



# **SOFTWARE MAINTENANCE: ELTIS-PROJECT**

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<b>XIV</b>	Koskinen, J., Ahonen, J.J., Kankaanpää, I., Lintinen, H., Sivula, H. & Tilus, T. (2006). "Checklist-based information system change decision making support method". <i>Proceedings of the 13th European Conference on Information Technology Evaluation (ECITE 2006)</i> , 324-332. Academic Conferences Ltd., Reading, UK. Conf. location: Genoa, Italy. Sept. 28-29, 2006. 8 p. (*)

## PREFACE

This report contains the main articles published, accepted or submitted so far related to the ELTIS (Extending the LifeTime of Information Systems) –project. ELTIS is a 3-year research project (funded during 2003-2006) of the *University of Jyväskylä's Information Technology Research Institute (ITRI, in Finnish: TITU)* with a budget of about 598,000 euros. The project has been funded mainly by *National Technology Agency of Finland* (in Finnish: TEKES) and partly by some of the Finnish software houses, including *TietoEnator Inc., Tietokarhu Inc., and International Business Systems - IBS Inc.* The project has focused on studying possibilities of extending the lifetime of information systems and especially on evaluating software evolution options.

The articles discuss software evolution, software modernizations, software process improvement related to modernizations, and development of methods for evaluating software evolution, modernizations and the related decisions. The articles have been published or submitted for publication to international refereed scientific conferences, including: CSMR 2005, BIS 2005, ECITE 2005, ISESE 2005, IASTED SE 2006, EASE 2006, BIS 2006, PROFES 2006, EuroSPI 2006, and ECITE 2006.

The articles marked with (\*) in the table of contents are to be studied related to the University of Jyväskylä's advanced level course: TJTSS63 (Software Maintenance) (as a partial fulfillment of the current course requirements).

**Part I** is an excerpt of the first major technical report by ELTIS-project. It has been published in the ITRI's series and its condensed version has been submitted for publication in an international refereed conference. The relatively large report presents a detailed analytical evaluation and comparison of 12 main methods for software modernization estimation. The evaluation is achieved by systematically applying NIMSAD (Normative Information Model-Based Systems Analysis and Design) meta-framework. The here included excerpt includes main parts of the report: Abstract, table of contents, introduction, conclusions, and a summarizing table of the results concerning the evaluation. Another study applying NIMSAD in presented in Part III.

**Part II** presents an empirical study of software modernization decision criteria. Information has been gathered from 26 industrial decision making experts representing 8 organizations by using questionnaires. The study revealed the relative actual importance of the 49 criteria suggested earlier in the relevant software engineering literature. The top-20 criteria are listed and the top-10 criteria discussed. The gathered data has later been applied in Part V and closely related information gathered in Part VI.

**Part III** provides a description of using NIMSAD in 18 evaluations of software engineering methods in three projects of ITRI (including ELTIS; as described in Part I,

component-based software development methodologies, and software testing in object-oriented software engineering methods). The study has revealed the strong sides and weakness of NIMSAD in these sort of evaluations. This theoretical study extends the mainstream research conducted in the ELTIS-project.

**Part IV** provides a method called ISEBA (Information System Evolution Benefit Assessment). The method supports selection of suitable benefit assessment metrics and methods in system/software evolution/change situations. The method is based on empirical research on industrial decision making and co-operation projects. There is a need for a practical framework, such as ISEBA in this context. Other methods developed in ELTIS are MODEST (represented in Part V), and VERDE (represented in part XIV).

**Part V** presents the current version of a method called MODEST (Modernization Pressure Estimation) for early system modernization pressure estimation. The method is based on the empirical data gathered in the ELTIS-project (Part II). A detailed description of the method is given. It has been validated by expert inspections and industrial use cases. It is a low-effort, easy-to-use and potentially effective method for its purpose.

**Part VI** presents an empirical study of industrial decision making for software modernizations. Information has been gathered by interviewing 29 decision making experts. The sample of experts was about the same as in the study presented in Part II. 26 questions regarding the nature of decision making were posed. Six important themes were identified and discussed: Role of intuition, economical evaluation, confirmation of the decisions, group decision making, tool support, and success and limitations of the conducted empirical study.

**Part VII** presents an industrial case study of software maintenance evaluations. The target of the evaluation was a large legacy system. The performed 526 maintenance tasks and the related effort were first characterized. Then versatile information concerning maintainability aspects, maintenance problems, and maintenance processes was gathered from seven maintenance experts via interviews. The study measured and related 11 maintainability quality aspects, and 27 maintenance problem types. The study provided e.g. insights on the nature of relevant maintenance issues in improving practical industrial software engineering. Other case studies are presented in Parts X, XII and XIII.

**Part VIII** is an overview paper of the topics covered in the ELTIS-project. It is a good concise introduction to be read first. The paper outlines the applied approach for developing and improving software evolution estimation methods. Various approaches and methods have been surveyed, developed and experimented. The applied method development approach includes activities concerning method evaluations and applications (Parts I, III, XI, and partly X and XIII) empirical studies for method development (Parts II, VI, IX), actual method development (IV, V, VIII, XIV), and related industrial case studies (VII, X, XII, XIII, and partly XIV).

**Part IX** presents an empirical qualitative study on one of the themes identified earlier (Part VI). The paper studies the role of intuition in industrial decision making concerning software modernizations and replacements. Intuition was found to be the dominant factor in decision making. However, most of the decision makers did not see intuition as a preferable way to make decisions. One reason to this is that it is generally assumed or even required that decisions are made based on rational argumentation.

**Part X** presents an industrial case study applying VDM (Value-Based Decision Model). The study aims at supplementing the empirical basis of using software evolution evaluation methods in industrial settings. The model considers the value of a legacy software system and proposes convenient evolution strategies. Use of VDM is

characterized and the case study described. VDM has been applied in case of a production-use, large-scale industrial legacy system. Results produced by VDM, VDM's evaluation, and system evolution strategy recommendations for the case are presented.

**Part XI** presents a short paper on the challenges of information system evolution benefit assessment. The paper relates to the ISEBA-method (Part IV). Classical investment criteria and their advantages and disadvantages with respect to system evolution options assessment are studied.

**Part XII** reports the results of an industrial case study. The study provided an outline of a process for software system modernization decisions. The rationale of the process is explained and the process is defined in a way that allows its adaptation for other organizations and situations. The process is a light-weight one and is based on the use of objective data. The process has been used to solve a real industrial decision making situation in which the process was successful.

**Part XIII** presents an industrial case study. Four approaches have been used to assess the replacement success of the case system. The target of assessments has been a large commercial legacy system. The applied assessment approaches concerned: User satisfaction, strengths and problems of the system, problem surveillance, and expert judgments. The assessments have been conducted by comparing the situations before and after the rewrite. The applied approaches have supplemented each other well and results provided by them have been mainly consistent. The study has offered a wide view of the system replacement effects and lessons for the replacement assessment process improvement in industrial settings.

**Part XIV** describes a checklist-based information system change decision making support method called VERDE (Verified Decision). The method e.g. aims at enabling verification of decisions. The method includes an extensive, hierarchical checklist for supporting the decision making at the desired level of details. The method has been developed based on software engineering literature and empirical data. The paper represents the basis of the method, its structure, and its testing based on multiple inspections and an industrial case study. The method provides a way to heed many of the issues to be addressed during evaluation and improvement of industrial decision making concerning information system changes.

There exists also ongoing, currently unpublished ELTIS-studies related e.g. to the differences of the software modernization and replacement initiation criteria, group decision making processes in industrial software evolution, and the general nature and characteristics of developing software evolution estimation methods for software industry.

The following web-page will give further information and instructions for the related TJTSS63 (Software Maintenance) course: <http://www.cs.jyu.fi/~koskinen/oyp0.htm>

Lecture notes on the material are available in Finnish:

<http://www.cs.jyu.fi/~koskinen/oyp0L-ELTIS.pdf>

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**Keywords:** Software maintenance, software evolution, information system management, information system evaluation, empirical software engineering, software industry, system lifetime, system lifecycle, software modernizations, decision criteria, decision processes, software evaluation, estimation methods, method evaluations, industrial decision making, case studies, legacy systems, software process improvement, software metrics, system evolution strategies, software benefits, software costs, benefit assessment, investment options evaluation, modernization pressure, software modernization need estimation, software maintainability, meta-frameworks, intuition, rational decision making, confirmation of decisions, light-weight methods, user satisfaction, SWOT-analysis, expert judgments, problem surveillance, system portfolio analysis, cost estimation methods, classical investment criteria, ISEBA (Information System Evolution Benefit Assessment), MODEST (Modernization Pressure Estimation), VERDE (Verified Decision), NIMSAD (Normative Information Model-Based Systems Analysis and Design), VDM (Value-Based Decision Model), SABA, Renaissance, COCOMO II, Function Point Analysis, Softcalc.