5 Regional Approaches

5.1 The Capability Maturity Model (SW and Integrated) Tailored in Small Indigenous Software Industries

Authors
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Abstract
The Irish Software Industry is undergoing rapid change due to increased competition from low cost global software service providers. Prior to this, Ireland had emerged as one of the leading low cost software exporters in the world. Then came the downturn in the global economy, the burst of the dot com bubble, and an increasing local cost base. Ireland now faces competition in the form of developing third world economies. The Irish software industry will struggle to compete with the vast workforce of cheap but skillful labor that these economies can offer in abundance. Can the Irish software industry compete in this changing environment? Software process improvement is recognized by the Irish government as a key differentiator in this competitive environment for the future. Quality improvement in Ireland had traditionally been the preserve of large software multi-nationals and the manufacturing industry. However, since the continued development of the local Irish software industry, this community is beginning to take software quality seriously. Research into the availability of software process models and best practices and how they can be effectively applied to small software industries in the Irish mid-west region is the main topic of this paper.

Research Environment (Small Organizations)
Research into software process in small to medium sized enterprises (SME) has grown within the University of Limerick over the past ten years. In 1996, there was one researcher, there are now eight people involved in SME process research at various levels, and this number continues to grow. As the economic environment within Ireland is supported by the presence of many SMEs, it is important that we focus this research within local industry. Our research to date has concentrated on the improvement of software processes within small companies, regardless of the model used. In some cases, companies are interested in implementing SW-CMM/CMMI, but due to market conditions, ISO9000-2000 is particularly important to the software industry in Ireland.
We collaborate with other research groups nationally and internationally, particularly with researchers in Finland and Wales, who face similar problems to ourselves. To develop and implement techniques, we endeavor to understand current processes and process improvements within SMEs and other companies. Using qualitative research methods, we interview, observe and analyze documentation within small companies to understand the conditions under which they work. Output is analyzed using, for example, content analysis. The next stage is to develop techniques and use action research methods to implement and evaluate what we have done. Supported by funding received from Science Foundation Ireland, our recent focus is researching how SMEs' software processes are operating within the global software development environment. We are developing collaboration with researchers from management to ensure that organization and change management are inherent in our output. This funding has also given us the opportunity to present our research to SMEs through various workshops and seminars.

**Research Approach, Models, and Techniques for Process Improvement**

The objective of CMMI version 1.1 was to provide a cleaner and more stable CMM. CMMI version 1.1 was released in January 2002. A significant number of organizations have committed to adoption of the CMMI.

However, the following questions still remain for organizations, especially small to medium organizations, that want to improve their processes:

- Which representation makes sense?
- What are the organization’s business goals?
- What product/service does the organization develop/maintain?
- What is the product life cycle and development/maintenance organization?
- How much process improvement experience does the organization have? [Menezes 02]

The research project described in this paper is an investigation of how software process improvement (SPI), change management, and industry best practice can be applied in small software industries. The definition of SME, which is a term used in the Irish market, is companies that have less than 50 employees, have less than 3,000,000 (Ir)/4,800,000(euro) turnover, were founded in Ireland, have no parent company, and produce software products. The main focus area of this research is the SEI’s software process improvement Capability Maturity Models (SW-CMM and CMMI) and investigation of other process models utilizing 9000-3 guidance for software (e.g., ISO9000, Tick IT). The IDEAL change model is investigated for implementation of SPI.

The following are the relevant research questions:

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20 Richardson, Ita. *Improving the Software Process in Small Indigenous Software Companies Using a Model Based on Quality Function Deployment.* University of Limerick, Ireland.
• Can the SW-CMM’s and CMMI’s tools and techniques be tailored for use in small indigenous software organizations?
• Can SPI be effectively achieved, utilizing the tailored CMMs and change management techniques, in this environment?

Two small companies were selected to perform an assessment that was to be tailored to best suit the organization. A literature review of SPI industry best practice was conducted, and the CMM was identified as the basis of an SPI program. We will quantitatively verify any process improvement through the application of the CMMI. We will use a triangulation strategy and will quantitatively verify any perceived improvements via

• CMM assessments tailored to the specific environment
• independent measurement utilizing questionnaire and interviews specifically focused on the business, organization, and customer perceived benefits (or lack of benefits) obtained from the improvement effort.
• questionnaire and interview feedback from authorized lead assessor networks based on their use of the latest CMM release, CMMI. A focus will be taken on their experiences in the small project environment across the software industry in a range of organization sizes.

The following topics detail the research phases.

Phase I–Company 1

The SW-CMM assessment process was tailored to suit the size of the organization and its business objectives. A tailored mentored self-assessment (MSA) was carried out against the SW-CMM. Its objectives were to identify software process improvements which were prioritized by the organization. The assessment process generated findings based on data gathered at the goal level for each key process area (KPA). Improvements identified and changes implemented over the next period were done based on this data, which was also used to validate assessment tailoring decisions made initially. The assessment process generated some global findings, which, at this stage, allowed some initial research conclusions to be drawn as answers to the questions posed. Phase I output acts as input to further assessment and validation in Phase II.

Phase II–Company 2

Prior to commencement of Phase II, the CMMI was published and consequently a tailored SCAMPI type C assessment was conducted with company 2. This assessment was focused on specific high priority process areas (PAs) identified in Phase 1, which were aligned to CMMI (i.e., Requirements Management and Project Planning). A decision to apply the continuous model introduced by the CMMI was taken in Phase II based on the outcome of Phase I. Findings data at goal level will be quantitatively analyzed at KPA/PA goal level to contrast finding across the 2 organizations.
Further data will be obtained via independent business measures (e.g., customer surveys to support the validation process after the SPI programs have been completed in both companies). Feedback from lead assessors of the CMMI and SCAMPI assessment process will also be gathered as further input to research conclusions.

**VALIDATION OF RESEARCH**

![Diagram showing the validation process]

- Analyze improvement based on matrix data and business value measures
- Research why improvement has not been achieved utilizing change management principles
- Compare data to literature review of the CMMI
- Compare data to lead assessor feedback on CMMI and SCAMPI assessment process

**Strengths and Weaknesses of the Models, Techniques, and Approaches Used for Process Improvement**

**Phase I Validation**

The validation phase of this research program has benefited from use of a formal assessment following a structured industry recognized standard regardless of the size of the organization. It may even be considered a major benefit, as small organizations do not have the resources to develop their own version of improvement programs. Significant improvement opportunities have been identified, as the organization and participants approved the tailored assessment final findings. Phase I was a success, but the opportunity existed to further tailor the assessment process and SPI plans as part of Phase II by applying the lessons learned in Phase I.

The closing assessment executive meeting with the Company 1 leadership identified the areas of Requirements Management and Project Planning as high priority areas for improvement in line with the organization's business goals. Further research into these areas formed the basis for Phase II of the research.
Organizations with less than 20 staff practitioners may have the greatest difficulty addressing specialized roles for process areas (e.g., Software Quality Assurance, Configuration Management, Measurement and Analysis). Key technical staff hold the major burden of these functions. Some sharing of specialized resources across small to medium enterprises may address these needs with distributed costs.

Evidence in the form of documentation is limited in a small environment, especially at the early stages of maturity, and knowledge of KPAs/PAs is necessary to ensure that valuable informal practices are not missed.

There is a considerable challenge to involve customers more actively in CMM and process improvement initiatives and changes. Small organizations may depend on one or two big customers and need to be perceived to be doing productive work all the time. CMM and the use of formal change methods (e.g., IDEAL) give a structured approach to building customer sponsorship in a competitive market.

The continuous representation and tailored assessments approach was seen to be more appropriate to small organizations. They can maximize use of the limited resources available for SPI activities by focusing on the PAs identified and prioritized by the organization. Use of tailored assessment processes (e.g., mentored self-assessments or SCAMPI type C assessments) give a good return on investment where budget is limited.

**Phase II Validation**

Company 2 has completed a tailored CMMI SCAMPI type C assessment using the continuous model on two high priority PAs, Requirements Management and Project Planning, identified in Phase I. Data has been collected via the assessment process in both these PAs at generic and specific goal level. The SPI program for Company 2 is in progress with several critical processes identified and under development. The next steps are to compare and analyze the data gathered via assessment against the corresponding KPAs in Company 1 to identify trends and support research conclusions.

**The Most Important Topics for the Research Community to Address in the Future**

Research into efficient tools and techniques, which give cost effective return on Investment, is a critical success factor in the small software industry. One of the most significant changes from SW-CMM to CMMI is the emphasis on measurement as a level 2 PA. However, this PA can still be overlooked if the continuous model is applied, especially in small organization where the resources required for an effective measurement program are sometimes perceived to be an overhead.

Process systems such as Six Sigma align with the quantitative process management, product quality management, and process optimization practices associated with levels 4 and 5. Research into how such systems could be used with the level 2 Measurement and Analysis
process area to address the requirements for levels 4 and 5 could lead to further improvement of the model.

Further data will be obtained via independent business measures (e.g., customer surveys to support the validation process after the SPI programs have been completed in both companies). Feedback from lead assessors on the CMMI and SCAMPI assessment process will also be gathered as further input to research conclusions.

References/Bibliography


Biographies

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Rosario Blowers BSc (UL) has participated in postgraduate studies and research into software process improvement in the Irish industry for the past four years as part of the Irish Software Engineering Research Consortium (ISERC) at the University of Limerick, Ireland. She previously worked for 20 years in the multi-national software industry at Electronic Data System (EDS), EMEA, where she was largely responsible for strategic initiatives including CMM, ISO 9001, and TickIT, and was an auditor and assessor across a matrixed network of 12 software centres. Her experience in organizational change management and project and software life cycle methodologies has been gained in the Irish financial services sector.

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