

# Towards the IT Support of Processes in Small Software Companies

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**Abstract.** *According to multiple surveys, there is a potential to improve how processes in small software companies are supported by IT. On the path to fulfilment of this goal, it is firstly necessary to define a process model specific for small software companies. When defining the model, multiple available resources were taken into account, e.g. CMMI, ISO 12207, ISO 29110, MoProSoft, MPS.br, ERP system reference models etc. Based on these resources, the Small Software Company Process Model is outlined.*

**Keywords.** small software company, process model, IT support of processes, ERP

## 1 Introduction

Although much attention has recently been devoted to the topic of software engineering, the results of published surveys show that a significant number of software projects are not successful. Ambler [1] states that the ratio of successful software projects reaches 60 % while the rest is categorized as challenged or failed.

Overall, researchers' effort worldwide concentrates on software development methodologies, practices and standards which usually focus only on the software development area while other areas of company processes are not in these methodological sources taken into account. There is a lack of comprehensive endeavor to look at a software company operation as a whole.

Performing software development tasks usually requires the usage of various software tools. The integration of these tools allows the streamlining of software development processes because of sharing data and methods within a company [8]. Such solution which enables information integration among various activities within a software development company represents an information system for a software company.

Multiple surveys, e.g. [7] and [15], brought up a desire of software companies to devote more effort to other areas of company processes, to connect them

with software processes and to support company processes as a whole with an appropriate information system. The aim of such an information system is an effective support of processes in all areas of company's life. Even small software companies have to manage all aspects of their operations, such as work scheduling and management, knowledge management, financial management, customer relationship management, and so on. Therefore they should benefit from the usage of described information system.

Considering all the facts stated above, a potential for an improvement was identified. The topic of an information system completely supporting a software company operation is not widely examined in literature and in practice. Most resources focus only on the software development area, not on the operation of a software company as a whole.

The main objective of our work in long-term is to propose, develop and evaluate a prototype of an integrated information system that would fulfill the needs of small software companies in the described area, i.e. to effectively support all crucial processes in various areas of company's operation.

To successfully address the main objective, it is necessary to breakdown the solution into multiple artifacts that will be iteratively designed, developed, demonstrated, evaluated, and communicated. Particularly:

- Small software company process model,
- Requirements specification for the information system,
- Prototype of the information system.

In order to support a software company operation with an appropriate information system, it is first necessary to define a small software company process model, which is also the main objective of this paper. Later, on the basis of the process model, it is possible to specify and evaluate requirements for the information system. Without an explicit process model, it would be very difficult to prepare an appropriate set of requirements. Finally, a prototype of the information system will be developed, evaluated and communicated in the target group.

For the purpose of our work, a small software company is defined as a company that deals with the development of both the custom and off-the-shelf software on any platform while having fewer than 25 employees. This definition is according to the working group WG24 of the ISO / IEC JTC 1 SC7 [6].

The paper proceeds as follows. Section 2 presents research methodology. Existing process models are introduced in Section 3. Further, the proposal of the Small Software Company Process Model is presented in Section 4. Lastly, conclusion, current development and further work are outlined.

## 2 Research methodology

Our research methodology is based on the Design Science in Information Systems Research [3], [10]. Specific activities are described in [11]:

- Activity 1. Problem identification and motivation,
- Activity 2. Define the objectives for a solution,
- Activity 3. Design and development,
- Activity 4. Demonstration,
- Activity 5. Evaluation,
- Activity 6. Communication.

This paper covers the activities 1, 2, and 3 of the artifact of a small software company process model. The rest of activities and artifacts will be realized subsequently.

The objective of the proposed process model is to include all crucial process areas of a small software company so that they can be later addressed by the requirements specification and by the prototype of the information system.

## 3 Related work

Although no model that covers all crucial processes in a small software company was found, there are plenty of solutions that cover some of them. When collecting the most important related work, multiple resources were taken into account.

The first group represents works focused on software development processes in general. In this area, CMMI process reference model and International standard ISO/IEC 12207 focused on software lifecycle processes were analyzed.

Beside software development processes in general, there is a group of approaches that focus on software process improvement in small software companies [12], in particular International standard ISO/IEC 29110 focused on very small software entities, Mexican national standard MoProSoft, and Brazilian national standard MPS.Br.

In order to address the operation of a company as a whole, ERP system were taken into account, i.e. generic solutions [2] and a proposal for software information system [8] as well.

The above mentioned approaches are briefly introduced in following sections. Each approach was analyzed particularly from two perspectives. First perspective examines the suitability for a small software company. Second one is focused on covering other process areas beside the software development.

### 3.1 CMMI

Capability Maturity Model Integration is well known approach to process improvement. Currently there are three CMMI models [14]. For the purposes of this article, CMMI for Development is the most interesting one. It helps organizations in developing products or services to integrate their software and systems engineering while improving their processes and performance.

CMMI defines five maturity levels. The process areas below and their maturity levels are listed for the CMMI for Development model:

- Maturity Level 1 – Initial (no process areas are listed at Level 1),
- Maturity Level 2 – Managed: Configuration Management, Measurement and Analysis, Project Monitoring and Control, Project Planning, Process and Product Quality Assurance, Requirements Management, Supplier Agreement Management,
- Maturity Level 3 – Defined: Decision Analysis and Resolution, Integrated Project Management, Organizational Process Definition, Organizational Process Focus, Organizational Training, Product Integration, Requirements Development, Risk Management, Technical Solution, Validation, Verification,
- Maturity Level 4 – Quantitatively Managed: Organizational Process Performance, Quantitative Project Management,
- Maturity Level 5 – Optimizing: Causal Analysis and Resolution, Organizational Performance Management.

Although the CMMI model is too complex for a small software company, selected CMMI processes can be applied for it. On the other hand, further areas essential for company operation are not included

### 3.2 ISO/IEC 12207

International standard ISO/IEC 12207:2008 Systems and software engineering – Software life cycle processes defines all the tasks required for developing and maintaining software. Current version of the standard (2008) defines 43 processes [5], which are

divided into two main categories: System context processes and Software specific processes.

This model is too complex for a small software company as well. When designing our process model, the basic segmentation of ISO/IEC 12207 was taken into account and all its relevant processes were included. This model includes only a few processes belonging to other areas than software development and many of them are still not covered.

### 3.3 ISO/IEC 29110

International standard ISO/IEC 29110: Systems and Software Life Cycle Profiles and Guidelines for Very Small Entities is targeted at very small entities up to 25 people [4]. The purpose is to define a subset of international Standards relevant to the context of very small entities, for example, processes and outcomes of ISO/IEC 12207 and products of ISO/IEC 15289.

The Entry and Basic Profiles of this standard contains only two process areas [4]:

- Project Management - the purpose is to establish and carry out in a systematic way the tasks of the software implementation project, which allows complying with the project's objectives in the expected quality, time and costs. It contains these activities: Project Planning, Project Plan Execution, Project Assessment and Control, and Project Closure.
- Software Implementation - the purpose is the systematic performance of the analysis, design, construction, integration and tests activities for new or modified software products according to the specified requirements. It contains these activities: Software Implementation Initiation, Software Requirements Analysis, Software Architectural and Detailed Design, Software Construction, Software Integration and Tests, and Product Delivery.

Due to its clear focus on very small entities, ISO/IEC 29110 can be used as an appropriate basis for our model to cover processes in the software development and project management areas. The Entry and Basic Profiles do not focus on other areas of processes. The Advanced Profile that is under the development within this standard will cover other process areas.

### 3.4 MoProSoft

MoProSoft is the Mexican national standard containing software process model for small businesses. The standard was based on the following standards: CMMI, ISO 9000, ISO/IEC 12207, ISO/IEC 15504, ISO 10006 [9]. MoProSoft proposes 6 processes in three levels:

- Top Management: Business Management,

- Middle Management: Process Management, Project Management, Resource Management,
- Operations: Administration of Specific Projects, Software Development.

This model allows Mexican software companies measure their level of maturity. Basic classification of processes corresponds with the vertical structure of the company. Unlike previous models mentioned above, there is at least a partial focus on other processes outside the actual software development, particularly with regard to the areas of Business Management and Process Management.

### 3.5 Brazilian national standard MPS

MPS.Br – Process Improvement of the Brazilian Software is a program whose main objective was to develop and extend a model of software processes which should offer an economically viable way to improve software processes in small and medium-sized enterprises [13]. The model is inspired by standards ISO/EIC 12207 and ISO/EIC 15504 and compatible with other maturity models like CMMI [12].

The model has three main process areas:

- Fundamental processes: acquisition, requirement management, requirement development, technical solution, product integration, product installation, product release,
- Organizational processes: project management, process adaptation for PM, causal analysis and resolution, risk management, organization process assessment and improvement, organization innovation and implantation,
- Support processes: quality guaranty, configuration management, validation, mediation, verification, and training.

This model delivers an extension to other areas of processes outside the actual software development, particularly with regard to risk management, process management, and training management. Yet other important areas are still missing.

### 3.6 ERP system reference models

An Enterprise Resource Planning (ERP) system integrates information flows in the organization within a single, comprehensive solution. It incorporates the practical systems used by organizations to manage the basic commercial functions of their business, such as: planning, inventory/materials management, purchasing, manufacturing, finance, accounting, human resources, marketing and sales, services etc. [2]

Since the effort of ERP systems concentrates on supporting of all important processes in the company,

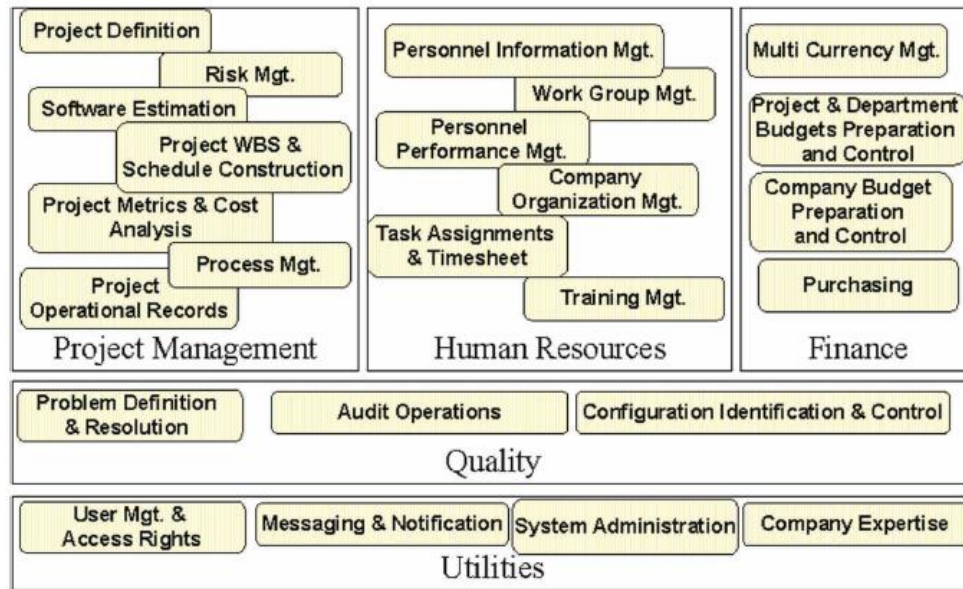


Figure 1. Modules of PACE [8]

the reference models of these solutions can be considered as an appropriate source while designing the Small Software Company Process Model. Basic areas usually covered by the ERP systems are present in Fig.2.

There is a large variety of ERP systems on the market. Some products are aimed at supporting companies operation only on selected market fields (e.g. manufacturing enterprises), but even that, it can be observed that the basic structure of these systems usually corresponds to Fig. 2.



Figure 2. ERP system [2]

In the market, no ERP system designed specifically for a software company was found. According to [8], generic ERP systems were thought to be customized for covering the needs of software

development organizations, but then the impossibility of this solution became evident, due to its high implementation cost. The proposal of PACE software information system described in [8] is very close to the desired functionality. Its basic modules and supported processes are evident from Fig. 1.

This model evidently overlaps to other process areas that should be supported in a software company, yet it still lacks some areas (such as CRM) compared to full-featured ERP systems.

#### 4 The Small Software Company Process Model

The approaches presented above focus mainly on the software development processes and for this area they are very well applicable. However, software companies need to take care of more than a pure software development. Current approaches in the area of software engineering do not take this fact into account at all. As a result, if companies want to support all their processes, they have to use a range of non-integrated software tools.

In this area a potential for an improvement was identified, while our long-term goal is to provide a verification of an integrated solution for a small software company which should enable the support of all important processes. The first step on this way is to design the Small Software Company Process Model. Later, on the basis of this model, it is possible to specify particular requirements for the integrated software solution and finally develop its prototype and evaluate it in real companies.

When assembling the model, related approaches presented above were taken into account. Beside that the feedback from a qualitative survey of

	CMMI	ISO12207	ISO29110	MoProSoft	MPS.Br	ERP (PACE)
<b>Software Specific Processes</b>	yes	yes	yes	yes	yes	partially
<b>Business Management</b>	partially	partially	no	yes	partially	partially
<b>Project Management</b>	yes	yes	yes	yes	yes	yes
<b>Human Resources</b>	partially	partially	partially	partially	partially	yes
<b>Quality Management</b>	yes	yes	partially	partially	partially	yes
<b>Customer Relationship Management</b>	no	no	no	no	no	no
<b>Finance</b>	no	no	no	no	no	yes
<b>Support Processes</b>	partially	partially	no	partially	partially	yes

Figure 3. Coverage of the process areas in the analyzed approaches

requirements for an information system for a small software company [7] was also included. Also, our rich experience in the subject area was included.

At first it was necessary to decide how the model should be structured. The basic process structure in the proposed model is based on ISO/IEC 12207, which distinguishes Software Specific Processes and System Context Processes. This structure allows highlighting the specifics of the software development while taking into account all the other processes that are necessary for the overall company operation.

For the definition of processes in the Software Specific Processes area, the processes of the ISO/IEC 29110 standard were used. These processes are designed especially for a small software company while they correspond to the processes of other standards such as ISO/IEC 12207, MPS.Br (fundamental processes), MoProSoft (operations processes) and CMMI.

Because the area of System Context Processes was too wide, it had to be divided into individual process areas. When designing the model, the breakdown of processes in the above analyzed approaches was taken into account. Following process areas were identified: Business Management, Project Management, Human Resources, Quality Management, Finance, and Support Processes. The area of Customer Relationship Management is not present in the above approaches at all, but the feedback from a qualitative survey [7] brought a desire of this area to be included. This also corresponds with our experience from the target group of companies. The coverage of individual process areas in analyzed approaches is illustrated in Fig. 3.

When selecting specific processes for each of these areas, each process in the above mentioned sources was analyzed. If the process is suitable and important for a small software company it is included in one of the defined areas.

Each process and each process area of the model will be further evaluated in the target group of companies.

The Small Software Company Process Model is shown in Fig. 4.

The purpose of the Business Management area is to support processes that relate to the mission, objectives and direction of the company, managing its internal processes and knowledge. This includes Process Management, Strategy and Policies, Business Intelligence, Reporting, and Knowledge Management processes.

The Software Specific Processes area includes processes for the software development. This includes Implementation Initiation, Requirements Analysis, Architecture and Detailed Design, Construction, Integration and Tests, and Product Delivery.

Project Management area represents planning, implementation, monitoring and evaluation of projects in the company. It includes Project and WBS Definition, Project Planning, Project Metrics and Cost Analysis, Workload Estimation, Risk Management, and Portfolio Management processes.

The Human Resources area includes Personnel Information Management, Personnel Performance Management, Timesheets Management, Task Assignments, Training Management, Personnel



Figure 4. The Small Software Company Process Model

Reporting, and Remuneration processes.

The purpose of the Quality Management area is to support the processes for ensuring the quality of software products. This includes Validation, Verification and Testing, Problem Definition and Resolution, and Checklist Management processes.

Within the Customer Relationship Management area processes for customer support and sales management are included, i.e. Helpdesk, Sales and Opportunity Management, and After-Sales Support processes.

The Finance area is used to control project and company budgets. This includes Project Budget Management, Invoicing Management, Profitability Reporting, and Purchasing processes.

In the Support Processes area other supporting processes necessary for a small software company operation are included, i.e. Configuration Management (i.e. also Version Control), Infrastructure Management, User and Access Rights Management, and Messaging and Notifications processes.

## 5 Conclusion and future work

The potential for an improvement was identified in the area of the IT support of processes in small software companies. For further work it was

necessary to define first the Small Software Company Process Model.

When defining the Small Software Company Process Model, the available resources that are more or less focused on this topic were taken into account. In particular, the standards CMMI, ISO/IEC 12207, ISO/IEC 29110, MoProSoft, MPS.Br and ERP system reference models were analyzed.

The proposed model includes following areas: Business Management, Software Specific Processes, Project Management, Human Resources, Quality Management, Customer Relationship Management, Finance, and Support Processes. The model will be subsequently evaluated in the target group of companies.

After the process model definition and evaluation, the detailed requirements for the information system will be specified and a prototype of this information system will be developed and evaluated.

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