

Enterprise Resource Planning (ERP) System for Subcontractors of Telekom Slovenije

Nikola Marin

Faculty of Mathematics, Natural Sciences and Information Technology

University of Primorska

Glagoljaka 8, Koper, Slovenia

marindzoni@gmail.com

Abstract—Telekom Slovenije has many subcontractors supporting their infrastructure and installations. Those subcontractors are small businesses who are using just email and a Microsoft Office package for their e-business. Because of that, they companies experience data loss, misunderstandings, human errors and non-optimal business. Also all repetitive tasks are done manually which produces loses in time and money. Based on previous research where business process analysis, implementation technologies, frameworks and methodologies were researched this paper aims to analyse business processes inside Telekom Slovenije subcontractor companies and to propose conceptual model of ERP system that could fit to those companies needs, and provide more optimal business in the long run.

I. INTRODUCTION

Enterprise resource planning (ERP) is business management software that is designed to integrate data sources and processes of an entire organization into a combined system [1]. ERP software is multi-module application software that integrates activities across functional departments such as production planning, purchasing, inventory control, product distribution, and order tracking [1]. ERP has different modules that run various business activities such as accounting, finance, supply chain, human resources, customer information and many others [1]. Observing the ERP definitions we conclude that it is a potential solution for problems arising in small and medium-size companies, such as subcontractors of Telekom Slovenije. Telekom Slovenije is a telecommunications company based in Slovenia, with many subcontractors supporting their infrastructure and installations. Those are small and medium-size companies specialized for construction, electromechanics and telecommunications. Since those small and medium-size subcontractor companies base their e-business only on email and a Microsoft Office, this paper has a goal to analyse business processes and problems inside those companies and to propose software solutions in the form of ERP. Although there are ERP software products such as SAP, Oracle and even specialized systems for subcontractors in construction industry such as Constructtrue, they do not entirely fit each and every type of business. The main reason why companies may prefer to develop

their own ERP type of systems, thus eliminating barriers such as long time and high cost required to develop the software, compared with the shorter time and lower costs of just purchasing the ERP system and customizing it to the targeted business. However in the short run lower cost will eventually result in losses in the long run, due to that the system is not perfectly adapted to business specifics and on the other hand customizing an ERP package can influence implementation of the standard benefits of the integrated system [2]. The main motivation for this paper was to analyse literature which presents different methodologies and principles for business process analysis and design of ERP systems, and to propose conceptual ERP model for Telekom Slovenije subcontractors. This paper firstly defines and analyses current business processes inside Telekom Slovenije subcontractor companies, then it analyses issues in current business processes. After this it proposes a conceptual model of ERP system based on UML diagrams, but it also discusses architecture, infrastructure and technology that should be applied in order to automate business processes and gain productivity, reduce losses and achieve cost effectiveness in the long run, in subcontractor companies such as those who work for Telekom Slovenije.

II. BUSINESS PROCESSES

A business process, business method or business function is a collection of related, structured activities or tasks by people or equipment in which a specific sequence produces a service or product for a particular customer [3].

Current business processes of Telekom Slovenije subcontractor companies is repetitive and it does not have variations, so we can divide it into sub-processes and automate them. Derived subprocesses are defined and analyzed below.

A. Human resources management process

Human resources management process is the strategic approach to the effective management of people in a company such that they help their business gain a competitive advantage. The main goal of this business process is to organize available workers into working groups for a longer

time period. Then working groups are registered via email to Telekom Slovenije and Telekom Slovenije can assign work orders to them.

B. Service preparation process

Subcontractor registers a number of available groups of workers for a specific day, and then Telekom Slovenije assigns work orders to subcontractors groups. Work orders are being sent to subcontractors via email in the form of excel table. Every work order contains a number of tasks listed in excel table, and every task in the table contains a number of relevant data. For example, a task contains customer data (name, phone number, address), connection technical data, task description, etc. Work orders are being printed on paper which is brought with workers to the work field since it contains all relevant information needed for finishing a task successfully.

C. Write report process

Besides relevant technical information, the work order task list contains a number of report columns. Subcontractors working group is obligated to fill those columns at the end of each task, by adding reporting relevant information, such as new connection status, technical data, remarks, description of problems if any is present and the amount of spent resources. Then when all tasks in working order are considered finished, the working order is sent back to Telekom Slovenije together with report data in it via email.

D. Accounting process

Accounting process refers to the process of generating financial statements. This process involves a number of steps that are repeated in each reporting period. By analyzing task reports manually (one by one), the accountant gets the most relevant financial information needed for financial statements and reports. The final step involves analyzing these reports and making decisions.

E. Business process problems

Subcontractor employees are mostly construction workers and electricians and they do not possess enough computer education to adequately use computers and software packages with complicated interfaces and operations. Manual service preparation process and report process takes them more than an hour a day, which is unnecessary since all processes can be automated. Besides that, they often experience data loss, since they are writing reports at the end of the working day and in the meantime they forget precise data, so reports may appear to be wrong or incorrect. Number of documents is growing very fast, and they do not have any defined system for archiving and searching the data, which also produces losses of time and data. They also do not have any automated system for accounting process, and business analysis and such tasks are accomplished manually. The problem is also in the logistics and business optimization. Namely, tasks from Telekom Slovenije are not optimally assigned to work groups. When assigning tasks they do not

optimize transportation, so it may happen that team A goes at location where team B was and team B goes to location where team A was, which again produces losses.

III. BUSINESS PROCESS PROBLEMS SOLUTION

Problems counted above can be solved by implementing ERP systems into the business process of subcontractors. The ERP system should read incoming work orders from email, automatically process them and prepare for printing. It should also facilitate mobile application, so workers do not have to print task documentation on paper and bring the paper with them to the work field, but they can use tablets or mobile phones. Also the reporting system should be simplified by a user friendly graphic interface and should be also supported in mobile application, so workers can easily generate reports through graphical form on tablets or mobile phones directly after finishing the task. After work order status is set to finished, it is automatically concatenated with report and sent to Telekom Slovenije via email and stored also in subcontractors database so the data can be archived and searched properly without losses. System should also support evidence and management of employees (human resource management), and provide functionalities for automated financial and statistical analysis (accounting) together with tools for financial and statistical analysis, including emerging and interactive data visualization. Since this system is supposed to be implemented for small and medium-size businesses every part of the system, including its infrastructure should be optimized and designed to fit a small company budget. Also, it should be modular as much as possible to reduce adoption time and price, since business processes can be changed and vary from company to company.

IV. CONCEPTUAL MODEL

This section has an intention to propose ERP system for Telekom Slovenije subcontractors, analyse and discuss different technologies, infrastructures and architectures that can be used to implement such ERP system. Analysis is divided into four sections, and every section is representing the ERP system from different viewpoints. At the end of the viewpoint, the proposition of solution is given based on previous analysis and some parts of the system are represented with UML diagrams. UML is an industry standard modeling language adopted by Object Management Group in 1977. UML is a modeling language intended to describe models of systems - real world and software - based on object concept. According to UML and Rational Unified Process (RUP), the viewpoint of describing a system is based on the "4 + 1" views. But since this is only a conceptual model of ERP system, where we strongly emphasizing a focus on domain concepts, not software entities, such as component of file type, implementation view will not be analysed and presented.

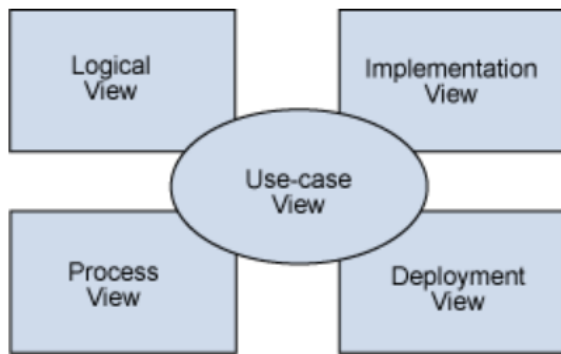


Fig. 1. The "4+1" view architecture model

Proposed ERP system should consist of four subsystems, ERP modules, including human resources, service preparation, reporting and accounting. Those systems actually automatize business processes described in section II and interact with user via user interface. Such ERP system should also have functionalities such as user management, email send/receive system and user authentication system but those are beyond the scope of this paper, since such functionalities can be generalised. Before we start to analyse system we have to introduce different types of users and define their roles in company. Based on previous analysis we can divide users into four groups:

- 1) Administrator
 - user management
 - company director or other person of trust
- 2) Task executor
 - construction worker or electrician, member of the working group that executes work order tasks from Telekom Slovenije
- 3) Human resource manager
 - manages working groups
 - reports working groups to Telekom Slovenije
 - responds to vacation requests
- 4) Accountant
 - analyses financial statuses
 - makes financial reports
 - dealing with third parties, such as vendors, customers and financial institutions

A. Use-case

A use case is typical interactions between user and ERP system and describes functionalities of an ERP system [5]. A use case diagram illustrates a set of use cases, actors, and relationships between actors and use cases. The purpose of the use case diagram is to show high level view of the ERP system. The first diagram (Figure 2) is splitting entire system into subsystems. Other use case diagrams show more detailed use case view of some subsystems.

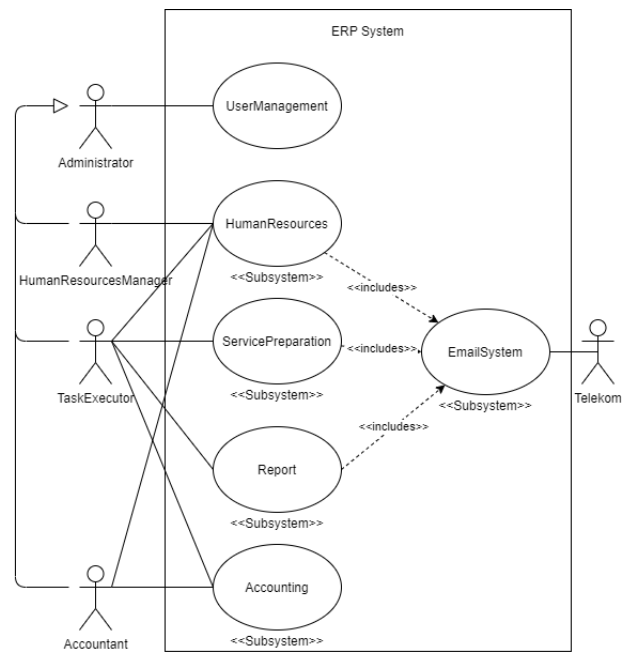


Fig. 2. Entire system with subsystems

Since small companies are not willing to pay administrator only to add new users and to manage their rights, a company director will get administrator user account. So besides user management, administrator account will be allowed to access to every resource of the system and to make changes, but also to add new administrator user if needed.

The human resource manager is allowed to interact with HumanResources subsystem, where he can list available workers for defined periods, respond to employee vacation request, create working groups, analyse workers profile and efficiency, and register available working groups to Telekom Slovenije via email.

The task executor user will mostly use functionalities of ServicePreparation and Report subsystems, but also they will be allowed to request vacation via HumanResource subsystem and to overview their personal financial information prepared for them by Accounting subsystem. With a help of ServicePreparation subsystem which processes tasks from work order and automatically generates task documentation for task executor, the task executor user can preview generated documentation on computer or mobile device, or print it with a few clicks without any action and time required for generating the documentation. To support agile work order information access, task executor is allowed to list all work orders and tasks that are or were assigned to his company and overview them, or get some necessary information.

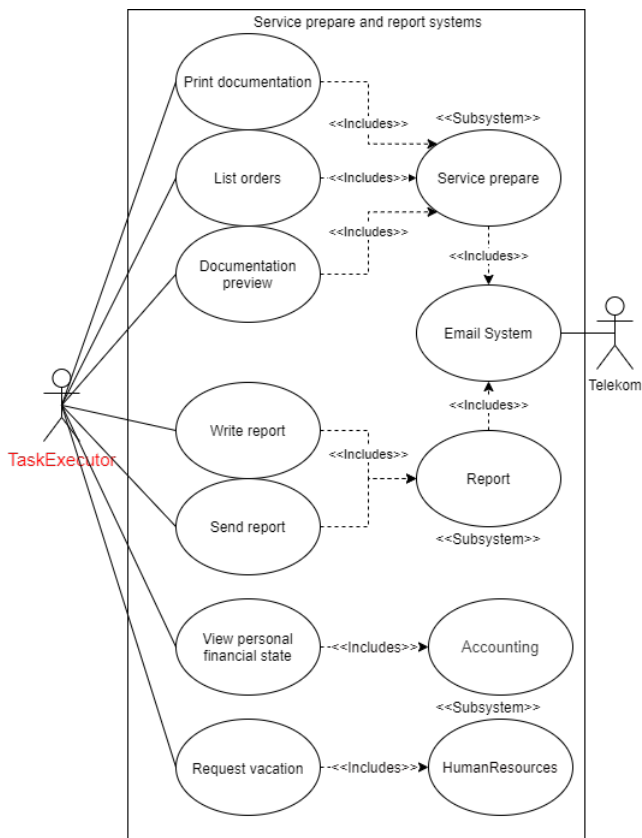


Fig. 3. Service preparation and report subsystem

The task executor writes report for every task after task is finished. So he can access Report subsystem, where he gets user friendly graphical user interface and form which are helping user to accurately fill the report relevant information. Then the user submits report (Send report (Figure 3)) and Report subsystem concatenates report data to task. When all tasks of work order have been reported, Report subsystem automatically generates proper excel table and sends task reports to Telekom Slovenije via Email subsystem. Task executor has send report action available in case that task report has to be sent even if it is not fulfilling conditions to be sent automatically by the system.

Accountant user has access to entire Accounting subsystem and its functionalities which facilitate automated calculation of financial states based on finished work orders. The accountant user is allowed to access calculated financial states and to make various types of financial and statistical analysis. Accounting subsystem provides number of tools needed for financial and statistical analysis including data visualization techniques. Accountant user has available functionalities to import documents and data into the system in case that it is required and data export functionalities which generate financial documents of desired file type. It is implied that every user has to be registered and authenticated to access any resource of the system.

B. Logical View

The logical view is concerned with the functionality that the system provides to end-users. UML diagrams are used

to represent the logical view and include class diagrams[6]. A class diagram shows a set of classes, interfaces, and collaborations and their relationships. A class diagram describes view of ERP system in terms of classes and relationships[4][5].

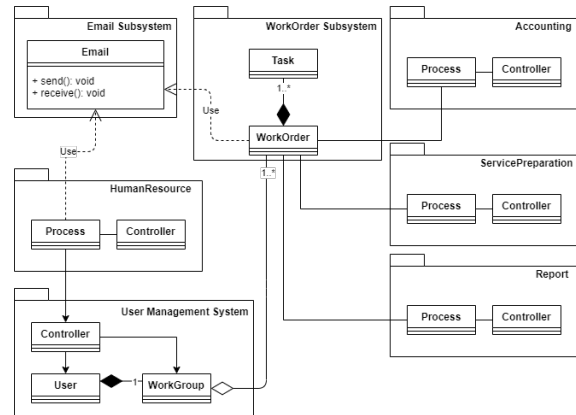


Fig. 4. ERP class diagram proposition

ERP begin as a system that only large manufacturing companies can implement. Web and web technologies enabled ERP to be more dynamic and customer-centric so ERP moved and spread to smaller companies. Internet implemented new ERP model which is Web-based Object-Oriented Model (WOOM) which is using internet component and technology as object oriented models for quicker, faster implementation and customization. WOOM made a new generation of ERP called web-based ERP [1]. Web-based ERP has the capabilities of internet access and real time information so it increases mobility. In Web-based ERP system we can recognise benefits for a small size businesses such as Telekom Slovenije subcontractors. With the right architectural choice Web-based ERP can be distributed and deployed on different platforms, which lowers infrastructure costs, and allows system-to-system integration that facilitates processes between multiple systems. Furthermore, system is always accessible and can be accessed through web browser and mobile app, which is great feature for company which core business is dependant on mobility. The main drawback of Web-based ERP is security since configuration of security issues can be complex. Regardless security issues, proposed ERP system for Telekom Slovenije subcontractors, is Web-based, and it has a number of packages, where every package represents one subsystem. Web-based ERP design focused on new technology arises on migration from client/server architecture to web-based client/server architecture. Classic client/server architecture is known also as Two-tier architecture where client's PC is interacting with central server. It gives lower cost and better processing to ERP but it has a lots of drawback such as performance will decrease as number of clients increases, no database change or modification can be added and limited flexibility in functions movement from one server to another [1]. Three-tier ERP architecture was introduced as a solution for two-tier ERP problems. It consists

of three layers such as Presentation layer (Graphical User Interface), Application layer, and database layer. Presentation layer is where data are graphically presented to client. Application layer is responsible for distributing requests across different application servers and for business logic execution. Furthermore, Application layer acts as an interface that facilitate communication between Database layer and User interface (presentation layer). Apart from the usual advantages of modular software with well-defined interfaces, the three-tier architecture is intended to allow any of the three tiers to be upgraded or replaced independently in response to changes in requirements or technology. For example, a change of operating system in the presentation tier would only affect the user interface code [7]. It provides easier implementation to reusable components. On the other hand Three-tier architecture has more complex and a bit expensive design than Two-tier architecture [1]. Although there are architectures that are better than Three-tier architecture, they are also more complex and more expensive. Since we are modeling ERP system for a small size companies, Three-tier architecture should be acceptable architecture which will balance between performance and price and also fulfill system requirements. Complete class diagram of Application layer is shown in Figure 4. From business process analysis, solution proposition (Chapter III. Business Process Problems Solution) and Use Case, we can perceive that work orders and work order tasks are the main information in business processes and all departments use them. Also, email is currently the main communication mechanism between Telekom Slovenije and its subcontractors. To support those data and functionalities, we introduce two separated packages (subsystems), WorkOrder and Email. Email subsystem has functionalities to support email communication through ERP. When new email with work order is received, it is read by WorkOrder subsystem, and stored in database. Since those two provide data and functionalities required by all analysed business processes (Chapter II Business Processes) we have a base for a modular system where different business processes can be added, modified or removed without affecting others. Even if communication between Telekom Slovenije and it's subcontractors transit from email to other technology, it will be possible to adapt just communication module in short time period without affecting whole system functionality. Since the system is Web-based, packages that receive user requests and respond to them, have controller and processor classes. User manipulates and accesses the data through controller by sending HTTP requests from Presentation layer, and response is produced relying on process class where business processes are automated. This way we separate business sub-processes into packages, where each package has processing module, where tasks are automated and controller which is actually interface and adaptor between Presentation layer and business logic in Application layer.

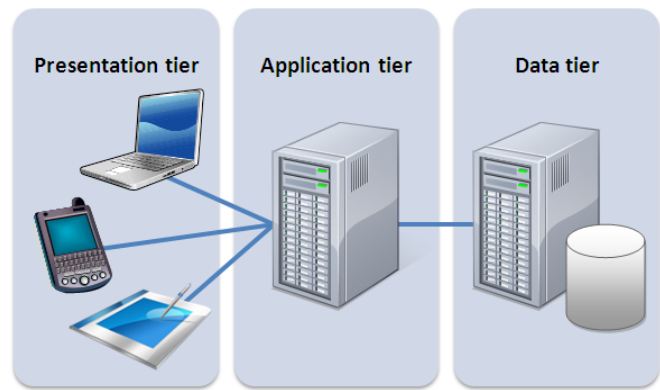


Fig. 5. Three-tier architecture

All this produces highly modular and distributed system where modules can be written in different programming languages and business processes can be changed smoothly, and whole system can be deployed in cloud.

C. Process View

A sequence diagram illustrates how objects interact with each other. It emphasizes on how messages are sent and received between objects [4][5] In this section two sequence diagram are shown. The first one (Figure 6) shows sequence diagram of service preparation module. Task executor sends HTTP request with work order ID argument to ServicePreparation controller to get list of tasks. ServicePreparation controller receives request and calls methods of it's Processor controller to get list of tasks. Then processor controller finds work order in database, takes it as an object, and takes a list of tasks from it. Then list of tasks is passed back to ServicePreparation controller which sends response back to user. The second sequence of this diagram shows how system is supposed to generate documentation. Task executor requests printing of document. ServicePreparation controller uses ServicePreparation processor to take only relevant data from WorkOrder, and returns back file which contains all relevant data needed for task preparation and execution. Report sequence diagram (Figure 7) represents interaction between classes used by reporting subsystem. User requests report form for particular task by sending report request and task ID as a parameter to Report controller. Report controller then gets task object from WorkOrder where task is found by ID. When returned to Report controller data from task controller are used during form generation, and prepared form is returned to user. When filled, form is sent back to the Report controller via HTTP post. Report controller validates the data of report form and if it is valid it is send to Report processor to concatenation with the rest of the task. Concatenation is being done in interaction between Report processor and WorkOrder. When task is updated, WorkOrder checks if all tasks in work order have status "Done", and if it's true, report email is sent automatically.

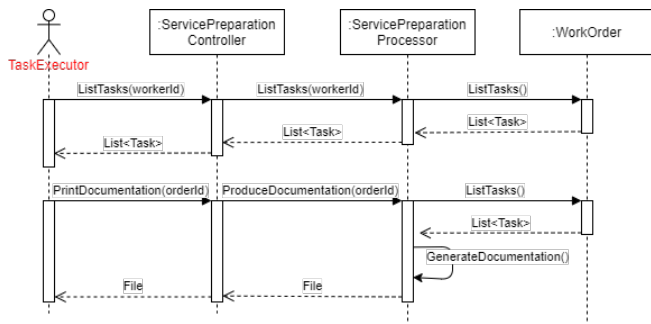


Fig. 6. Service preparation sequence diagram

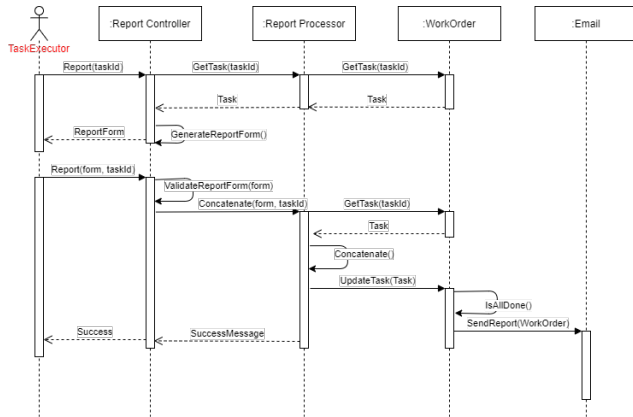


Fig. 7. Report (subsystem) sequence diagram

D. Deployment View

A deployment diagram shows the physical description of the system topology, including the structure of the hardware units and software that executes on each unit [4][5]. The ERP systems traditionally used are implemented in the company premises. The servers and required packages of software are installed in the company itself. All the software is loaded onto the computers in house. The maintenance of the servers and emergency recovery is managed by the company itself. The enterprise itself is responsible for complete maintenance. Another option for ERP implementation is hosted networks, where the servers are located at different places and the company is connected through a direct network. The recent trends are utilizing the services of cloud based ERP systems[8]. Cloud based systems are generally sub divided into three types based on the services provided. The three types are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [8]. **SaaS** gives users the ability to use the provider’s applications on a cloud infrastructure. These applications are typically accessible from various programs or web browsers. The user does not maintain any of the underlying cloud infrastructure, with exceptions of user specific configuration settings [9]. Rather than purchasing the software and paying subsequently for regular software upgrades/patches, the company using SaaS will only pay the subscription fee. All relevant upgrades are usually provided by the service provider during the term of the subscription. **PaaS** provides users the ability to

utilise cloud infrastructure as a platform to build and deploy applications using various IT resources provided by the provider. The ERP implementation based on cloud services is grouped under SaaS. Cloud ERP systems are accessed via common internet connection and allow the user to get all the information through client configuration. The cost of the cloud based ERP implementation is lower compared to the traditional implementation. The cost of energy, maintenance and configuration is reduced. The scalability feature of cloud based ERP is enormous. The elasticity of the cloud based approach is one of the main advantages. Also changes suggested by the consumer can be implemented easily [9]. The main difficulty of cloud approach is security and confidentiality. The reliability of the network and integration issues is few other disadvantages of cloud ERP. When we compare all advantages and disadvantages of cloud ERP we conclude that cloud ERP is a good choice for Telekom Slovenije subcontractors.

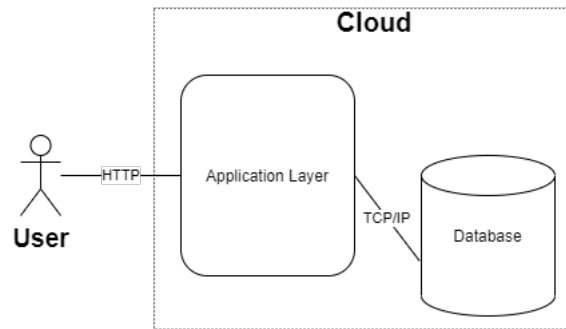


Fig. 8. Deployment diagram

V. CONCLUSION

Telekom Slovenije is a telecommunications company with many subcontractors which are supporting their infrastructure and installation. Those are small size companies specialized for construction, electromechanics and telecommunications. Since those subcontractor companies base their e-business only on email and Microsoft Office, they experience losses, errors, and misunderstandings. This paper has a goal to analyse to analyse business processes and problems inside those subcontractor companies and to propose software solutions in the form of Enterprise resource planning (ERP) system. ERP is business management software that is designed to integrate data sources and processes of an entire organization into a combined system. ERP software is multi-module application software that integrates activities across functional departments such as accounting, finance, supply chain, human resources, customer information and many others. We first analysed current business processes of Telekom Slovenije subcontractor companies, and then we noticed and analysed problems which can be solved by implementing and ERP system. Before we proposed conceptual model and started to analyse it, we defined system requirements. System should automate business processes and provide friendly user interface to reduce number of

human errors, decrease time required for financial analysis, documentation and report preparation such as human resources organization. Since the system is supposed to be implemented for a small business every part of the system, including its infrastructure should be optimized and designed to fit a small-size company budget. Also it should be modular as much as possible to reduce adoption time and price, since business processes can be changed and vary from company to company. Then conceptual model of ERP system is proposed with an intention to analyse and discuss different technologies, infrastructures and architectures that can be used to implement an ERP system for small-size company. Analysis is divided into four sections, and every section is representing the ERP system from different viewpoint, Use-Case View, Logical View, Process View and Deployment View. Use-case view shows interactions between user and ERP system and describes functionalities of an ERP system. In this chapter different user roles are defined and different use cases are described for those different user roles, and some of them are shown on UML diagrams. Logical view is concerned with the functionality that the system provides to end-users and it is represented with UML class diagram. In this section we analysed traditional ERP architecture and Web-based ERP architecture, and we came to conclusion that Web-based ERP architecture is a good choice for such a system since Web-based ERP has the capabilities of internet access and real time information so it increases mobility. Also with Web-based Three-tier architecture our ERP can be distributed and deployed on different platforms and in the cloud which lowers infrastructure costs. The main drawback of Web-based ERP is security. Every business process is package which can be added, removed and changed without affecting other packages (business processes). Three-tier architecture and separation of business processes into non-dependant packages are establishing required modularity of the system. Process View illustrates how objects interact with each other. It emphasizes on how messages are sent and received between objects. Deployment View shows the physical description of the system topology, including the structure of the hardware units and software that executes on each unit. Comparing traditional ERP infrastructure and deployment with modern cloud technologies, we came to conclusion that cloud ERP can give more benefits to our system than traditional practice of deploying ERP system on the company's infrastructure in company itself.

REFERENCES

- [1] Bahssas, AlBar and Hoque, *Enterprise Resource Planning (ERP) Systems: Design, Trends and Deployment*, Atlantis Press
- [2] D. Litan, A. Apostu, L. Copcea (Teohari) and M. Teohari, *Technologies for Development of the Information Systems: from ERP to e-Government*, Issue 2, Volume 5, 2011 151 INTERNATIONAL JOURNAL OF APPLIED MATHEMATICS AND INFORMATICS
- [3] www.en.wikipedia.org/wiki/Business_process
- [4] J. Park and N. Lee, *A Conceptual Model of ERP for Small and Medium-Size Companies Based on UML*, School of Computing, College of Information Science Soongsil University, Seoul, Korea
- [5] I. Jacobson, G. Booch, and J. Rumbaugh, *The Unified Modeling Language User Guide*, Addison Wesley, 1999
- [6] www.en.wikipedia.org/wiki/42B1_architectural_view_model

- [7] https://en.wikipedia.org/wiki/Multitier_architecture
- [8] C.M.Navaneethakrishnan, *A Comparative Study of Cloud based ERP systems with Traditional ERP and Analysis of Cloud ERP*, IJECS Volume 2 Issue 9 September, 2013 Page No. 2866-2869
- [9] Koh Zhan Xiong Josiah, *ERP Systems in the Cloud*
- [10] Y. Zakaria, O. Hegazy, *Enhancing service design in ERP systems using patterns*
- [11] Quiescenti, Bruccoleri, Manfredi, La Commare, Umbero, Noto La Diega, Sergio, Perrone, Giovanni, *Business Process Oriented Design of ERP Systems for Small And Medium Enterprises*, International Journal of Production Research, 2006
- [12] M. Lutovac, D. Manojlov, *The Successful Methodology for Enterprise Resource Planning (ERP) Implementation*, (2012)
- [13] M. Hilman, F. Setiadi, I. Sarika, J. Budiasto, and R. Alfian, *Comparative Study Of ERP Implementation Methodology Case Study: Accelerated SAP VS DANTES HASIBUAN Methodology*