



Middle East Technical University
Informatics Institute

UNIFIED BUSINESS PROCESS MODELING METHODOLOGY (UPROM) APPLICATION: CASE STUDY RESULTS

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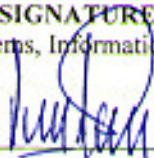
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8. ABSTRACT <p>UPROM is a unified business process modeling methodology for conducting business process analysis and modeling, requirements analysis, software size estimation and process documentation practices in an integrated way based on business process models. We conducted multiple case study research to evaluate UPROM. We used UPROM tool to conduct modeling activities and automatically generate outputs in conformance with UPROM methodology. In this report, we present the detailed outputs created as a result of case study applications. The first case study focuses on the functional size estimation practice of UPROM. The second and fourth case studies implement system requirements, functional size estimation and process documentation practices. The third case focuses on process documentation. The second and third cases are real life projects where UPROM is followed to prepare project deliverables. The fourth compares the coverage of artifacts generated by UPROM to the outputs already developed in an existing project. The outputs of these four case studies are provided in this report.</p>	
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LIST OF ABBREVIATIONS

BPMod	: Business Process Modeling
e-LegalEntity	: Company Central Registration System Project
e-Trademark	: Trademark Central Registration System Project
FP	: Function Point
FSM	: Functional Size Measurement
IIS	: Integrated Information System Project
KPI	: Key Performance Indicator
METU	: Middle East Technical University
PublicInvest	: Public Investment Project
SDLC	: Software Development Life Cycle
UPROM	: Unified Methodology for Developing Business Process Models for Diverse Goals

CHAPTER 1

INTRODUCTION

Business process modeling (BPMoD) is one of the most significant means for transferring process experience into structured process knowledge. Process modeling methodologies are useful in defining existing processes for a better understanding and analysis to discover current problems as well as depicting the to-be processes. BPMoD covers analyzing, defining and improving business processes of organizations in alignment with the organization's strategic objectives. BPMoD has become a common tool in various areas like business process analysis, process documentation, process improvement and process automation. There are many other disciplines that require the knowledge captured in business processes. Specifically, if an organization plans to automate its business processes, the knowledge of business processes is necessary throughout the software development life cycle; mainly for the activities of requirements analysis and project management by means of software size measurement.

In all of these areas, the knowledge that resides in the organization to conduct business processes is critical to achieve diverse goals. This knowledge may be explicit, defined as process documents or models; or it may be inherent in the culture of the organization, where it designates the operations as the organizational instinct. If an organization conducts BPMoD activities, the organization creates opportunities to improve its processes while it captures valuable and high amount of knowledge that can be utilized for other purposes. If the organization conducts activities related to other purposes, with the help of methodologies to transfer business process model knowledge to other activities; the related artifacts can be developed in a more complete, consistent and maintainable way.

UPROM methodology is developed as a unified BPMoD methodology that provides an integrated approach supporting BPMoD activities targeted for diverse goals. This BPMoD methodology guides users for process improvement while enabling them to transfer this knowledge to artifacts to be developed for other goals. As a result, these artifacts are developed as consistent, complete and maintainable. The practices supported by the methodology are, in addition to business process modeling, user requirements analysis, software early size estimation and process documentation. The process, notation, guidelines and principles to conduct unified activities are described in the methodology to provide modelers a full approach to develop process models while guiding for these diverse goals in an integrated way.

The detailed information on UPROM methodology is provided in the doctoral thesis named "A Unified Methodology for Developing Business Process Models for Diverse Goals" by the same author of this technical report from Informatics Institute, METU. The aim of this technical report is to provide the full version of artifacts developed as a result of case study applications and other raw data regarding the case studies. The details of the case study design, description and conduct are provided in the thesis document.

Between **Chapter 2** to **Chapter 5**, the related case is briefly described and the generated artifacts in conformance to UPROM methodology are provided. All of the artifacts provided as appendices in this technical report are generated by UPROM tool. Appendices can be found on the attached CD.

CHAPTER 2

CASE STUDY OUTPUTS FOR CASE 1: THREE SIMPLE APPLICATIONS

In this chapter, the outputs of the first case study are provided, which is focused on the functional size estimation practice of UPROM.

2.1 DEFINITION OF THE CASE

In Software Management Research Group [1], three different simple business application systems are defined for research purposes. The group utilized them for different FSM experiments, so both the requirements and size measurement results of these systems are peer reviewed many times [2], [3]. These are simple business applications which are not designed to follow long processes, but rather describe basic operations. To evaluate how well UPROM performs on size estimation, we developed simple business process models, and compared the results of the UPROM size measurement with measured COSMIC FP [4] values.

We need to consider that these three cases describe the data movements in detail so that the size of the applications are identified precisely. UPROM describes an analysis methodology in the business domain and from a user perspective. Thus, UPROM is not used to express requirements in this much detail, as the aim is to develop user level system requirements. However, COSMIC utilizes software requirements as input to calculate the measured size precisely. So, these cases provide a good opportunity to evaluate UPROM size measurement methodology for detailed cases. The three systems are as follows.

Paparazzi Information System: This is an application for managing celebrity information, keeping the relationships between celebrities, and recording the catches of celebrities in specific places.

Veterinary Record System: This application is used to record pets, their owners and the applied vaccines.

Movie Manager System: This system keeps the information on movies together with its directors, producers, writers and actors/actresses. The inquiries and listings are also conducted for the movies.

2.2 UPROM OUTPUTS FOR CASE STUDY 1

The case study outputs for the three systems within the case study are provided separately in this section.

2.2.1 Paparazzi Information System Case Study Outputs

The definition of the system and requirements for Paparazzi Information System can be seen in **Appendix A**. The FSM of the system measured by COSMIC is given in **Appendix B**. Business process model report generated, including EPC, FTD and OC diagrams for Paparazzi Information System is provided in **Appendix C**. Analysis models report generated including FAD and ERD diagrams is provided in **Appendix D**. Size estimation report including early size estimation details and overall estimated size in FP is provided in **Appendix E**.

2.2.2 Veterinary Record System Case Study Outputs

The definition of the system and requirements for Veterinary Record System can be seen on **Appendix F**. The FSM of the system measured by COSMIC is given in **Appendix G**. Business process model report generated including EPC, FTD and OC diagrams for Veterinary Record System is provided in **Appendix H**. Analysis models report generated including FAD and ERD diagrams is provided in **Appendix I**. Size estimation report including early size estimation details and overall estimated size in FP is provided in **Appendix J**.

2.2.3 Movie Manager System Case Study Outputs

The definition of the system and requirements for Movie Manager System can be seen in **Appendix K**. The FSM of the system measured by COSMIC is given in **Appendix L**. Business process model report generated including EPC, FTD and OC diagrams for Movie Manager System is provided in **Appendix M**. Analysis models

report generated including FAD and ERD diagrams is provided in **Appendix N**. Size estimation report including early size estimation details and overall estimated size in FP is provided in **Appendix O**.

CHAPTER 3

CASE STUDY OUTPUTS FOR CASE 2: E- LEGAENTITY AND E-TRADEMARK PROJECTS

In this chapter, the outputs of the case study 2 are provided. This case study is focused on requirements analysis, functional size estimation and process documentation practices of UPROM.

3.1 DEFINITION OF THE CASE

Company Central Registration (e-LegalEntity) project aims to automate the establishment of new legal entities and management of changes in their data through their lifetime. Another goal of the project is to develop the system so that different types of legal entities which are registered separately at the moment is gathered under one database and given a unique id. In project's scope, only the processes related to companies are to be automated. The rest of the legal entity types are to be registered to the system by simple registration processes, which require basic processes to be conducted.

Within the same project, one more system is to be developed: Trademark Registration System (e-Trademark). By means of this system, all the trademark applications, approvals and related workflows are to be automated by an online application. e-Trademark project's scope include operations on patent and geographical indications together with trademarks. As the processes are very similar for three of them, thus it is decided to analyze the trademark processes in detail, and reference to it for the patents and geographical indicators.

The project is subcontracted to our analyst group by the main contractor organization. Our group consists of three analysts one of which is the researcher of

this study. The three experts from the contractor also work as the analysts in the project; they conduct peer reviews on the artifacts, change, update and approve them together with our group. All the documents are also presented to SMEs which are composed of officials from different entities and their consent is necessary to finalize the studies. Both e-LegalEntity and e-Trademark system studies are conducted by the same analyst group, but different SMEs (one for each) are responsible for them. To ensure that all the stakeholders are in common terms, a one day training is provided both for the analysts of the contractor and the SMEs. The training topics included basics of business process modeling, modeling with EPC and brief explanation on the UPROM methodology and usage of the tool.

The contractor required that the analysis of the current situation is conducted, the user requirements of the system to be automated is analyzed and defined, the development of the software is planned and the processes to be performed by means of the software is disseminated to the stakeholders as written process definition documents. Then, the development of the software is subcontracted with the technical contract that is developed by using the developed user requirements.

We conducted interviews with two analysts from our group, three analysts from contractor organization and two SMEs. The interview questions are presented in **Appendix P**. The summary and highlights of answers to each question given by the interviewees are listed in **Appendix Q**.

3.2 UPROM OUTPUTS FOR CASE STUDY 2

The case study outputs of the two projects within the case study are provided separately in this section.

3.2.1 e-LegalEntity Project Case Study Outputs

Business process model report generated including EPC, FTD and OC diagrams for e-LegalEntity project is provided in **Appendix R**. Analysis models report generated including FAD and ERD diagrams for e-LegalEntity project is provided in **Appendix S**. System requirement document generated for e-LegalEntity project, which is used to develop technical contract for the project is provided in **Appendix T**. Size estimation report including early size estimation details and overall estimated size in FP for e-LegalEntity project is provided in **Appendix U**. Process definition document generated for e-LegalEntity project covering all processes defined is provided in **Appendix V**. Business glossary generated for e-LegalEntity project is provided in

Appendix W. Improvement opportunity list generated for e-LegalEntity project is provided in **Appendix X.**

3.2.2 e-Trademark Project Case Study Outputs

Business process model report generated including EPC, FTD and OC diagrams for e-Trademark project is provided in **Appendix Y.** Analysis models report generated including FAD and ERD diagrams for e- Trademark project is provided in **Appendix Z.** System requirement document generated for e- Trademark project, which is used to develop technical contract for the project is provided in **Appendix AA.** Size estimation report including early size estimation details and overall estimated size in FP for e- Trademark project is provided in **Appendix BB.** Process definition document generated for e- Trademark project covering all processes defined is provided in **Appendix CC.** Business glossary generated for e- Trademark project is provided in **Appendix DD.** Improvement opportunity list generated for e- Trademark project is provided in **Appendix EE.**

CHAPTER 4

CASE STUDY OUTPUTS FOR CASE 3: PUBLICINVEST PROJECT

In this chapter, the outputs of the case study 3 are provided. This case study is focused on the process documentation practice of UPROM.

4.1 DEFINITION OF THE CASE

The objective of BĪHAP project is implementation of research and development services for information map of the Ministry of Development, processing the information map items electronically after extraction, visualizing the information map items and relating them to the business processes, and developing a methodology and model on information map building that can be applied by other public institutions. The project is conducted as a consortium of three organizations. One of the groups is working on analyzing and defining business processes for one of the main functional areas of the ministry: Public Investments.

The public investment processes mainly cover development and publishing of investment programs, deciding on the projects to be executed within the programs and execution and completion of the investment programs. This part of the project is named as “KB_Kamu_Yatirimlari” (Public Investments - PublicInvest). Process analysts worked on these processes together with SMEs using UPROM tool and following UPROM methodology to analyze and model the processes. Project’s scope does not include automation of the related processes. The outputs required by the project are business process models, process definition documentation related to those models, business glossary and a report for improvements. The whole project already included definition of data in detail and the generation of an

information map. But before that work is completed, they required to obtain a list of terminology utilized through the defined business processes, which will be the basis for ontology studies in further steps. Business glossary is also generated by UPROM to meet this need.

As researchers, the authors of this study were not involved in the process modeling and analysis activities of this project. Before the start of the project, a training session was conducted to train analysts on the usage of UPROM methodology and the tool, and necessary support was given when necessary. The resulting outputs; business process models, process definition document, improvement list and business glossary; were collected upon finalization of the study and data is collected using those. Additionally, interviews are conducted with the analysts and SMEs from the organization to evaluate the results. The interview questions are presented in **Appendix FF**. The summary and highlights of answers to each question given by the interviewees are listed in **Appendix GG**.

4.2 UPROM OUTPUTS FOR CASE STUDY 3

Business process model report generated including EPC, FTD and OC diagrams for PublicInvest project is provided in **Appendix HH**. Process definition document generated for PublicInvest project covering all processes defined is provided in **Appendix II**. Business glossary generated is provided in **Appendix JJ**. Improvement opportunity list generated is provided in **Appendix KK**.

CHAPTER 5

CASE STUDY OUTPUTS FOR CASE 4: METU-IIS PROJECT

In this chapter, the outputs of the case study 2 are provided. This case study is focused on requirements analysis, functional size estimation and process documentation practices of UPROM.

5.1 DEFINITION OF THE CASE

METU has 24.000 students currently enrolled. There are 40 undergraduate departments and 160 graduate programs. METU also has 21 interdisciplinary research centers. More than 5.000 personnel are working for the university. A large number of IT systems have been developed since the establishment of the university Computer Center. However most of these IT systems run independently, not communicating with each other and using various technologies for data storage and communication. As a result of this crowded, complex environment, problems emerged such as out-of-control duplication of data, non-standard communication, lack of control over IT service levels and very high maintenance costs.

The Integrated Information System (IIS) project was initiated in 2009 by Computer Center in order to solve these problems. IIS aims at integrating the existing IS applications in accordance with the university strategic plan. Initially Computer Center developed a business process map consisting of all the business processes of METU. These processes were prioritized in line with the master project plan.

Since the beginning of the project, the activities of analyzing and modeling of business processes and eventually developing software running on automated

business process models are conducted iteratively for each process module. More than 300 person-months are utilized in the last 3 years.

The method for defining business processes can be summarized as follows. First all stakeholders involved in the business process are contacted. Then modeling experts start analysis sessions with the stakeholders. The analysis team puts in additional effort to produce process definitions documentation. Then the BPMN models of the processes are developed in accordance with the textual definitions. The data elements are fed into the university business glossary. In compliance with the data element definitions, the web services are implemented and SOA mediation layer are integrated with them. Then the software models associated with the process model are developed. After functional testing the process automation software to the university portal are integrated via the user interface portlets.

The models are developed by using Eclipse BPMN modeler, in compliance with BPMN 2.0 standard. Activiti is utilized as the underlying process engine. Business rules are represented in Drools. All programs are coded with Java, JSP and Javascript.

There are about 90 process modules identified in the business process map. The concept of “process module” is used for a group of process models which are coherent and focus on a specific working area of the organization (like budgeting). All of the process models under a process module are connected to the hierarchical structure of the related module. Until now, the team completed the development of 10 modules. Business process analysis and definition effort and total development effort are available for the modules completed.

In summary, there are two kinds of outputs for defining business processes: Process definition documents (named as “definitive process models” by the organization) and process models in BPMN (named as “analytical process models”). Process definition documents are organized in a tabular format and contain textual definitions of processes, detailed activity definitions, stakeholders, business rules, risks, inputs and outputs, objectives, entry and exit criteria of the process and data elements. Moreover, these documents also contain the requirements related to the automation of the process, and key performance indicators to be collected. Process models are developed using BPMN notation, however they are high level models representing only the control flow. The images of process models are also embedded in the process definition documents. In this case study, when the statement “native process definition document” is used, we refer to the existing documentation that is

developed by the organization that contains all information about process, requirements, KPI and definitions.

The organization does not use any formal method for functional size estimation of the process modules to be automated. However, at every phase, they make an estimation of time and effort for each process module using similarity approach. They also collect effort and duration data for the development activities. This shows that they are willing to apply some formal approach to estimate the size of their modules. They also state that the organization needs to make effort estimation for the rest of the modules to be developed in phases to use as the basis of planning and budgeting.

The organization is willing to conduct different methodologies for their analysis activities and accepted to share information with us and to allocate personnel to study together in the research activities and evaluate the results. Considering the scope of the project, METU-IIS project conforms to all our criteria for our case study. We can conduct a case study that covers business process improvement, requirements engineering, software size estimation and process documentation practices. It is a retroactive type case study where we apply UPROM to obtain outcomes where the outcomes are already developed in the study previously. We compare and evaluate the results with the previous results and discuss the findings. The organization agreed to work together and provide necessary effort to explain the system and evaluate the outputs together.

Among the process modules for which the process and requirements analysis is completed, we selected two process modules together with the organization. First process module is “Establishment of Research Opportunities” (will be called shortly as “IIS-ERO Module”). This is one of the process modules in research process area group, which is a high-importance process area for the organization which is planned to be fully automated. Second process module is “Announcement”, which is a central module utilized as a service by many other process modules. These two modules have mature process definitions. The automation of IIS-ERO is completed.

5.2 UPROM OUTPUTS FOR CASE STUDY 4

Business process model report generated including EPC, FTD and OC diagrams for METU-IIS project is provided in **Appendix LL**. Analysis models report generated including FAD and ERD diagrams is provided in **Appendix MM**. System requirement document generated is provided in **Appendix NN**. Size estimation

report including early size estimation details and overall estimated size in FP is provided in **Appendix OO**. Process definition document generated covering all processes defined is provided in **Appendix PP**. Business glossary is provided in **Appendix QQ**. Improvement opportunity list is provided in **Appendix RR**. Process KPI list is provided in **Appendix SS**. Coverage analysis for METU-IIS documents by the models and artifacts produced by UPROM is provided in **Appendix TT**.

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APPENDICES

Appendix A: Paparazzi Information System Definition and Requirements

Appendix B: Paparazzi Information System FSM Solution

Appendix C: Paparazzi Information System Business Process Models Report

Appendix D: Paparazzi Information System Analysis Models Report

Appendix E: Paparazzi Information System Size Estimation Report

Appendix F: Veterinary Record System Definition and Requirements

Appendix G: Veterinary Record System FSM Solution

Appendix H: Veterinary Record System Business Process Models Report

Appendix I: Veterinary Record System Analysis Models Report

Appendix J: Veterinary Record System Size Estimation Report

Appendix K: Movie Manager System Definition and Requirements

Appendix L: Movie Manager System FSM Solution

Appendix M: Movie Manager System Business Process Models Report

Appendix N: Movie Manager System Analysis Models Report

Appendix O: Movie Manager System Size Estimation Report

Appendix P: e-LegalEntity and e-Trademark Interview Questions

Appendix Q: e-LegalEntity and e-Trademark Summary and Highlights of Interviews

Appendix R: e-LegalEntity Business Process Models Report

Appendix S: e-LegalEntity Analysis Models Report

Appendix T: e-LegalEntity System Requirement Document

Appendix U: e-LegalEntity Size Estimation Report

Appendix V: e-LegalEntity Process Definition Document

Appendix W: e-LegalEntity Business Glossary

Appendix X: e-LegalEntity Improvement Opportunity List

Appendix Y: e-Trademark Business Process Models Report

Appendix Z: e-Trademark Analysis Models Report

Appendix AA: e-Trademark System Requirement Document

Appendix BB: e-Trademark Size Estimation Report

Appendix CC: e-Trademark Process Definition Document

Appendix DD: e-Trademark Business Glossary

Appendix EE: e-Trademark Improvement Opportunity List

Appendix FF: PublicInvest Interview Questions

Appendix GG: PublicInvest Summary and Highlights of Interviews

Appendix HH: PublicInvest Business Process Models Report

Appendix II: PublicInvest Process Definition Document

Appendix JJ: PublicInvest Business Glossary

Appendix KK: PublicInvest Improvement Opportunity List

Appendix LL: METU-IIS Business Process Models Report

Appendix MM: METU-IIS Analysis Models Report

Appendix NN: METU-IIS Systems Requirement Document

Appendix OO: METU-IIS Size Estimation Report

Appendix PP: METU-IIS Process Definition Document

Appendix QQ: METU-IIS Business Glossary

Appendix RR: METU-IIS Improvement Opportunity List

Appendix SS: METU-IIS Process KPI List

Appendix TT: METU-IIS Coverage Analysis for METU-IIS Documents