Software

1. INTRODUCTION

Business information systems were created in order to reduce the time burden in administrative activities, to obtain required data faster or to increase the clarity of documentation [1]. In some cases, the selection, topicality, performance, reliability and at the same time the functionality of the used information system can play a key decisive role in the competitiveness, profitability or efficiency of the company [1,2]. The demand for information systems has been increasing in the last decade also due to the entry into force of the legislation - Act no. 177/2018 Coll. on some measures to reduce the administrative burden by using public administration information systems and on the amendment of some laws (law against bureaucracy) as amended [3]. An appropriately chosen information system can help decision-makers determine the overall efficiency of observed objects and facilities. In aviation, these systems help ensure compliance with strict regulations, manage complex assembly processes and maintain a high level of quality control. They monitor the movement of parts, control work orders for assembly, e.g. aircraft, monitor compliance with industry standards and facilitate documentation of test and inspection processes. The production information system often encounters the merging of its functioning with the SCADA system [6], ERP [4] or CRM [5]. Within the framework of innovative trends and innovations, today the implementation of cloud connectivity of modern production information systems is the backbone that enables the global interaction of systems, devices and users involved in this activity. The use of artificial intelligence is also coming to the fore to predict development, reducing the workload of administrative workers and simultaneously increasing the efficiency of production. All these advanced technologies and capabilities make it easier for companies to compete in the digital world [7][8][9]. Research related to productivity and performance for multi-robot systems in aviation production was also devoted to the issue of information systems in the field of air transport [10]. However, an important point is the direction and future of such systems. This brings with it the upcoming topic of next-generation manufacturing information systems. In essence, it is a vision when manufacturing companies strive to acquire a high level of digital capabilities. Industrialized countries are expected to join the drive to strengthen the economy by leveraging manufacturing competitiveness through advanced manufacturing operations. Automation product innovations will play a key role [11]. Enterprises of the future should effectively use real-time manufacturing data to meet

customer needs. The main idea is their integration into digital production and its simultaneous simulation in real time. A change in the service-oriented structure and the decentralization of the database system of consistent data should also be present [12, 17]. In this context, many companies are trying to meet the requirements of future digital factories by investing in advanced software to efficiently manage production using available data. The literature suggests that companies that invest more in technology-based initiatives may achieve higher competitiveness in future volatile markets [13]. Currently, the main appeal is the security of such systems, as it turns out that security is the weakest link. The transition from proprietary technologies to more standardized and open solutions, together with the increased number of connections between systems and the Internet, have made them more vulnerable to certain types of network attacks that are relatively common in computer security [6]. However, ensuring the security of these systems is extremely important due to the potentially serious consequences of cyber attacks on industrial equipment [6]. These attacks lead to complete or partial shutdown of critical equipment, financial losses, data leaks, and potential health risks [14,15].

2. INFORMATION SYSTEMS FOR ENTERPRISES

The most important part of every business computer system are data and their processing [5]. They form the decisive basis for the valid application of such a system. The need for reliable data is not a new concept. It's about finding the right tools and understanding how to use them to meet your needs. An organization may have all the tools at its disposal, but if they are applied incorrectly, they are essentially worthless. As part of our research, we decided to assess several software solutions that have certain common features, but each of them has a specific scope. All these software solutions are bound by Slovak legislation. We subjected each of the systems to an assessment according to selected criteria such as the user's point of view (overall impressions of the system), functionality (fulfillment of requirements in the area of scope), sustainability (maintenance, support, personalizability, extensibility), interface (communication with external IT systems), business and legal aspects (licensing and legislation in the given states).

2.1. Anasoft EMANS

Smart Industry EMANS, a division of ANASOFT, is dedicated to digital transformation, development and implementation of automation and process optimization solutions. This company provides EMANS software in three main areas: a warehouse management system, under the name WMS (Warehouse Management System), a production information system and a system for optimizing and monitoring the state of production OEE (Overall Equipment Effectiveness). It focuses mainly on conglomerates. The positive references of these softwares point to good possibilities of use and application both on the Slovak market and on the foreign market. However, in some cases, especially for small enterprises with up to 30 employees, such an extensive system can seem oversized. In such cases, it is important from a long-term perspective to consider in advance the financial point of view, whether the measure (buying software) does not needlessly exceed the capabilities and/or assets of the company that it is supposed to protect, make more efficient, increase, etc.

2.2. ISPadmin

The company NET service solution, s.r.o. offers a modular administrative and information system under the name ISPadmin. The basic module contains elements of the ERP system, i.e. options for managing client data. Statistical tools for creating internal or official reports are also provided. The API interface allows the ISPadmin system to be integrated into the company's system hierarchy, either as the main superior system or as a subordinate system [16]. Other options of the ISPadmin system include activities related to invoicing and planning, which enables the addition of new tasks to the service plan and the central warehouse module designed for a detailed overview of the movement of the provided goods. Based on our experience, ISPadmin can be considered user-friendly and functionally rich enough for full use by small and medium-sized businesses. The advantage over the competition is the active

function of interpreting the stored data using system variables in the form of batch or mass generation of electronic documents with the possibility of electronic signature by both the organization and the client.

2.3. ABRA

The ABRA information system is divided into ABRA Gen and ABRA Flexi. ABRA Gen represents an ERP system that has the task of covering the entire company area and extends from CRM to production and service. It includes activities related to management, CRM, purchasing, warehouse, production, sales, service provision, accounting, HR and reporting. ABRA Flexi is aimed at smaller businesses that facilitate and automate routine processes, especially in the management of business contacts, warehouse management, business processes, property and finance management. The intuitiveness of some modules for the computer version of the ABRA solution is not exactly the strongest point of these software. However, mobile applications are clear, but often offer only limited functions. The overall services offered by the software are fully sufficient to cover almost all main as well as supporting processes of the company operating in this sphere. A big advantage over the competition is the automatic display of current data in the form of graphs.

2.4. GX Solutions

GX Solutions offers a set of complex tools to evaluate such measurable aspects managed in the company, which are related to the field of municipal services, transport and forwarding, construction, forestry, agriculture, vehicle tracking or industrial production. Thanks to this, we can talk about sophisticated electronic data collection. These tools specifically use digital data collection using telemetry units, sensors, as well as sensors and other digital components to transmit data. The software solution is built on the idea of processing and accessing data in real time in cooperation with cloud technology and an API interface. As part of transport, there are solutions available for the evaluation of operations during the transport of goods and people. Vehicle, bus and train monitoring provides detailed information about transportation, including fuel control. The system from GX Solutions provides reports for several levels of the company: dispatching, economy, operation and maintenance, freight forwarding, but also business. It also supports compliance with legislation by individual carriers. It follows that practical application to the aviation sector is not completely impossible, but very limited. However, it would be possible to cover some uniform operational activities from transport as well as other departments. The GX Solutions system is not yet linked or adapted to communicate with another system. Its integration into the hierarchy of the company's unified system is therefore not possible.

2.5. Discussion

Thanks to the provided results, companies obtain information, estimate and model situations, plan and make strategic and investment decisions. Due to the constant development and large number of software solutions of this company, we have listed only some projects related to our work, focusing on the field of transport. Available modern information systems in the form of software solutions are often a unique tool adapted for given processes or entire companies. The basic element connecting all such system or software is any help (facilitation, transparency, acceleration, etc.) with the work of its users. Table 1 shows a summary comparison of the systems. Each of the listed and at the same time evaluated computer information systems could be used within air transport, but at a different level of integration. Individual software solutions are either very single-purpose for our needs or too complex. For this reason, it was not possible to choose one specific tool sufficient for the needs of an organization operating in the air transport sector. Therefore, based on the assessment of the requirements for the information system and the company in the air transport process, we came to a solution to develop a specific information system directly for the given organization with the possibility of its further expansion according to the need and requirements for its functionality. In addition to the technical parameters, we evaluated the individual parts of the systems in relation to the legislation, which must

be followed and complied with. Based on market research, we therefore decided to develop from the concept of a modular information system established for management support. Finances are an important consideration for the organization when choosing any system where costs are highly considered. That is why we used supporting technologies with Open Source licenses of individual system elements during the development as much as possible. The possibility to unify the communication of specific industry systems can contribute to reducing the time required to obtain aggregated data. We want to fulfill this idea of a unified information system with our developed software solution.

Table 1 Final Comparison of Systems

	Anasoft	ISPadmin	ABRA	GX Solutions
User view	4.5 ★★★★★	4.5 ★★★★★	3.5 ★★★★☆	3.5 ★★★★☆
Functionality	4.5 ★★★★★	4.5 ★★★★★	3.5 ★★★★☆	4.5 ★★★★★
Sustainability	4.5 ★★★★★	4.5 ★★★★★	4.0 ★★★★☆	4.5 ★★★★★
Interface	3.0 ★★★☆☆	4.5 ★★★★★	4.5 ★★★★★	0 ☆☆☆☆☆
Commercial and Legal Aspects	4.5 ★★★★★	4.5 ★★★★★	4.5 ★★★★★	4.5 ★★★★★

3. DESIGN AND IMPLEMENTATION OF THE MASTER INFORMATION SYSTEM

We are considering an organization operating in the field of air transport, which participates with several components within the defined areas of the airport. It also performs management activities of the parties involved in the air transport process. These actions may also include activities associated with, for example, the operator of parking spaces in the perimeter of the airport, cleaning service, internet service provider, premises tenants, but also other various entities. The organization also received the following requests for individual points:

1. Register certificates and documents of employees.
2. Digitally manage, record and plan the work of the cleaning and service department. Electronic form, adding files, possibility to report a malfunction to a technician.
3. Automate the transfer of digital data between the economic, business and marketing departments.
4. Digitize the method of issuing entry documents.

We assessed all the conditions for the digitalization of processes and activities individually and adapted them according to the company's requirements. We will conceptualize the individual activities that we have been given the task of treating into modules. As part of the functional segmentation of the implemented information system, we will take into account the practical division of individual modules, information flows and security so that the individual modules of our system are divided according to the level of employees and the structure of the organization. Our efforts will be directed so that our system can be deployed at every level. From executives at the lowest level through administration, first-level, middle and top management.

3.1. The system's modular architecture

The MASTER system consists of functional modules where each of them fulfills its specific role. Figure 1 shows the connection of the company's hierarchy to the modules implemented in the system. When designing the system, we also took into account the levels of management (primary, middle and senior), as we believe that security and controlled access to the given sections is important.
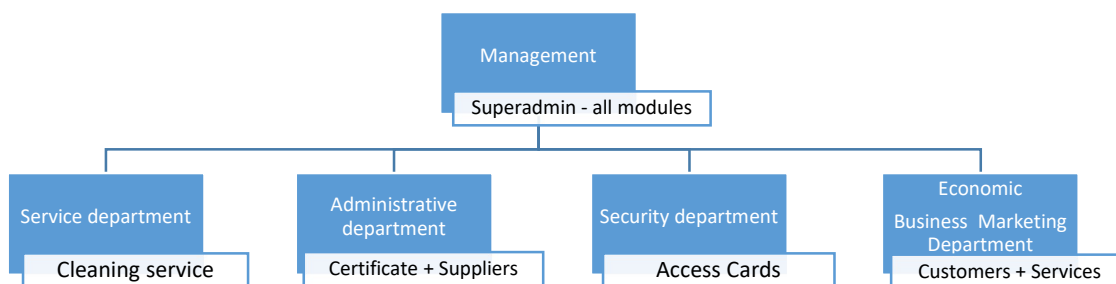
Figure 1 Linkage of company hierarchy to MASTER system modules

3.2. Records of vouchers and employee documents - Certificates module

Certificates are recorded directly in the MASTER system. The input for this module is detailed electronic data for the documents in question. The output is a record of documents, email notifications and at the same time a basis for activities connected with the possibility of certification of the organization according to ISO 9001. The user fills out a form when inserting a new record of the certificate record. After entering the mandatory fields, the record will be entered into the system. It will be possible to insert attachments in PDF, docx, png, etc. format to the given records. Part of the system, its supplement regarding the registration of certificates, also includes active email notifications. The system will send these e-mails with basic data about the approaching end of the validity of the record automatically to the selected addresses entered in the relevant record. The day of dispatch is set/entered by the user as needed when creating the entry.

☐	ID ↓	Name	ID systém XY	ID ISPadmin	Rámcová zmluva	Nový	Vloženie do systému XY	Aktívny
☐	991117	Ryanair	14	780	222111	✓	✗	✓
☐	991115	Fusakle	185	36	333111	✓	✗	✓
☐	41948	Združenie používateľov Slovenskej akademickej dátovej siete SANET		850	151617	✗	✓	✓
☑	6488	Fajne s.r.o.	146	475	000111	✗	✗	✓

Figure 2 Records of client data synchronized between systems

3.3. Module for business section - Suppliers

It is a module for registration and quick allocation of telephone contact to persons and companies that provide services and/or products to the organization. This is a solution that can be used, for example, in cases of malfunction. In some cases, we need to know as soon as possible who the company should contact for supply matters.

Figure 3 Listing of the business section record– suppliers

In large organizations where tens to hundreds of supply companies are involved, it is sometimes physiologically difficult to remember who and what service or product is being supplied to us. This raises the question: Who should be contacted in case of need? Searching for such information in paper

contracts or purchase orders is time-consuming and inefficient. The solution is therefore a simple and clear tabular statement from which these data are immediately available.

3.4. Cleaning service module

For the service section, we propose an electronic form that is filled out by a cleaning service worker. In general, at regular intervals, the worker performs the maintenance of social facilities (toilets, showers or changing rooms) at the airport. Therefore, it is necessary to ensure the assignment and record of assigned work and service operations, e-mail notifications, but also the planning of repairs.

Figure 4 Listing of cleaning service module records

3.5. Digital data transfer module from external systems

As part of the organization's request to automate the transfer of digital data between the economic, commercial and marketing departments, we designed an application program interface for obtaining data from the ISPadmin system and Pohoda economic software. The outputs are e-mail reports about new items from external systems and at the same time entering data into other subsystems. Therefore, the data that traders register in the ISPadmin system for its advantages from the point of view of the CRM system will be entered into our system only in order to inform the marketing department based on the data obtained. They can further make more informed decisions based on clients and their services. In the case of new data in the system, ISPadmin writes this data into our database, automatically marking it with the "new" flag. The number of new records separately for customers and services will be listed in the information e-mail for the selected persons and their corresponding e-mail addresses. We have chosen this general information (number of new services and/or clients) due to increased security and GDPR protection. Persons from other departments, on the basis of this e-mail and more detailed information in the system, can continue to perform activities such as issuing advance invoices, creating payment schedules for customers, changing the marketing strategy, and the like.

3.6. The module for recording permits to enter the building – Access Cards

The module called Access Cards is a practical application for the 4th request of the organization - to digitize the method of issuing entry documents. It contains an entry form for entering a record of permission to enter the facility, which consists of five parts: information about the user of the card, validity of the permit, choice of object and sector, purpose of entry, total number of persons for the given entry/permit, expiration date of the permit, entry issued keys and cards and tabular list of granted permissions. It will be possible to automatically insert data from individual records into the organization template and generate documents for printing using system variables. The resulting generated documents will be in docx and/or xml format.

3.7. Database Architecture

As part of the database management system, it is a method that defines data and enables safe handling of this data. It ensures their protection and processing. It is thus structured data stored in the computer's memory, to which the user can access on the basis of the SQL language. In our case, it will be an object-

relational database system PostreSQL. Within our database and its respective tables, there are several logical relationships, which are visualized in the following entity-relational diagram showing the database for the cleaning service module.
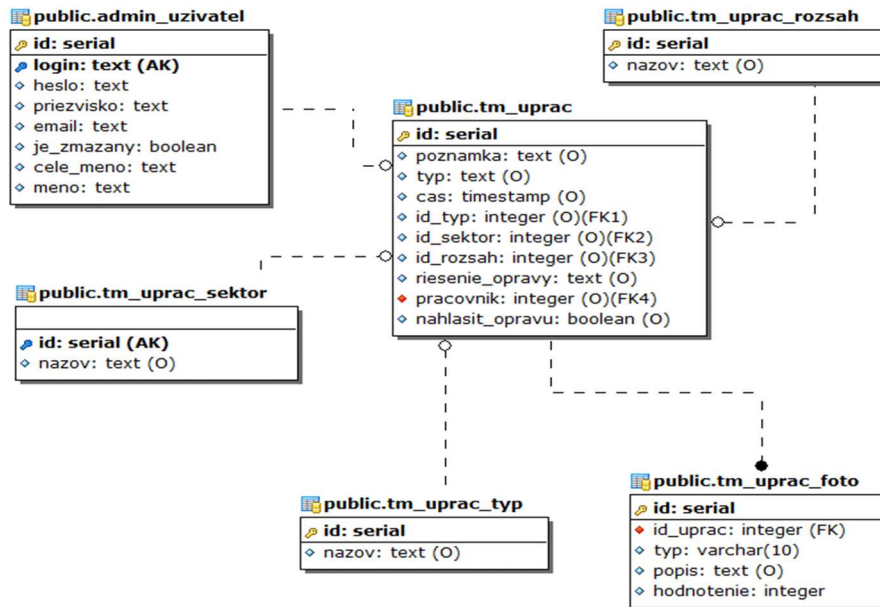

Figure 5 Entity-relational diagram for the cleaning service module

4. CONCLUSION

As part of the overall feedback, we would welcome the completion of a short satisfaction questionnaire constructed by us as a response to our software from the customer. The request to fill it out will be sent by e-mail at the time when our software will have been implemented, installed and correctly started in the given organization for a period of three months. With this feedback, we try to get a little closer to the customers and find out their satisfaction/dissatisfaction, but also get any suggestions for improvement from them.

In this work, we compared and evaluated individual software solutions in the concept of computer information systems based on predefined criteria. It was software already available on the market to support the management and control of an organization in air transport. We chose the selected aspects mentioned in the chapter as a matter of priority with regard to functionality, sustainability, interface, but also business and just aspects of the system linked to Slovak legislation from the point of view of the common user but also from the developer's point of view. After testing them and the resulting comparison, we came to the conclusion that there is currently no versatile software on the market that could effectively and completely manage all the required processes of this segment compared to the established requirements. However, each of the listed and at the same time evaluated computer information systems could be used within air transport, but at a different level of integration. Individual software solutions are either very single-purpose for our needs or too complex. Based on market research, we therefore decided to develop from the concept of a modular information system established to support management. Compared to similar solutions, our solution represents a unique and successful connection between the influence of global events, organizational and legislative requirements, technical possibilities and environmental protection. Our system provides a technical solution to a frequent and required goal of organizations, namely increasing the level of computerization and digitization. Among other advantages, we can include the reduction of the company's paper waste generation, as the system contributes to this in the form of electronic customizable sheets, forms or other various electronic documents with the aim of replacing physical copies.

In the resulting implementation of the system, we offered the organization a total of eight main modules covering a really wide range of work from cleaning service, records of entrances to the building, network monitoring, records of certificates used to meet the conditions of ISO 9001:2016 certification to commercial, financial, invoicing and marketing. linked processes. The certificates module is a unique solution, the benefits of which have been appreciated even by experienced auditors. Thanks to the use of modern Internet technologies and online access to the system interface, we have reduced the time needed to obtain aggregated data for the end user several times. We think in order of tens of minutes compared to the situation when the user has to search and at the same time obtain the required data in several separate systems at the same time. All this with precise management of user access to information according to system rights.

5. LITERATURE LIST

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