D.4.2.4. INTEGRATED TICKETING SYSTEM IN CROATIA

Technical description of necessary changes for establishing future sales system, considering good practices in the EU Market

WP 4 - Intermodal Seamless solutions
Act. 4.2 - ICARUS cross border development

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Table of Contents

List of abbreviations and terms

BI	Business Intelligence
CMS	Content Management System
CRM	Customer Relationship Management
DWH	Data Warehouse
EAM	Enterprise Architecture Management
EPA	Elektronische Platzreservierungs Anlage
ESB	Enterprise Service Bus
HHT	Hand-held terminal / mobile terminal
HŽPP	Hrvatske željeznice - Putnički prijevoz
ISPRO	Integral Sales System of HŽPP
IT	Information Technology
MERITS	Multiple East-West Railways Integrated Timetable Storage
OLAP	On-Line Analytical Processing: synonym “Business Intelligence” - analytical reporting and business intelligence systems
PI	Process Integration
PRIFIS	Price and Fare Information Storage
ROMAN	Route and Track Management system
TSI	Telematic Specification for Interoperability (EU law)
TVM	Ticket Vending Machine

1 Introduction

Goal of the project

The goal of this project is to create good (technical) basis for establishing an advanced sales system which will:

- attract larger number of users to rail transport
- (Based on its functionalities) promote modern and eco-conscious concepts (e.g. Maas*), with primary focus on passenger and bicycle tickets integration

*MaaS (engl. Mobility as a Service) – the concept of providing a wide range of intermodal transport services (public or private) through digital platforms that integrate all steps of the door-to-door journey - route planning, seat reservations, tickets and reservations payment and issuance etc.

Project background

The modern and fast-paced way of life has turned the increased mobility not only into a necessity, but into a lifestyle as well. Due to a lack of transport services integration, poor collaboration among transport providers and a lack of information integration, car transport still accounts for 80 % of land transport in EU with tendency of this share to increase furthermore. Unfortunately, this leads to EU members confronting repercussions such as traffic congestions, accidents, and environmental pollution.

HŽ Putnički prijevoz d.o.o. (hereinafter: HŽPP) is the only provider of public passenger transport services by rail in the Republic of Croatia and is, therefore, required to continuously upgrade sustainable business processes. Thus, HŽPP recognized a need to join interregional project ICARUS (Intermodal Connections in Adriatic-Ionian Region to Upgrowth Seamless solutions for passengers1[1]), whose goal is to improve quality, safety and ecological sustainability of maritime and land transport services, as well as transport hubs, by promoting multimodality in the program area (Adriatic-Ionian region).

This goal will be achieved by introducing solutions based on innovative digital and smart technologies, which will enable and promote MaaS concept and therefore activate positive change in passengers' behaviour in terms of transitioning from their own (environmentally harmful) transporting means towards environmentally friendly ones.

[1] Interreg V A Italy Croatia Cross-border Cooperation Programme 2014-2020

There are 10 ICARUS project participants from two countries (Croatian and Italy). ICARUS project consists of eight (8) pilot projects. Project *Preparation and delivery of technical description of changes needed for establishing a future sales system* is a pilot project no. 3.

In addition to the aforementioned, HŽPP focuses on passenger satisfaction, quality of the service provided, and motivation and professional growth of employees. Thus, HŽPP needs to design a modern, operational, fast, and accessible sales system that will, in addition to sales functionalities, provide users a service based on complete, timely, and easily accessible information when deciding to travel by train, thus making the ticket purchasing process more efficient and resulting in increased customer satisfaction and, subsequently, recurrent use of the service.

Document structure and content

This document is a final project deliverable, realizing the project goal. Alongside the *Introduction*, *Executive summary*, and *Appendix* sections, the four central chapters (3 to 7), detail the following:

- current sales system solution - Integral Sales System (ISPRO) of HŽPP
- identified shortcomings of ISPRO
- analysis of good practices employed by EU suppliers of advanced sales systems and EU public railway passenger transport operators
- suggested changes needed for establishing a future sales system of HŽPP.

2 Summary

ISPRO of HŽPP is a set of tangible (hardware) and intangible (software) internal and external informational-communicational components which enables the execution of key business sales processes.

According to the functional specification of the software, ISPRO can be divided into four main parts (Figure 1):

- sales channels
- backoffice tariff and device maintenance
- integration to external systems
- revenue and reports.

Business sales processes can be divided into four groups of processes:

- ticket and reservation sales (in domestic and international transport)
- sales management (i.e. management and modelling of tariffs and special offers, customer/passenger relationship management, and domestic and foreign partners relationship management)
- system management (i.e. sales channel management, master data management, internal and external resource management (including the management of paper supplies) and system administration)
- report preparation (for the purpose of controlling, analyzing, and planning sales).

Based on the identified good practice, a comprehensive set of technical and organizational changes was suggested that HŽPP should implement to secure the successful establishment ofa future sales system. The summary of key changes is provided below:

- Transition from monolithic to modular/microservice architecture, with top priority microservices
- The purchase of new HHT devices
- Design of a new smartphone application for ticket and reservations sales
- Improvement of the business rules/processes
- Setting up the process of monitoring the system maintenance and upgrades.

3 Description of the system according to the functional specification

ISPRO of HŽ Putnički prijevoz is a set of tangible (hardware) and intangible (software) internal and external informational-communicational components which enables the implementation of key business sales processes.

Implementation of ISPRO system was realized (in 2014) by the company KING ICT d.o.o., in collaboration with companies Scheidt & Bachmann GmbH from Germany and Četrta pot d.o.o. from Slovenia. Company KING ICT d.o.o. was responsible for maintaining the system.

Graphical representation of ISPRO from the functional specification is shown in the following figure.

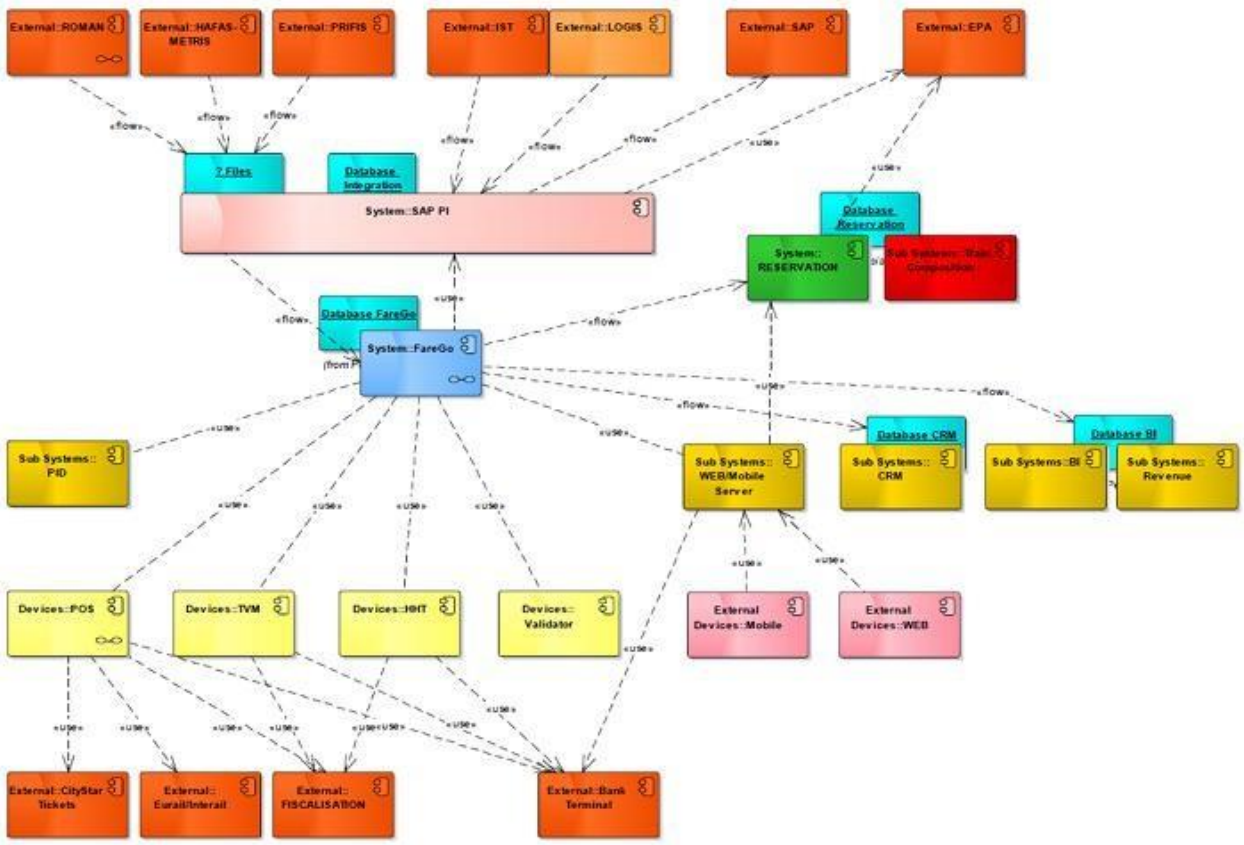

Figure 1 ISPRO system

Source: The functional specification of ISPRO (authors: Scheidt & Bachmann, KING ICT, Četrta pot, HŽPP)

According to the functional specification of the software, ISPRO can be divided into four main parts:

- sales channels
- backoffice tariff and device maintenance
- integration to external systems
- revenue and reports.

The following image presents the division of ISPRO into four main parts:

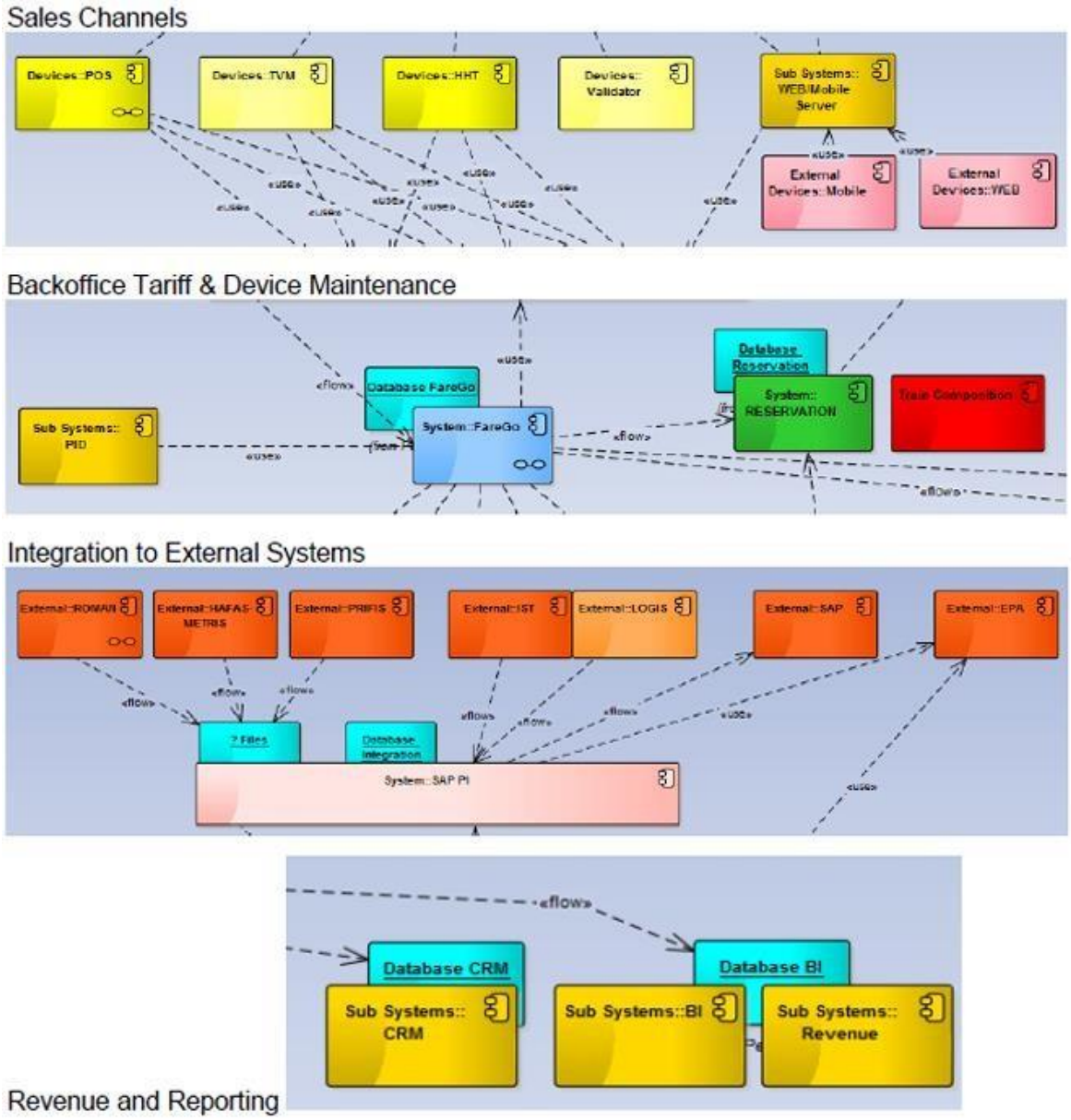

Figure 2 Specification of ISPRO

Source: The functional specification of ISPRO (authors: Scheidt & Bachmann, KING ICT, Četrta pot, HŽPP)

4 Analysis of good practices on the EU market

The aim of this chapter is to provide a concise and consolidated overview of good practices on the EU market. Good practices on the EU market were identified by an analysis of the sales system of three EU suppliers and three railway operators. All technical and non-technical statements in this Chapter were based on data and information presented by suppliers and operators during their presentations and from the materials they provided.

4.1 Business processes supported by analyzed sales systems

Business processes supported by modern sales systems are the following:

- Ticket sales for domestic and international transport (with cash, credit card and smart card payment options), including: IRT and NRT tickets, individual and group tickets, vehicle tickets (e.g. bicycle tickets), intermodal and multimodal transport tickets, disabled/reduced mobility tickets/passes, global and regional transport tickets/passes (e.g. Interrail, Eurail, City Star, etc.)
- Domestic and international transport reservations
- Sale of additional services:
    - on the train: e.g. luggage, Wi-Fi, food, drinks, etc.
    - at destination: e.g. taxi transport, overnight stay in hotel facilities, car rental (rent-a-car), etc.
- Sales of previously mentioned tickets, reservations, and services via sales channels compatible with the system, such as: POS registers, Ticket Vending Machines, mobile terminals (HHT/on-board devices), Web sales (through websites and smartphone apps) and sales by agents / sales partners
- Tariffs and special offers modelling (including relational, fixed, zonal and kilometer based tariff modelling) for tickets (including bicycle tickets) and other services on the train, for all passenger profiles and for any combination of trains and train times in domestic and international transport
- Discounts and subventions modelling (e.g. modelling based on passenger types, passenger segments and number of passengers (in the case of group trips)) for all passenger profiles and for any combination of trains and train times in domestic and international transport
- Customer relationship management, including informing passengers via e-mail, push notifications on the mobile application, SMS, on-board screens to provide real-time notifications, or any other way based on the client's request

- Management of domestic and international partners
- Sales channel management (e.g. activation of tariffs, special offers, discounts, subventions and types of tickets, reservations and services on all sales channels and individually by sales channels)
- Master data management (e.g. codification of stations, trains, etc.)
- System administration
- System resource management (e.g. management of train composition, inventory and services), including resource visualization
- Management of resources coming from external systems
- Preparation of reports required by law and regulations, operational reports, revenue control reports, business intelligence reports, passenger/user reports

Smart card use

All presented systems support a certain type of smart card use:

- smart cards as a means for identifying users, enabling the management of users' assets, although they do stress the presence of a trend of abandoning the use of smart cards since they require expensive hardware with high maintenance costs, and all smart card functionalities may be realized via smartphone applications.
- data recording and validation (e.g. ticket data) on the smart card via all sales channels with physical devices. Solution for managing virtual smart cards through a smart phone application.
- The use of smart cards as safety "tokens" used for identifying accounts/users, tickets, and other products and discounts available in the back end of platform.
- The system which supports electronic identification cards used for realizing discounts when purchasing tickets and other services.
- The system that supports the use of personalized smart cards for recording certain ticket types (e.g. tickets for integrated public transport covered).
- Smart card allowing passengers:
    - many discounts in relation to standard travel tariffs
    - bonus points collection, which can then be used for additional benefits when purchasing tickets
    - use of discounted tariffs even when travelling abroad
    - use of the travel insurance function
    - favourable parking rates
    - credit card function upgrade

Subsidies/discounts definition and processing

All suppliers' systems support defining subsidy/discount amounts and ticket processing:

- option of defining subsidy/discount amounts, and the option of creating reports by comparing the initial and subsidized ticket price (with additional data on the type of transport, passenger etc.), that may then be sent for further processing in relevant external systems.
- option of defining subsidy/discount amounts and subsidized ticket processing; however, it must be configured in line with specific business rules of individual operators.
- comprehensive module for managing concessions and discounts that allows the definition of all business rules concerning subsidies/discounts.

Ticket returns and refunds

Although the ticket returns and refunds processes constitutes primarily the operator's business decision, below please find an overview of usual practices seen with operators and system suppliers. Furthermore, we should definitely stress the fact that sales systems merely support the ticket return and refund process, thus the relevant process and all related business rules (e.g. refund terms and conditions) must be completely and clearly defined and documented in the business documentation of HŽPP.

Some of the potential refund reasons are the following:

- operator's business error
- operator's strike
- train cancellation within a certain period (e.g. one or more days) or in a given route
- passenger withdrawal.

Standard types of refund are the following:

- full refund or partial refund
- creating and storing digital financial funds in a digital wallet located in the user account for later use
- creating and sending vouchers (for the same type of ticket).

The refund option, type, and amount depend on many parameters, such as:

- time of delay
- user's loyalty program status

- travel cancellation period before the first day of ticket validity (EPA)
- type of sales channels
  - E.g. on-site refunds at cash registers in the following cases: ▪ if the operators are the ticket distributor/seller
  - only for cash register and TVM sales channels
  - only up to a certain amount.
- For all other sales channels and cases that do not meet conditions, refunds are processed only in customer support centres (or refund departments, if they exist in the operator's organizational structure)

Printing travel documents and internal documents

Printing travel documents and internal documents with one joint printer or several separate printers is the exclusive business decision of the operator.

Examples of business decisions are as follows:

- print travel documents (for domestic and international transport) and internal business documents using separate printers:
  - travel documents are printed using special printers and each travel document is printed on a separate sheet.
  - internal documents, such as the daily cash register settlement, list of sleeping carriage reservations, ticket agents' work guidelines etc. are printed using standard A4 laser printers.
- use separate printers.

System administration

The administration supporting the above-mentioned processes usually requires up to 6 workers who are exclusively engaged in system administration (focusing on tariff modelling and tariff activation processes across all sales channels or individual sales channels, and commercial inventory and ticketing, reservations and train services management processes).
The level of (technical) competencies required for the administration of the analyzed systems is low and does not require knowledge of programming, other than in case whose administration (primarily referring to the change of business rules such as tariff modelling) requires basic programming skills.

4.2 Architecture of analyzed sales systems

Analyzed sales systems predominantly comprise modules presented in the following table. Modules have been divided into two groups:

- modules made available by suppliers of sales systems in the transport sector
- modules made available by suppliers of other IT solutions

Table 1 Modern sales system module
Source: Deloitte (based on data and information provided by the suppliers and operators)

Module	Modules made available by suppliers of sales systems in the transport sector	Modules made available by suppliers of other IT solutions
Ticket sales	x	
Reservations and train composition/inventory management	x	
Price modelling (tariffs, special and action offers)	x	
Planning trips and routes	x	x
Revenue management	x	x
Smart card management	x	x
Customer relationship management (CRM)	x	x
Contract management	x	x
Partner Management	x	x
Financial and regulatory reporting	x	
(Basic) operational reporting	x	
Business intelligence (with OLAP)		x
Coin and paper management		x
Application for POS registers	x	x
Application for web sales	x	x
Application for smartphones	x	x
Application for mobile terminals (HHTs)	x	x
Application for ticket vending machines (TVMs)	x	x
On-board screens to provide real-time notifications	x	x

The sales system market analysis showed that there is a sales systems trend of transition from monolithic to modular architecture. A modular approach implies a modern approach where the system is built with microservices that connect to each other via API and can be independently deployed and maintained. The disadvantage of a monolithic approach is that even small changes to one of the sub-systems entail changes to the central system, with deployment being lengthy because the change in one part of the system must be carried out concisely in all other parts.

4.3 Implementation of analyzed sales systems

The estimated duration of the project implementation of the analyzed sales systems by the supplier is:

- Up to 1 year for the implementation of functionalities related to the operation of online sales channels
- 2-3 years for the implementation of functionalities on all sales channels, including the business logic redesign (e.g. switching from distance tariffs to route, fixed and zonal tariffs) based on good practices (that can be provided by suppliers if necessary).

The system implementation includes:

- Installation of the off-the-shelf solution
- Integration and configuration of the off-the-shelf solution
- Modifications of the off-the-shelf solution according to the specific needs of the client.

All analyzed suppliers have developed their sales systems by cooperating with a particular railway operator that they also use during implementation as sources of good practices, i.e. they are also able to provide advisory support related to the redesign of business logic and business processes.

Upon completion of implementation, i.e. at the moment when the sales system enters the production environment, suppliers guarantee the compliance of the system with the relevant laws of the Republic of Croatia and the EU, international standards (UIC) and the requirements of local regulators (e.g. HAKOM in he Republic of Croatia). During production work, the task of monitoring changes in legal acts, standards and requirements of regulators is primarily on the system user, i.e. the railway operator, but, if necessary, this task and responsibilities can be transferred to the supplier of the sales system.

4.4 Hosting, monitoring and maintenance of infrastructure and software

Key terms (and corresponding explanations) related to hosting are:

- On-premise – a variant of hosting in which the entire IT infrastructure (servers, network equipment and other connected hardware) is owned by the operator and installed on a location owned by the operator (e.g. in the operator's administrative building) and therefore the owner independently takes care of the power supply, cooling and maintenance of IT infrastructure

- Colocation – a variant of hosting in which the operator owns servers and network equipment, but these are installed in the rented data center space
- Cloud – a hosting variant in which the operator does not have IT infrastructure, but the system is located on a virtual server (i.e. cloud)

Key terms (and corresponding explanations) related to system monitoring and maintenance are:

- Managed services:
  - A concept in which responsibilities for activities related to IT infrastructure and applications (e.g. care about hardware, hosting, installation of all parts of the system – from the operating system of the server itself to the installation of new versions of the software, as well as networking (availability of servers and all software over the Internet and internal network)) are transferred to the Managed services provider (e.g. sales system vendor and related equipment)
  - In the concept of Managed services it does not matter whether the supplier provides services through a colloquial computing center or through the cloud - only performance and network availability of software are essential, especially in the conditions of combined sales (POS/TVM/HHT/Smartphone/Internet) and intensive communication with external systems through various interfaces

- Software as a Service (SaaS):
  - A concept in which the responsibilities around software maintenance are left to the supplier, in a similar way as mentioned for the Managed services concept, where the basic difference is that in the SaaS concept the operator does not own the software as long as the entire software is not paid off (depending on the contract – a concept similar to classical leasing)

5 Recommendations for establishing a future sales system

There are three categories of changes to be implemented to create a basis for establishing a future sales system:

- changes to the system architecture
- changes to the system management
- business-organizational changes

5.1 Changes to the system architecture

It is essential to transition from the current monolithic to modular architecture that is based on microservices. Microservices are independent modules of systems performing a certain group of tasks or processes. They may be deployed independently, that is without stopping or restarting the entire system.

Furthermore, every (temporarily) non-functioning microservice may be turned off without affecting the operation of another microservice.

Microservice architecture is the opposite of monolithic architecture, that has a series of shortcomings:

- even small changes to the components of a monolithic system result in the changes to the central system and all other related system components, which results in a long-term deployment
- complexity of the monolithic central system based on old technology and logic will increase with every improvement and upgrade, making the operational maintenance and future improvements and upgrades require ever more time and financial resources; therefore, the system will increasingly lag behind advanced solutions, ultimately resulting in the need to replace the complete system
- vendor lock-in for system changes and upgrades, potentially resulting in:
    - suboptimal system performance (i.e. functionalities and use efficiency of system components provided by a particular supplier may vary as suppliers often specialize for certain components, and are less focused on others)
    - lower levels of price competitiveness.

Although a modular system implies several suppliers, it is not recommended to use more than three suppliers since a larger number of suppliers increases the complexity of the suppliers' services supervision process.

Based on the market analysis of suppliers and operators, and the analysis of the shortcomings of the current system, we made four key findings based on which we can assume that the most efficient method for implementing the aforementioned transformation is replacing the existing system components with new ones:

- The supplier analysis showed that there are suppliers offering developed microservice-based solutions that may support modern sales business processes, i.e. they already have the functionalities that the ISPRO could achieve only via complex adjustments.
- The existing sales system has already been adjusted and upgraded on several occasions, pointing to the fact that it might not have supported business processes in an optimal way
- The estimated complexity of adjusting the existing system is high (the system is based on the technology and programming logic that is several years old, and lacks certain key functionalities, such as managing commercial inventory and efficient tariff modelling), therefore it would be more efficient, in terms of both time and costs, to replace the existing central system with new solutions/microservices based on modern technology and logic.
- The adjustments of the existing system would not transform the system into a modular microservice system, instead the system would remain monolithic (even more complex than the current version, requiring even more resources for its maintenance, adjustments and upgrades).

5.2 Changes to the technical system management

In the technical system management domain, we suggest transitioning to Managed services, that is a concept of transferring responsibilities for IT infrastructure and applications maintenance and improvements to the Managed services provider.

In that case, some of the potential benefits for HŽPP are:

- All risks concerning system unavailability, regulatory compliance, data safety etc. would be transferred to specialists performing the relevant tasks and improving the performance thereof every day; some of the currently identified risks that may be avoided by introducing Managed services are the following:
    - The data center
    - Server operating systems

- Increasing investment predictability / maintenance
- Managed services eliminate the number of procurement units, which is suitable for entities required to conduct public procurement procedures
- Re-purposing existing maintenance resources

Furthermore, in the Managed services concept, it will no longer be relevant for HŽPP whether the supplier provides services through a colloquial computing center or cloud - only performance and network availability of software will be important.

Also, in case of transition to Managed services, operator should strengthen the ability to monitor the provision of services, i.e. officially set up and activate the process of monitoring system maintenance and system adjustments and upgrades. As detailed in the figure below, when implementing the concept of Managed services, monitoring is crucial and based on the following:

- Monitoring
- Logging
- Controlling

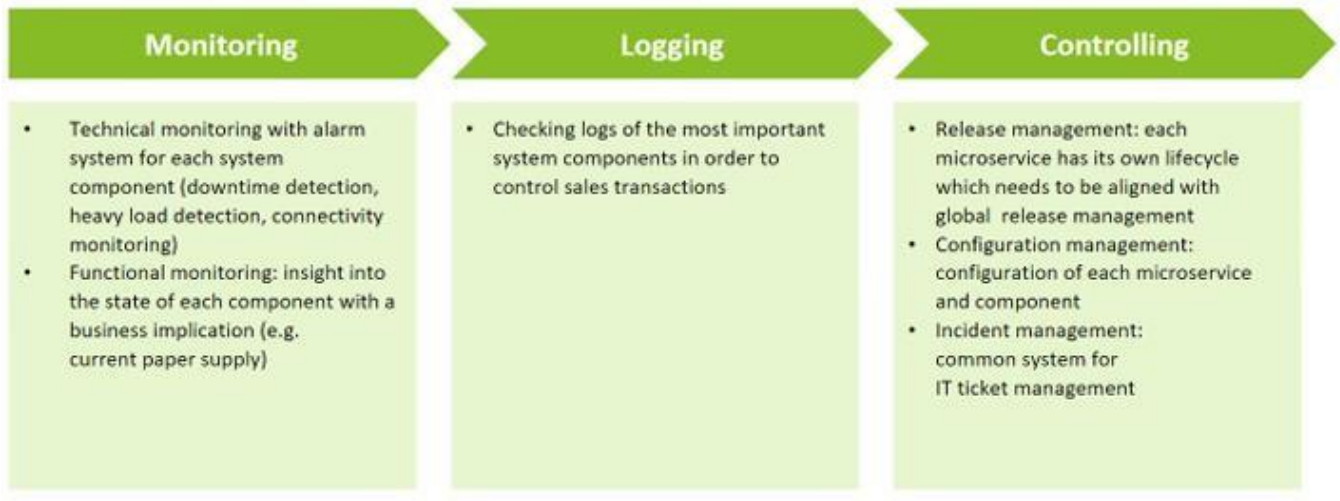

Figure 3 Monitoring operating system maintenance and implementing new functionalities
Source: Deloitte

5.3 Business-organizational changes

Key business-organizational changes that HŽPP should make to avoid risks concerning the functional (in)adequacy and (un)timeliness of the future sales system and its monitoring are the following:

- Renaming the “ICT Steering Committee” to “Steering Committee” and reforming it.
- Improving the business logic, that is:
  - improving the tariff models, in line with the guidelines of the National Recovery and Resilience Plan,
  - division of administrative system domains
  - breaking down external system resources
  - recognizing the importance of the CRM microservice*/system as a strategic tool
- Setting up the process of monitoring the system maintenance and adjustments/improvements.

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