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BUSINESS PROCESSES SUPPORT AND AUTOMATIZATION SYSTEMS IN EDUCATIONAL INSTITUTIONS

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Summary

Digital transformation of public education encompasses various usage implementation options and possibilities of Information and Communication technologies. While ICT is well accepted for teaching purposes, its systematic design and application for managerial processes improvement in education institutions is slightly neglected. Our research emphasis lays on investigating how ICT can support effective planning and resource management based on effective multileveled resource tracking, managing and reporting by implementing automatic exchange formats, services and procedures. A platform for any multileveled resource management information system is the underlying data architecture that needs to be designed and developed by building common data registries as well as a unique transaction system incorporating a process approach in order to ensure interoperability on all management levels.

Introduction

This paper presents the implementation approach and basic concepts of developing a System for Support and Automation of Business Processes in Schools (SSABP), as well as an illustration of such system being built at the national level in the Republic of Croatia. By structure and functionality, business support and business process automation systems in schools combine typical ERP (Enterprise Resource Planning) functionality in relation to public registry functionality, workflow management, and object and documentation management. In addition to assisting and automating business processes, intermediary effects, such as standardization of business technology and data content, multileveled reporting and interoperability with other systems, need to be achieved when building similar systems. However, before defining the design and implementation approach, the context in which business information systems of educational institutions are developed should be identified.

Digital economy and society are looking for people with improved, but also for some with completely new skills. Educational eco-systems respond to new demands with redefined and new concepts, paradigms and methods, and many of these changes are technologically enabled or conditioned. Changes are obvious at all levels, from intra- and interpersonal micro level, to national and global policies and macro-level initiatives. Thus, the concepts of open learning, distance learning and e-learning have their counterparts in business concepts such as MOOCs, digital credentials and open badges. Information and Communication Technologies (ICT) are

the foundation for development and integration of teaching, administrative and other supporting processes. Clearly, this applies to all levels of educational institutions, as well as informal and non-formal learning. Schools face the challenges and requirements of the information society, and use ICT to make knowledge, information, and education more open and accessible.

Progress in the primary processes of acquiring knowledge and skills should be accompanied by new concepts in management and administrative processes, such as human resources, financial, asset and ICT management. According to Prokopiadou (2012) "ICT have been increasingly incorporated into school administration, in order to improve the organization of official data and to facilitate administrative transactions". Effects of ICT application in management of schools, measured through performance indicators such as time saving, availability of resources always and everywhere, cost reduction, scalability, flexibility, reduced workload, speed etc., can be achieved only through training of teachers and administrative staff. The level of ICT use in support processes is often lagging behind the level of use in teaching. Selwood (2005) states that "reasons for this relate to the lack of training, availability of time and quality of ICT resources". Spontaneous implementation of ICT and various applications are more easily implemented in teaching processes than in supporting processes, which are based on integrated databases, transactional systems, and workflow management systems. Building of business information systems requires commitment and support of school management, significant financial resources, as well as well-defined business processes. In such projects, a shortage of specialized knowledge can be offset by outsourcing, but there should be positive and supportive attitude (Potamias & Iordanidis, 2015; p.12).

For the success of complex ICT implementation projects in schools, it is necessary to measure and monitor the effects on teaching and management. In order to measure the indicators relevant to the learning and business analytics, appropriate models of educational and business processes are needed (Rodríguez, Nussbaum, & Dombrovskaia, 2012; p.13).

Further, implemented ICT in daily school work can be a strategical guidance for developing technology competencies, better exchange of information and projects with community, founder and state, implementing different plans and support for informed decision taking and problem solving. On a daily level it means leadership and mentorship easily managed through technology. Some reports show that "ICT use in school units may catalyse radical restructuring and transform administrative processes by establishing an enhanced digital infrastructure for the latter's implementation" (Vlachopoulos & Pitsiavas, 2016).

All of the abovementioned features and transformations are not only specific to educational eco-systems and organizations, but involve all areas of society and are referred to as the concept of digital transformation. Digital transformation is a comprehensive business transformation with the aim of exploiting all the advantages and opportunities of contemporary digital technologies and their impact on society, taking into account the future (i-SCOOP, 2018).

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Process, registry and transactional data in primary and secondary education institutions

In order to create a platform for a multileveled resource management information system in educational institutions the underlying data architecture had to be designed. In our research activities bounded to this project goal we strongly relied our methodology on reference models. A reference model is an abstract framework for understanding essential relationships between the concepts of a problem area as well as for the development of standards and specifications related to problem domain (Reference model, Wikipedia). It is based on a small number of concepts. It can serve for explaining and mapping related objects in the problem area. It is used to create concrete implementation models, e.g. Computer programs. Reference models contain (a) Information systems requirements, (b) Business model requirements extracted from goals, organizational architecture, business processes, data, business rules, etc. and (c) Information system Models describing its Architecture, Structure, Function, Behaviour, Communication, Interface, Deployment and other aspects. Reference Models are mainly used as a tool for Documenting and sharing knowledge on the business area, defining common terminology, overcoming complexity, embracing best practices, implementing standards, performing compliance checking, development of information system and other purposes.

Information systems requirements

Incorporating a process approach into an information system starts by building a unique set of operational requirements in order to ensure process, semantic and technical interoperability on all process management levels. A linking concept between business processes and information system procedure can be found in data objects that replicate business events into transactional data records.

Business model requirements

For developing Business model requirements our research was focusing on investigating how ICT can support effective planning and resource management in primary and secondary education institutions. Our primary goal was to identify their processes and data the processes generate or use. In order to gather all relevant data about the resource management of primary education institutions a methodology based on Mendling's BPM Life-cycle was developed (Dumas et al, 2013). In the first phase relevant business process areas were explored and modelled for a selected representative set of schools and other process participants (founders, i.e. local municipalities, Ministry of Science and Education-MoSE, etc.). Later on, the development of reference process models for each of the identified process area was performed. The existing "as is" state was modelled for those processes where it makes sense to illustrate the difference between the current and the future state of the process and the benefit of such improvement. The conceptual model of the future system ("to be") was an attachment to the specification of the new Information system. Detailed models of some representative processes were created as well as a set of procedures and services for various stakeholders (like for the area of student standard) were also developed, with the realization of one or more sub-areas (like

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subsidies and scholarships within student standard improvement). Main business areas of Primary and secondary education institution management are listed in Table 1, column one.

Information system models

The introduction of a new IT system for supporting processes recognized in the previous business requirements stage should be based on future principles of single entry of data into operational open ERP modules, automated reporting based on the common registries, technical interoperability with the existing (legacy) systems in real time, and semantic interoperability at the level of the overall education system. These operational concepts are well known in various business industries and could be mapped to a school environment. Operatively, this would mean that primary and secondary education institutions can replicate ERP modules from the business industry sector for supporting processes that are performed in a similar way in schools. Transactional data leans on data registries as well as on computer software procedures and algorithms. For distributed organizational systems like public school systems, it is essential to build a common data infrastructure in form of data registries which can ensure compliance with demands on semantical and technical interoperability. Main data objects generated or used in main business areas are listed in Table 1, column two.

Table 1: Main business areas of Primary and secondary education institution management and their main data objects

Business Area	Data objects
Teaching (Teaching scheduling)	Teacher, Subject, Student, Classroom, School calendar, Teaching schedule
Registry of students and other program participants	Student, Grade, Grade Reports
Information system Management	IS users, Authorization
Student Standard and Subsidies	Grant, Subsidy, Donator, Donation, Selection options
Library Property Management	Book, Borrowing data, Dues, Dues reports
Human Resource Management	Staff, Teacher, Staff assignments, Staff Progress, Leaves, Absences, Travel Management, Life-long education
Project management	Project, Activities, Goals, Materials resources, Funding
Property Management	Building, Classroom, Sport hall, Auditorium, Amortization, Rentals
Finance	Pay-roll data, Funding, Accounts, Budget, Receivables, Credits and Debits, Cash management
Purchase	Supplier, Item management, Purchase order, Credits and Debits, Contracting
Sale	Customer, Customer Order, Invoice, Receivables, Contracting
Warehouse operations	Item management, Purchase order, Receipt of goods, Issuance and delivery notes
Office management	School certificates, Public documents

Case study: Croatian e-schools project

The project is called "e-Schools: Establishing a System for Developing Digitally Mature Schools (pilot project)" and it is part of a wider e-schools programme which is carried out through

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several projects aimed at introducing ICT into the school system in the 2015-2022 period. The e-Schools programme consists of the pilot project, which will be implemented in the 2015-2018 period and the major project, which will be implemented in the 2019-2022 period based on the results of the pilot project. The project coordinating body is the Croatian Academic and Research Network – CARNet and partners on the project are: Agency for Vocational Education and Training and Adult Education (AVETAE), Education and Teacher Training Agency (ETTA) and Faculty of Organization and Informatics.

In digitally mature schools, the appropriate use of information and communications technologies (ICT) contributes to the following: an efficient and transparent management of the school (direct objective); the development of digitally competent teachers prepared for the application of innovations in their own pedagogical practices (direct objective) and; the development of digitally competent students, who are prepared for a continuation of their schooling and are competitive on the labour market (Indirect objective).

A subset of objectives of the e-Schools pilot project is to pilot organizational, technological and educational concepts of introducing ICT in the educational and operational processes in selected schools during two school years and to develop, based on the experience of the pilot project, a strategy for the implementation of a system of digitally mature schools in the entire primary and secondary education system in the Republic of Croatia, that is for the application in the major project (e-Schools, 2017).

Process, registry and transactional data management in Croatian primary education institutions

The goals of building a system for computer support and automation of business processes in schools (SSABP) differ from project to project. However, some goals are common to different projects, and are often related to the specificity of the activity or technology that is applied at a given time. As an illustration, specific objectives related to efficient and transparent school management defined in the case study, i.e. in the Croatian e-schools project are given:

- Enabling of effective planning and resource management at three levels: school, founder, state;
- Equalizing of business technology in areas that are common to most schools (processes, procedures, data, business rules);
- Developing of reference process models for particular types of schools;
- Enabling of effective multileveled reporting on resource usage based on standardized and automatic exchange formats, services and procedures;
- Providing of ICT support to school processes based on the use of infrastructure, platforms and applications as a service (IaaS, PaaS, SaaS).

The project takes into account the diversity of stakeholders and their interests: (a) Emphasis is on common processes, as there may be more scenarios for each process (different types or sizes of schools, etc.); (b) Specific processes are addressed by specific applications, with which the interoperability is established (e.g. library management, farm, restaurant, etc.); (c) If there are

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standard applications at the founder level, interoperability needs to be established with such applications.

The main idea behind building an effective resource management system is to establish and share a common set of registry and transactional data which is generated and used at all levels, from students, through schools and founders, to MoSE. Processes in this area require exchange of data with other legacy systems through services, which are necessary to achieve a desired level of interoperability.

Potential of a new integrated Information system was tested on several processes. One of simulated processes was dealing with creation of a report on request in a two-levelled reporting case. The figure 1 shows process model for Report generation developed as a BPMN process model using Bizagi Modeler (Bizagi, 2018).

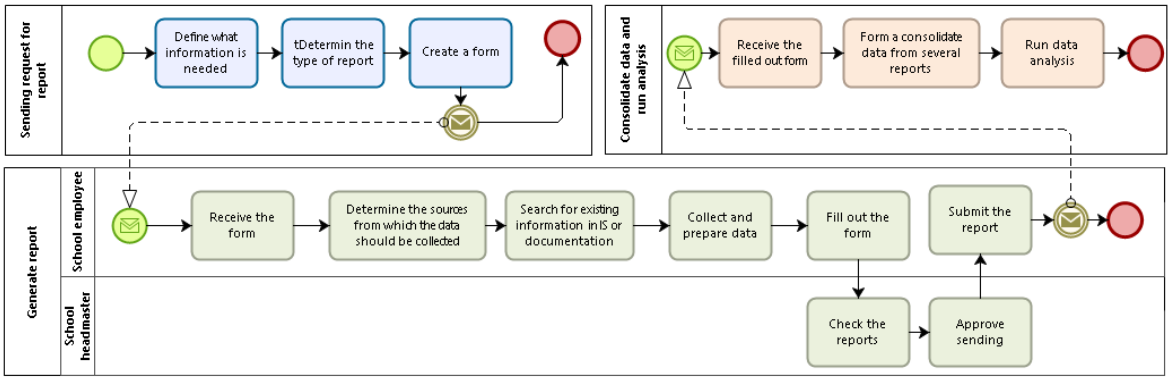

Figure 1. Process model for Report generation

Current ("As Is") architecture of ICT usage for resource management in primary education institutions is done in a way that the schools use some individually purchased applications, applications provided by the founder and some applications provided by MoSE. Reporting to the MoSE and founder is performed in very few cases somewhat automated and only in cases where available data that are semantically consolidated by the ministry and / or founder. Mostly the reporting is done by delivering data in the default format (xls or paper reports).

Table 2 shows a description of the potential savings based on a process simulation, applying conservative assumptions about resource usage for executing the process, Qualitative and quantitative indicators for improvements. Based on these process parameters future scenarios can be tested and their impact evaluated.

Table 2: Description of the process Report generation (Creating a report on request)

Description	Assumptions (conservative)	Qualitative Indicator	Quantitative Indicator
Upon receipt of the founder's request or other party (e.g. the MoSE), the school	The report requester defines what information is needed, the type of report is determined and the form to be filled out by the school is provided. (Average time spent 30 minutes)	The occurrence of interruptio ns of	Report requester: 30 min + 30 min per school = 180 min Report submitter:

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employees draw up reports based on data contained in some information subsystems or collect data from the documentation. After that, the report is delivered to the request seeker, and the seeker performs merging and analysis activities.	The submitter of the report receives the form, determines the sources from which the data should be collected, searches for existing information subsystems or documentation, prepares the data, fills out the form, the responsible person checks the reports, approves them and submits the report to the applicant / requester at the end of the report. (Average time consumption of 60 minutes) The requester receives the filled out form, forms a consolidated view for all institutions and conducts the analysis. (Average time spent 30 minutes per school)	regular work for multiple employees (and 2nd setup time) Multilevel approval of output data Errors when rewriting data	60 min x 5 schools = 300 min Average gross payable 09/2016 = 7644 Kn /180 working hours= 42,47 kn/h Costs: 480 min= 8 hours *42,47= 339, 76 Kn per Report

Process simulation results from Table 1 show Qualitative and quantitative indicators for improvement potentials. Based on these indicators for improvement potentials a future architecture of ICT usage for managing primary education institutions is designed, as shown in Figure 2. In the "To Be scenario" schools should use a new open ERP system for supporting common processes related to main areas of Primary education institution Management which were identified through previous activities within this project.

Reporting to the relevant ministry and founder is performed either automated or through ad hoc queries and reporting using the New e-school Information System for the purpose of more efficient and more effective Management of all resources that need to be managed centrally.

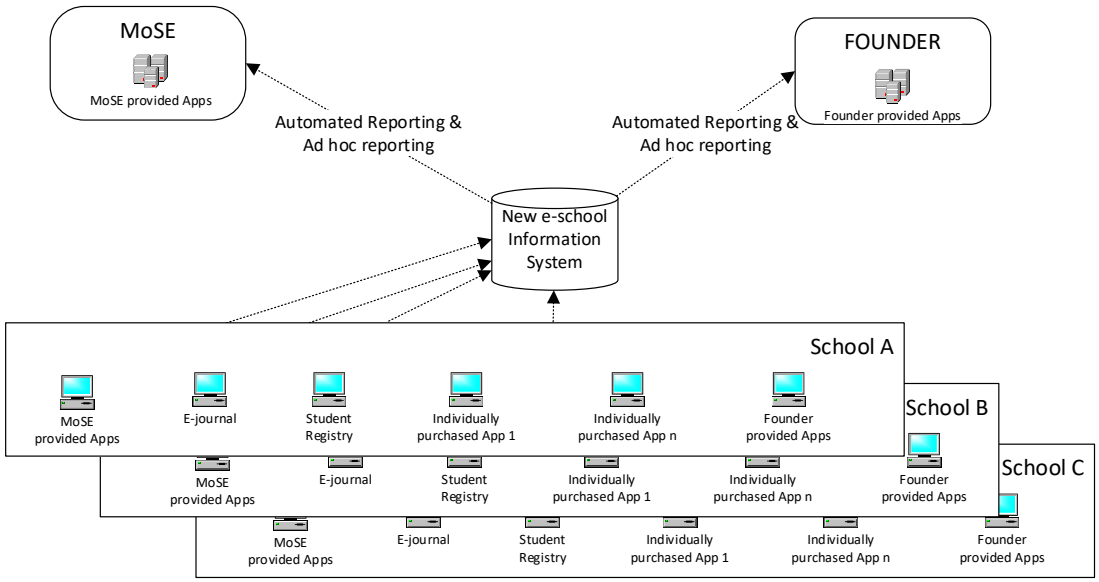

Figure 2. "To Be" Reporting architecture

Operatively, this would mean that schools / primary education institutions can use open ERP modules for all the activities envisaged by the e-School project, as well as additional applications

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provided by the founder and MoSE, whereby data will be entered once and exchanged between systems based on semantic and technical interoperability. Schools can, in a smaller scale, continue to use their own applications for specific tasks that are not covered by the open ERP (e.g. borrowing books at a school library). Reporting to the supervisory institutions will be performed automated via the open ERP by providing access to analytical data in accordance with legal authorisation options.

Conclusion

Digital transformation is not the introduction of an automated process, or a digital product or service. This is a continuous and strategic use of ICT, i.e. digital technologies to improve workflow and business operations within the organization, finding new innovative business models and creating new value-added through user experience.

During previous project activities data about the ICT usage, the process parameters and the relevant data were gathered. According to this input, a new information system architecture was proposed based on applying concepts from business industries into a school environment. The expected impacts of a future system based on common registers, a unique transaction system and an implemented process approach are as follows: Simple forms for data entry, processing and updating; Use of unique sets of master data; More effective management of business events and processes by various key performance indicators; Automatic generation of business documents; Automated reporting; More efficient planning of resources at system level; More accurate monitoring the operational process performance primary education institutions.

Further on, it is necessary to identify other relevant improvement potentials as well as savings options that can be achieved with the use of ICT. This will also contribute to the further development of the information system and its adaptation to school practice and needs.

References

1. BizAgi. (2018). Bizagi Modeler version 3.1. Retrieved January 05, 2018, from https://www.bizagi.com/en/products/bpm-suite/modeler
2. Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. (2013). *Fundamentals of Business Process Management.* Berlin Heidelberg: Springer-Verlang.
3. E-Schools (2017). Project description. Retrieved January 05, 2018, from https://www.e-skole.hr/en/e-schools/project-description/
4. i-SCOOP (2018). Digital transformation: online guide to digital business transformation. Retrieved January 05, 2018, from https://www.i-scoop.eu/digital-transformation
5. Potamias, G. H., & Iordanidis, G. D. (2015). The contribution of the school head in the introduction and implementation of ICT (information and communications technology) as innovation in an elementary school: A case study. *International Journal of Management in Education, 9*(3), 255-266. doi: 10.1504/IJMIE.2015.070121

ISBN 978-615-5511-23-3

6. Prokopiadou, G. (2012). Using Information and Communication Technologies in School Administration: Researching Greek Kindergarten Schools. *Educational Management Administration and Leadership, 40*(3), 305-327. doi: 10.1177/1741143212436953
7. Reference model. (n.d.). In *Wikipedia.* Retrieved January 05, 2018, from http://en.wikipedia.org/wiki/Reference_model
8. Rodríguez, P., Nussbaum, M., & Dombrovskaia, L. (2012). ICT for education: A conceptual framework for the sustainable adoption of technology-enhanced learning environments in schools. *Technology, Pedagogy and Education, 21*(3), 291-315. doi: 10.1080/1475939X.2012.720415
9. Selwood, I. (2005). Primary school teachers' use of ICT for administration and management. *Proceedings of the IFIP Conference on Information Technology in Educational Management,* 11-22. Retrieved from https://link.springer.com/chapter/10.1007/0-387-24045-4_2
10. Vlachopoulos, D., & Pitsiavas, D. (2016). The digital profile of primary school principals: Achieving effective educational administration through ICT. *International Journal of Educational Organization and Leadership, 23*(3), 17-28.

ISBN 978-615-5511-23-3