

# Public Administration Development through ERP System Implementation and Interoperability Growth

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**Abstract.** *Public administration development generally depends on various influences and public needs, so that need a careful consideration, for future development and improvement. ERP and related systems need to be incorporated into certain organization, according to its' specific conditions. Interoperability represents strong support, even the key condition for implementation, integration or further development for public administration. This paper aims for contribution to awareness growth and platform for further work. Considering various case studies, ERP implementation, interoperability, critical success factors and contingency approach, paper aims for further development in this area. ERP becomes a platform for further development towards quantum computing.*

**Keywords.** Public administration, development, ERP, interoperability, CSF, contingency approach, quantum computing

## 1 Introduction

Contemporary ICT systems represent key support to almost each of the public sector functions, towards further intensification of their competitiveness and development. In order to improve efficiency throughout the system, to avoid and reduce inadequate resources utilization, to improve functionality by implementing advanced information systems, government institutions emphasized their strategic plans towards complex solutions, such as Enterprise Resource Planning (ERP) systems. ERP as a system may be defined through various definitions, but for this paper author considered Gartner's "as the ability to deliver an integrated suite of business applications the most relevant" (Gartner, 2016).

New generation ERP or ERP III systems (Wagner, Lederer Antonucci, 2004), are expected to ensure the most suitable solution for various and numerous

governmental ICT requirements, in order to improve their competitiveness.

There are still doubts whether those systems represent an appropriate solution for the public sector with its traditional, fragmented organizational structure and culture (Sommer, 2011).

This paper also considered the various information systems strategies. Accordingly, there were various case studies related to ERP systems implementing – considering specific political, cultural or technical complexities, as well as public sector traditional structure.

According to the case studies and findings, author would like to suggest a systematic and careful use of communication and change management procedures, to ensure ERP systems appropriate implementation and institutional interoperability. That will ensure solutions for some of the key issues.

Growing number of articles and papers in this business critical area are suggesting interdisciplinary and contingency approach, considering each system specific circumstances, so ERP suits them accordingly (Panetto and Molina, 2008).

This paper objective was also a contribution to public administration development through connection of ERP system implementation and interoperability growth. Public services improvement plans are based upon the public-sector ERP implementation and interoperability recognition, implementation, growth and improvement.

There were various relevant articles and projects performed in this area, particularly during the past two decades, but there are still uncovered areas, so there is a need for additional awareness building and connecting that to organizational interoperability. Another aim is the platform design for the ERP implementation and interoperability development, as key points in public service and development.

Public administration represents strong economy growth potential, considering the fact that near 1/4 of employees in European Union (EU) are public sector employees.

This sector became influential stakeholder at each level (local, regional or global), actualizing awareness and need for further activities (European Commission Communication - "EUROPE 2020, 2010"). EU public sector, as large and complex system, processes millions of activities (administrative, financial, organizational etc.), so there is a need for an adequate ICT, as well as all kind of other support systems and activities, in order to ensure basic set of services and activities (Directive 2013/37/EU on the re-use of public sector information, Regulation (EU) No 1316/2013/EU establishing the Connecting Europe Facility). Improvements and further developments - so called "administration reform", once announced, are putting an agenda for additional efforts in preparation and implementation (EIF, European Interoperability Framework, 2004, Decision 922/2009/EC, 2009).

Solving the challenge of outdated IT systems is another issue, followed by lack of adequately educated experts, as well as continuous reductions in IT budgets to basic maintenance. That may result in reducing efforts, outputs and results, so there is a need for new projects, meeting planned budgets, goals, programs and strategies (Tolk, 2003). In order to support flexible architecture development, incorporating ERP system for an appropriate public administration, system planning will include preparation, scope definition, budget estimation, implementation, program and project approval, tender, proposals evaluation and contract realization. In order to ensure successful implementation and further steps, public sector needs set of an adequate strategies and legal framework to support the system with strict legal requirements (Daniel, 2005).

There are strategic areas that need careful consideration:

- management processes: budget control, risk management, steering committee meetings, etc.,
- timeframe tracking, searching for risk sources,
- establishment of special experts and crisis management team for urgent problems solving,
- vendor negotiations preparing,
- alternatives for unplanned change requests,
- ensuring continuous financial flows, and
- monitoring system establishment.

This paper is based on the analysis of case studies, aiming to describe the influence, interconnection and impact of ERP implementation and interoperability, particularly in the public sector. It considers the topic at a general level of review of relevant literature. It is not based upon specific targeted research and an approach of deepening the knowledge of the research

field, but aims to describe the growing influence of contingency ("tailor-made") approach to connection and combined development of interoperability across the ERP implementation.

## 2 Case studies on the ERP public sector implementation

This paper goal is also a description of ERP implementation influence to public administration improvement and development, as well as relation to interoperability improvement. In order to describe ERP implementation various aspects and its influence to public administration development, author has studied various relevant case studies.

Exploring a public sector ERP implementation offers excellent opportunities and great examples for successful implementation in USA, UK, Scandinavian and Baltic countries, as well as EU and other countries that succeeded in integration and interoperability issue solving, in public administration and private companies. Considering case studies and papers, connecting them to the topic, author focused his attention onto following papers:

1. Public Sector ERP Implementation: Successfully Engaging Middle-Management (Sommer, 2011),
2. Methodologies for Measuring E-Government Development: The Croatian Case (Hajdin, Vrčec, 2010),
3. Information technologies for value network integration (Hemilä, J., 2002),
4. An Analysis of the Imagine PA Public Sector ERP Project (Wagner, Lederer Antonucci 2004),
5. A Comparative Study of Critical Success Factors (CSFs) in Implementation of ERP in Developed and Developing Countries (Moohebat et al. 2010),
6. Maturity Model for Enterprise Interoperability (Guédria et al., 2008),
7. Architecture of Interoperable Information Systems. An Enterprise Model-Based Approach for Describing and Enacting Collaborative Business Processes (Ziemann, 2010),
8. Managing ERP, Interoperability Strategy and Dynamic Change in Enterprises (Wan, Clegg, 2011),
9. Enterprise Integration and Interoperability in Manufacturing Systems: trends and issues. Computers in Industry (Molina et al 2007),
10. The interoperability force in the ERP field (Bozaa et al. 2014).

## 3 ERP and interoperability impacts

ERP and interoperability development, need to be planned, prepared and implemented as a project, becoming a start point for new set of activities. An adequate timeframe, organizational, financial and legal

framework, are opening new set of opportunities for implementation, monitoring, improvements and future developments.

In order to ensure project output and outcome, ERP and interoperability are considered complementary, as parallel set of processes, serving the same objective. In addition, studying this from national and EU viewpoint, there are additional conditions for consideration (ATHENA, 2003).

### 3.1 Expected impacts

ERP implementation and interoperability growth impact may represent a critical change in public administration and their improvement. This change aims for innovation capacity improvement and knowledge integration, by strengthening the competitiveness, growth, developing innovations and meeting the citizens' needs. That will ensure social and public change – growth and development through public service reform.

There are also barriers and challenges, recognized in existing organizational framework, at the moment public services are not satisfying completely public needs, through lack of efficiency, efficacy, and low usage of contemporary ICT accomplishments.

EU is in need for further development and transformation of public services and the most of the member states need further development in this area (European Commission Communication: Towards interoperability for European public services, 2010, Interinstitutional Agreement of the European Parliament, the Council and the Commission 2013).

Public administration services in Croatia and many new EU member states aren't sufficient to satisfy growing needs, not efficient enough and less using available ICT. EU is facing transformation challenge, structural reforms, new working places needs, efficiency growth needs, particularly new ICT and innovation utilization. The key point is the development of new services and public service system upgrading, as well as research and studies area opening (Central State Administrative Office for e-Croatia: e-Croatia Implementation Plan for Year 2008 and 2009). Recent findings upon public administration needs are quite supportive to this project, simplification trends in legislation on the EU level also (INTEROP, 2007).

#### 3.1.1 Key impact – interoperability as a keyword

Interoperability is defined as "the capability to communicate and execute programs or transfer data to multiple functional units in a manner that requires from user to have little or no knowledge of the unique

characteristics of those units" (C–A Information Technology Vocabulary, 2013).

It includes multiple relation, continuous providers' communication, users, servers, carriers and each role multiple connections.

There are various interoperability modes: semantic, syntactic, cross-domain, search, open standards and post-facto interoperability.

Successful ERP and interoperability implementation and public services development based on new technologies will ensure efficient, effective and quality public service, so there is a strong justification for such a project (Wagner, Lederer Antonucci 2004).

Specific challenge is how to think of the systems and services combined with new technologies, to provide opportunities for innovative designs and public sector transformation (Naudet et al., 2009).

ERP participate in interoperability projects, so this paper leading idea is to identify the role that interoperability plays in the ERP systems evolution. It has been first identified within interoperability frameworks. Interoperability initiatives in the ERP field have been identified from two perspectives: technological and business (Torbacki, 2008).

ERP has evolved from information system integration to a new generation of fully interoperable ERP. Interoperability is changing the management approach and ERP systems are adapting to the stream of interoperability (Wagner, Lederer Antonucci 2004).

#### 3.1.2 Environment and influences, political and legal framework

Institutional interoperability has significant impact on organizations, raising ownership and usability issues. The lack of interoperability regularly results in standardization gaps during the design phase. It has important economic consequences; Chapman has presented inadequate interoperability cost in the U.S. capital facilities industry to be \$15.8 billion annually (Chapman, 2005).

Interoperability has growing importance across the EU, throughout the market, society, organizations, institutions, covering each part of organizational life, EU institutions have ensured strong legal and institutional support as a legal and institutional framework (IDABC, 2004).

There are not only political declarations, but also series of documents, regulations, directives as a basis for interoperability and ERP development and

implementation (European Commission Communication: Towards interoperability, 2010).

In order to reach planned functionality and efficiency, institutions have ensured framework for interoperability and further steps in ERP and other systems implementation (Sjoquist et al. 2002).

Since the mid 1990's European Parliament, European Commission, as well as related institutions and organizations have prepared set of legal and political conditions, bringing interoperability into new perspective. This is not only from the technical viewpoint, but also political and organizational, as the awareness upon political influence was raised. Additionally, there were set of expectations amongst interest groups, science and tech (INTEROP, 2007).

### 3.2 Measures to maximise implementation

Measures to maximize implementation are necessary as the implementation have significant impact onto stakeholders and users in general.

When considering communication, there are strong evidences that dissemination have great impact onto various project segments and stakeholders, as it includes reporting, as well as media and professional campaign, meetings, focused onto experts and expert area targeted, i.e. – dissemination of information, in order to prepare public for the planned activities and processes (IDABC, 2004).

Dissemination has strong influence, critical role and ensures communication to each project stakeholder and public awareness building. It contributes to initiation of data base and data centres, and research points (Regulation (EU) No 1291/2013).

Cooperation and communication to public administration representatives as key stakeholders will ensure opening the critical chapter of the project – connection to public administration officers and ensuring their targeted education are another critical point of this project (Sommer, 2011).

### 3.3 Consultation of stakeholders

Stakeholders have the need for accurate, timely and overall information system for everyday decision-making and long term strategic planning (Chituc et al, 2008). Many public IT non-integrated systems can't ensure such support.

Public sector ERP implementation resulted in similar experiences. The most of decision makers were aware of the fact that their organization couldn't complete the

ERP project within the original timeframe (Sanchez, 2010).

ERP and interoperability are taking into account the social, political and legal factors influencing new ICT technology based public services, to include inputs and feedbacks from citizens and civil servants, and identify the ways how they can contribute to modernising policies and innovative services of general interest (Watson et al. 2003).

Previous findings suggest that enterprise structures design and governance, as well as interoperability strategy can be affected by preferable information systems besides of the core competence (Davis and Spekman, 2003).

Most of the public sector enterprises are generally interested in ERP. They need to upgrade IT systems that needed more functionality and flexibility.

### 3.4 ERP implementation in public sector

Organizations' leaders usually were unsatisfied with ERP implementation timeline, regularly exceeding two years. Causes for such exceeding were: inadequate preparation, lack of knowledge and experience, inability to predict and find an appropriate solution for future issues (Bozaa et al. 2014).

Usually implementation meets following issues: 1. Unreliable timeline, 2. Unexpected changes to the project's scope, 3. Unpreparedness for change. Organization's unpreparedness to change were often and seen as the cause to underestimating the ERP real impact on the organization and a failed change management strategy (Wagner, Lederer Antonucci 2004).

Delays were often because enterprises are meeting challenges to identify and recruit targeted staff. That's not always an issue, particularly when the original timeline was unrealistic. But they may result in financial issues, productivity reduction, employee costs rising and lost opportunity costs. ERP budget exceeding is usually directly linked to delays.

When considering human resource issues, enterprise management usually meet sourcing and assigning the right staff as critical component of project planning. ERP implementation and institutional interoperability development may ensure achievement of various benefits, like:

- Personalized public services for individual users,
- Faster and cheaper interaction with government,
- Opportunities based on available public sector data,
- Sophisticated services / products development, and
- Improved processes based on modern ICT technologies.

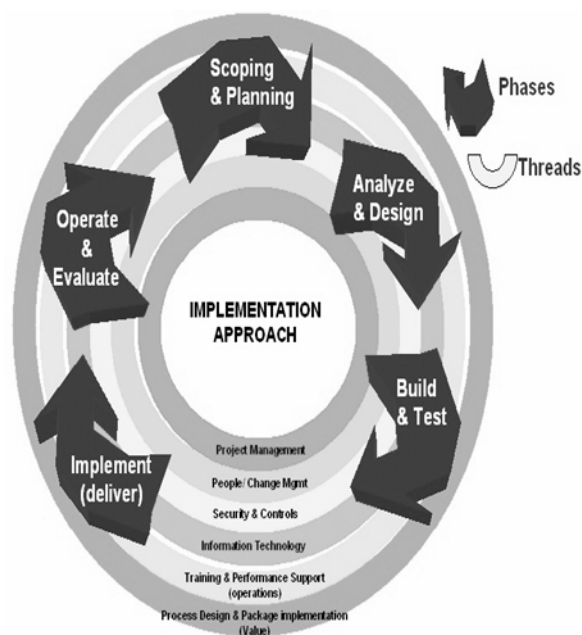
## 4 Related works and contemporary references

This area has growing importance and influence, as “new generation” ERP implementation starts with series of changes throughout entire organizations. Globally, many authors, faculties, organizations, are putting additional efforts in contributing to this topic enlightening, giving us an adequate insight into this area and discipline (E-Business Watch, 2010).

Croatian authors, mostly from the IT area contributed to this area. Additionally, their timing correlated mostly with EU, UK and US authors and findings (United Nations e-Government Survey 2010). Hajdin and Vrček described set of methodologies for measuring e-government development in their paper with the same name, developed upon the Croatian case (Hajdin and Vrček 2010).

Sommer conducted various studies upon public sector ERP Implementation, and his paper upon middle-management role successfully described impact this management segment has onto enterprise in ERP implementation (Sommer 2011).

Wagner and Lederer Antonucci have conducted the Imagine PA Public Sector ERP Project and ERP implementation in Commonwealth of Pennsylvania, local and federal aspect of this project and related activities (Wagner and Lederer Antonucci, 2004).

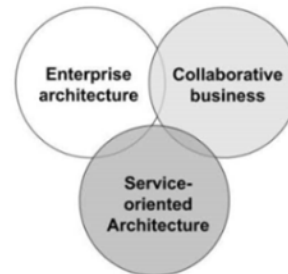


**Figure 1.** Generalized ERP Implementation Approach (Wagner and Lederer Antonucci, 2004).

Moohebat et al. have conducted a comparative study of Critical Success Factors (CSFs) in implementation of

ERP in developed and developing countries (Moohebat et al. 2011).

In his work Architecture of Interoperable Information systems, Ziemann described architecture of interoperable information systems throughout contemporary enterprise, considering ERP and interoperability (Ziemann, 2010).

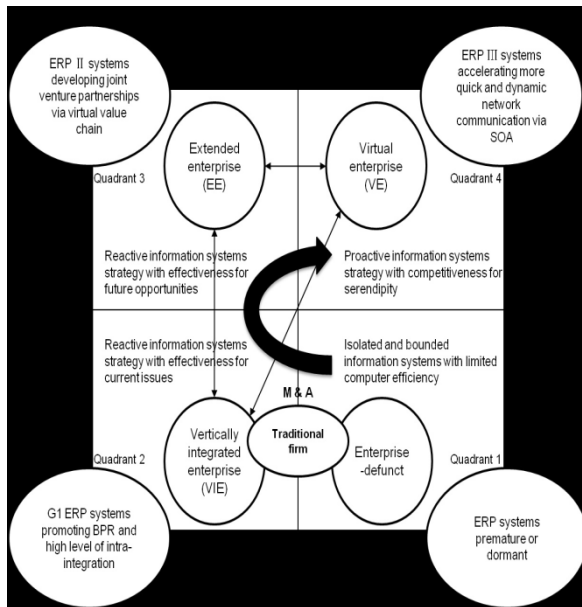


**Figure 2.** Development of collaborative business processes based upon three research fields (Ziemann, 2010).

Hemilä analysed and described IT for value network integration, analysing the case study InElog-project (Incap E-logistics) of VTT Industrial Systems (Hemilä, 2002).

Guédria successfully analysed and described a maturity model for enterprise interoperability, including 4 stages that may be presented and measured (Guédria et al., 2009).

Wan and Clegg have conducted a study of ERP, interoperability strategy and dynamic change in enterprises, in their paper “Managing ERP, Interoperability Strategy and Dynamic Change in Enterprises” (Wan and Clegg, 2011).



**Figure 3.** Novel sustainable conceptual framework for managing ERP systems development and dynamic enterprise strategies (Wan and Clegg, 2011).

Panetto and Molina have analysed and described trends and issues in enterprise integration and interoperability in manufacturing systems (Panetto and Molina, 2008).

Bozaa et al. analyzed and described interoperability force in the ERP field (Bozaa et al., 2014).

## 5 Trends in ERP implementation and interoperability

Integration in manufacturing was the first systemic paradigm to organise humans and machines as a whole system, in order to produce an integrated and interoperable enterprise system.

Contemporary software systems became available to meet the ICT integration requirements. Key issues remain between the corporate and the manufacturing level, so that management and operation decisions within a closed loop are facilitated to pace the production according to the life-cycle dynamics of the products (World Economic Outlook, 2009).

Contemporary networked businesses regularly include difficulties due to the lack of interoperability between enterprise systems. The future relies on collaboration networks among companies, people and societies in order to generate shared knowledge and wealth.

A number of important enablers are needed to support the creation of successful collaborative networks e.g. common reference models, effective interoperability mechanisms, infrastructures and approaches based on open architectures, design and engineering

methodologies to duplicate successful cases, and standardized market technologies and tools.

Not only future scenarios place ICT as new business developments' core, recent digital megatrends such as: e-Government, e-Tailing, virtual education, Entertainment on demand and a wide set of online services (finance, publishing, marketing) became a part of everyone life (West, 2007).

## 6 Conclusion

Following the analysed case studies, findings in various interdisciplinary studies and researches, there are strong evidences upon the growing influence, interconnection and impact of ERP implementation and interoperability, in public sector, as well as in private sector, regardless of the specific characteristics and conditions.

Many governments developed specific strategies and programs to ensure successful strategies, ERP and related implementation activities, particularly metrics for evaluation and further work (MAREVA methodology guide, 2010). Also, considering global trends in ICT development, investments in development and innovation are becoming closely related to ICT development and strategically incorporated into national strategies and programmes. Public sector adopted the most of ERP solutions from private sector, with respect to specific differences, structure, culture and dynamics. Furthermore, issues related to ERP success in implementation are mostly the similar with the interoperability, as there are practically the similar conditions, constructs, structures and strategies (E-Business Watch, 2010).

Public sector ERP implementation started a bit later than in private sector, following it less intensive and in slow speed, due to various reasons. Yet, according to slow dynamics and low intensity, ERP implementation have shown a kind of predictability and according to public sector legal and organizational framework, decisions were brought upon consensus and stakeholders influence. Yet, most of the ERP was implemented in large organizations such as defence ministries and departments, NATO and related organizations (C3 Technical Architecture, 2003; C4ISR Interoperability Working Group, US Department of Defense, 1998).

When compared to private sector, ERP implementation and interoperability intensification have not enough indicative experiences, as they are less numerous, intensive and with less feedback.

Considering ERP implementation and the growth of interoperability, there are significant differences between developed and less developed countries, not

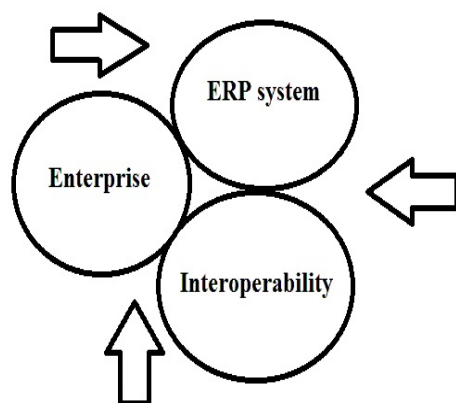
only in EU, US and America, but also in Asia and Africa (Rajapakse, 2005).

Contemporary business environment and tech development are pushing the ERP implementation agenda and interoperability development towards ERP III and/or newer versions. Considering the technology, as well as social and economic development, researchers have to take into account new trends in each of component (Clark and Jones 1999).

Quantum computers and emerging technologies are supportive to interoperability development and “ERP III” solutions. Yet, there are still timeline gaps and issues in planning and realization of the most appropriate solution.

Connecting ERP with enterprise and interoperability becomes priority and considering ERP III and new circumstances, ICT development and standardization, as well as interoperability growth and development. There are strong connections between planning and implementation, as many authors are indicating growing importance of planning (O’Leary, 2000).

Accordingly, there are reasonable expectations for mutual and strong influence or interdependence, as shown in Figure 4.



**Figure 4.** ERP, Enterprise and Interoperability mutual interdependence and strong influence

Delivering ERP solutions and ensuring architecture for the most adequate implementation, opens a set of opportunities for interoperability development and their mutual influence will ensure feedback, as well as support for further success (Galbraith, J.R., 2002).

This paper goal was to contribute the state of the art presentation and initiate new discussions, ideas and studies, in order to ensure their further development and implementation in the most successful and suitable manner.

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