SPI Program Retrospective: evaluating long-term benefits for small firms

Aileen Cater-Steel
University of Southern Queensland, Toowoomba Australia
caterst@usq.edu.au

Terry Rout
Griffith University, Brisbane Australia
T.Rout@griffith.edu.au

Abstract

A retrospective review of participants in a SPICE-based process improvement program is currently underway. The objective of the review is to consider the long-term impact of the program on small firms. After establishing the need to evaluate the long-term effects in small firms, this paper presents a detailed account of the experiences of two small firms. These firms participated in a software process improvement (SPI) program in 1999. In 2000, a follow-up meeting was held with each firm to determine the extent to which the recommended actions from the assessment had been implemented. In 2005, a retrospective interview was conducted with each firm to discuss SPI actions subsequent to the follow-up meeting.

Although both firms continued to implement process improvement initiatives, surprisingly, the firm with higher capability is no longer in business. Factors such as senior management commitment, readiness for SPI and the culture of the firm are found to influence the long-term outcomes.

1. Introduction

In 1999-2000, 22 small software development firms participated in a software process improvement (SPI) program sponsored by Software Engineering Australia (SEA) Queensland. The RAPID (Rapid Assessment for Process Improvement for software Development) process improvement initiative provided each firm with a one-day on-site process assessment, then about 10 months later, a follow-up meeting was held to determine the extent to which the assessment recommendations had been implemented [1]. At the follow-up meetings, many of the firms expressed the view that the RAPID assessment had provided an accurate profile of their strengths and weakness, and also realistic and worthwhile recommendations. However, for many, the recently defined processes were too new to be adequately assessed at the time of the follow-up meeting [2].

Recently, a retrospective review of the SPI outcomes was held with two of the firms that participated in the RAPID program. After describing the methodology, this report considers the long-term impact of the RAPID program on two small firms five years since it was conducted. Firstly, changes in each business are summarised, then the major outcomes of the program, as reported at the follow-up meetings are reviewed to determine progress subsequent to the follow-up meetings. The firms are then compared and contrasted, and conclusions are presented.

Faced with an enormous choice of methods, tools and techniques, software development managers need evidence that their investment in new practices will produce benefits [3, 4]. Unfortunately, many approaches are adopted 'based on anecdotes, gut feelings, expert opinion and flawed research, not on careful, rigorous software engineering experimentation' [3, p. 87]. Therefore, researchers are urged to undertake evaluative research involving realistic projects with sufficient rigour to ensure that any benefits identified are clearly derived from the concept in question [3]. Although past studies have indicated factors which inhibit adoption of SPI, empirical research on SPI is largely lacking. Consequently, there is insufficient knowledge about which innovations are effective, and which factors influence their adoption. It is vital to understand the processes currently used, and to evaluate the effectiveness of process improvement programs, or investments in SPI are wasted [5]. This research provides evidence of the long-term outcomes of software process innovation in two software development firms.

The lack of theory-based empirical research pertaining to SPI adoption has been noted, but nowhere is the research shortage more acute than in relation to small software development firms. In the Australian and

international software development industry, there is a large proportion of small software development firms. There have been many calls to recognise the importance of small business, to increase the attention given to the small business sector, and to develop government policies appropriate to the needs of small business [6]. It is also recognised that to date, business research in general, and software process improvement research in particular, is biased towards large corporations [7], and that empirical research into the rate and success of implementation of process improvement initiatives in small and medium enterprises is largely considered to be inadequate [8].

Recent research has raised doubts about whether traditional SPI models are appropriate for small software development organisations. This study responds to demands for more research to evaluate the long-term effectiveness of assessment-based SPI programs within small development firms [9, 10]. In particular, there have been few reports on the long-term benefits that may have been derived from improvement initiatives [3]. Recently, similar long-term follow up studies have been conducted on participants in the SPIRE Project [11] in Europe. The approach we have taken is quite different from that in the Irish study [12], and in the longer term a comparison of the findings from the two studies will be of value.

This work answers the call to evaluate the implementation of a culture of improvement in organisations which took part in improvement programs long enough ago to call these long-term benefits, in particular in small or medium-sized organisations, a part of the software community for which we have few statistics [13]

For competitive reasons, the firms wish to remain anonymous, but are probably typical of many of the myriad of small software development firms in Queensland. In this report, the firms are referred to as Firm A and Firm B.

2. Methodology

Organisational behaviour and management literature establishes that small organisations are different from larger organisations in terms of formalisation, centralisation, complexity and personnel ratios [14]. Furthermore, research has highlighted other characteristics of small firms compared to large firms. Small organisations have a flat structure and are managed by their owners in an organic, free-flowing, personalised management style that encourages entrepreneurship and innovation, less formalised decision-making structures and procedures, and more freedom for employees to depart from the rules [6, 7, 14, 15]. Uncertainty,

evolution and innovation play a greater role in small firms [16]. All the critical management decisions such as finance, accounting, personnel, purchasing, processing or servicing, marketing and selling are made by one or two persons, without the aid of internal specialists, and with specific knowledge in one or two functional areas [6].

Of particular relevance to SPI efforts, small firms tend to be averse to consultants and reluctant to seek external help [17]. The personal involvement of employees in small firms encourages motivation and commitment because the employees identify with the company's mission [14]. Small organisations have the advantage of being responsive and flexible [14, 18, 19], but compared to larger firms, small firms tend to neglect training [20].

In small firms, much of the work is coordinated through direct supervision and mutual adjustment [21]. Small firms are important as they have faster employment growth rates and generate more new jobs than giant ones [7].

Therefore, small firms should not be considered to be scaled down versions of large firms [16, 22], and it is clear that process improvement models such as the SW-CMM which were developed for large software contractor firms may not be appropriate for small firms. Much of the research to date is biased towards large corporations [7], and does not take into account issues relating to small organisations. This is particularly the situation when considering the role of senior management in supporting improvement initiatives. Lack of senior management commitment is recognised by Debou and Kuntzmann-Combelles [23], Abrahamsson [24], El Emam et al. [25], and Wilson, Hall and Baddoo [26] as a major bottleneck to the success of SPI initiatives. However, for most small firms, the business operator is often involved in all aspects of the business and would therefore instigate the SPI and participate heavily in it.

Motivated by follow-up reports from the SPIRE project [12], in early 2005, the authors decided to contact the firms that had participated in the RAPID program. Of the 22 small firms initially assessed, two had withdrawn from the program prior to the follow-up meeting. Of the remaining 20 firms, four had ceased to operate and one had merged with another firm. At many of the still-existing firms, the staff who had been involved in the RAPID program have moved on to other organisations, making it difficult to establish a contact for a retrospective interview.

The overall timeline involved for each of the organizations involved is shown in Figure 1. The initial RAPID assessments were conducted late in 1999, and follow-up evaluations were held from 6 to 12 months later. The retrospective interviews were held in 2005.
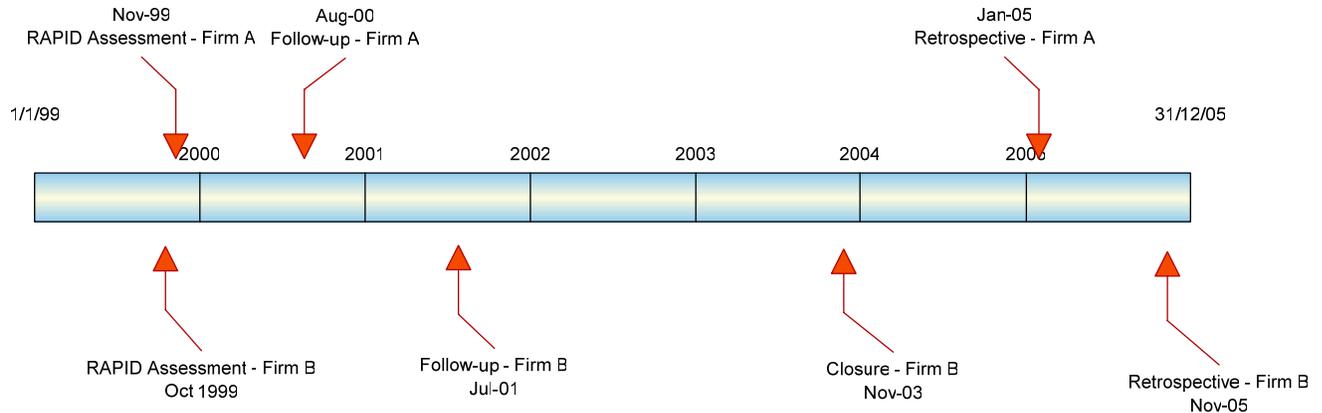
Figure 1: Timelines - Firm A and Firm B

To conduct the retrospective interviews, a questionnaire was developed to ensure that the data would be collected in a standard format to enable collation and comparisons. The first part of the questionnaire contained general questions about the performance of the firm since the assessment, the impact of the RAPID program on the firm, and the sponsors' perceptions about the value of SPI. The second part of the questionnaire contained specific questions for each firm based on the prioritised actions from the initial assessment report and the review of these actions at the follow-up meeting.

Each retrospective interview was conducted face-to-face between one of the authors and one representative from each firm with a duration of 30 minutes to 1 hour. Each interview was transcribed from audio recording and validated with the respondent.

3. Firm A

Firm A has been in business for about 20 years, and develops a software package. It does not undertake custom development. In November 1999, when the initial assessment was conducted, the firm employed ten full-time staff and was enjoying a sales growth phase due to the introduction of the Australian Government's Goods and Services Taxation legislation (GST). By the time of the follow-up meeting in August 2000, the number of staff employed almost doubled, but then dropped back to the same level as at the time of the assessment. The firm coped with major staff changes: since the initial assessment, at least three key developers had left the firm. The retrospective interview was conducted in January 2005 with one of the firms' software developers. The respondent had commenced employment at Firm A subsequent to the follow-up meeting and was unable to answer many of the questions directly related to the RAPID program.

3.1. Project management

At the initial assessment in November 1999, the project management planning process in existed for the major releases of the product, but activities to achieve the plans were only tracked informally. The first step to improve the project management process involved the use of MS Outlook to record the staff assignment of tasks related to six projects. At the time of the follow-up meeting in August 2000, actual effort was not being recorded. Now the firm is finding MS Project useful for managing projects and actual effort is being recorded. The firm recognises that the hours recorded are not entirely accurate as the developers are often interrupted to perform technical support tasks when they are scheduled to work on new projects or enhancements for the new release of the core product.

3.2. Problem resolution

In 1999, the firm was in the process of developing a help-desk system to manage client registration, despatches and to record problem reports. This system was successfully implemented by the time of the follow-up meeting but it was intended to further develop the system to track problem reports through to their resolution in new versions or releases. Due to the loss of senior staff, and the need to focus resources on products for sale, rather than for internal use, no further development was undertaken on the in-house developed system. A more workable solution was found by implementing a problem tracking system called Mantis – an open source web-based bug tracking system to track issues raised, issues with existing products, feature requests from clients, and the status of the fixes in relation to the firm's development schedule. Due to the small number of developers involved, and effective

personal communication, there is no need to have a formal interface from Mantis to the help-desk system.

The firm has also added a component to development projects to assist in trouble-shooting. EurekaLog is integrated with Delphi's IDE and builds applications with the capability to intercept every exception and trace a detailed log from the start of the application to the point where an exception was raised. The client is prompted to send an email with the problem report to the support team, where the problem can be identified and quickly resolved.

3.3. Configuration management

At the initial assessment, a coherent process was found to be in place for configuration management and it has continued to improve since the follow-up meeting. The firm experienced some problems with MS Visual SourceSafe and trialled FreeVCS for a time because it behaved more seamlessly in a Dephi environment. One identified improvement since the follow-up meeting is that all the help files, release documents and technical support documents are now under version control with SourceSafe.

3.4. Software development

The need for a more formalised testing process was identified as a major issue at the initial assessment, and treated as a high priority in the recommendations. The firm employed a tester to develop test cases and record test logs in a MS Access database, but this person was gradually diverted to a technical support role and has since left the firm. Rational Robot (test automation tool) was implemented for regression testing and as a first step towards using the Rational Rose suite. Staff attended Rational Robot training in Sydney, and a test suite was developed for the core product. After this, the firm decided to develop a new version of the core product to provide a new 'look and feel', using components to give themes capability to the product. When themes were added, every single form in the project had changed its reference. Consequently, the regression tests no longer functioned, as the objects sought were no longer referenced in the same way. After adding the themes capability, the developers also found some problems with Rational Robot not correctly recognising the state of some of the properties, causing more time to be spent in investigating incorrect test results. Management decided it was not worth the cost to build a new suite of regression tests in Rational Robot, and the ongoing costs to maintain a licence for the product were not justified and so the firm discontinued its use.

Testing is still considered to be an area where improvements could be made but market and financial concerns and lack of resources make it infeasible to address at this time. Internal testing is performed to the extent resources allow, and key clients are successfully involved in Beta testing.

3.5. Further process improvement

With the imminent departure of key developers, it was stated at the follow-up meeting that Visio would be used to ensure that documentation of the software modules was available to the new staff. This did not eventuate, but reverse engineering was tried to extract UML from the program code. Unfortunately, this attempt was abandoned as the documents produced were unreadable.

As well as improvements resulting from the assessment, other processes have changed with the firm adopting a more Agile approach to development. This change in methodology came about as a direct result of the interest of a new staff member. Now there is less documentation done at the start of each project, and the development is done in shorter cycles. The firm has found many advantages from this approach: the managers can see the product as it is developed; they can provide more input as they are not working from abstract specifications and designs; they are able to respond to market pressures, and can tailor the features to be included in response to the market.

The firm has adopted a Virtual Machine environment using VMWare. This allows preservation of the total build environment, a consistent hardware environment for development, the ability to test new development components, and restoration of the development environment in the case of hardware failure to a development machine.

4. Firm B

Firm B was founded in 1992 to commercialise a information systems development methodology developed by the owner/manager. Its principal business was the delivery of professional services to the government and semi-government sector; most projects involve database solutions, with an emphasis on Ingres applications. Firm B also developed several software products, all specialised tools supporting Ingres development and maintenance; these were marketed to a limited degree.

Firm B showed strong growth and employed 10 full-time staff and one contractor at the time of the initial assessment. Most projects were 12 to 18 months duration. Firm B's quality management system (QMS)

was based upon ISO 9001 and it was central to the company's operations.

The initial RAPID assessment was performed in October 1999 and revealed that Firm B had a remarkably mature process for a small business. The principal business of the organization focused around a well-defined process, based upon the firm's methodology and quality manual. There was excellent control of initial project requirements, and changes over the course of a project were well handled, though on an individual project basis. Firm B effectively addressed financial risks, through undertaking work on a 'time and materials' basis. Project management was limited in scope but effective.

As a result of relatively rapid growth in recent years, Firm B faced problems in ensuring consistent application of its defined process across the life cycle. Many of its approaches to project management, while appropriate to its current environment, were limited in their use in less well-controlled environments. There was a need for a thorough review of the quality management system, to ensure that it retained its usefulness in a changing business environment. Firm B also needed to take more advantage of its strengths by developing effective measures for monitoring performance in terms of both productivity and product quality.

The follow-up meeting was held July 2000 and established that the changes implemented by Firm B impacted on the capability of four of the target processes: software development; configuration management; risk management; and process establishment. Many of the changes were too new to have impacted at the time of the follow-up meeting. However, the configuration management tool and error-tracking software had made it easier to manage multiple developer projects, and testing had been enhanced in terms of efficiency and quality.

At the follow-up meeting, Firm B considered that the assessment provided valuable motivation to review and improve the software development process. The assessment provided the impetus to make available resources to address the action items from the assessment report. Staff at Firm B also considered the assessment results provide evidence of their software process capability and therefore provide competitive advantage in formal tenders. Finally, the strengths highlighted in the assessment report improved the morale of the team by providing positive feedback about the value of process improvement. Firm B was convinced the improvement actions resulting from the assessment would return great value in the future by ensuring it was better placed to bid for large projects.

Towards the end of 2003, although Firm B was performing well, the owner/manager decided he no longer wished to continue with the business. He became bored after 12 years in the same role and felt he needed a new challenge. As efforts to sell the firm did not produce a buyer, he closed the doors in November 2003. The owner/manager assisted staff to find alternative employment and is now employed in a senior IT position in a large organisation.

The retrospective interview was held in November 2005 and focussed on the 3.5 year time period from the follow-up meeting mid 2000 to the closure of the firm in November 2003. During this time, Firm B continued to develop in terms of earnings. Although post-Y2K was difficult, it maintained its position in the market releasing new products at the start of 2003. All the RAPID recommendations were implemented, and impacted to a limited extent on the business processes and methods, and in a positive way on the financial results.

4.1. Software development

Prior to the follow-up meeting in July 2000, Firm B undertook a major review and update of the development methodology. It became more flexible, for example the methodology relating to modelling has been extended to include OO concepts and UML. A hands-on workshop was designed and conducted to train all staff in the enhanced methodology. Also, all templates were updated to reflect changes. Every staff member was given responsibility for auditing part of a project for conformance against the Quality plan. As well as sharing the work load for conducting audits, this process provided valuable training for all staff by giving them a different perspective of the QMS, and encouraged all staff to suggest future improvements. From the non-conformances found, it was concluded that the Quality Plan needed to be more rigid. Subsequent to the follow-up meeting, further updates were performed on the methodology. As well as the workshops, post-workshop reviews were conducted to check the effectiveness of the workshops. The area most impacted by the RAPID program related to preventative and corrective actions. The standard templates relating to these areas were updated and refined on an ongoing basis.

4.2. Quality assurance

As Firm B is restricted by the client's quality process, it was considered impossible to fully control the quality process. However, the follow-up meeting revealed some procedures had been improved eg. those relating to the initial process with the client, and also documentation of clients' variation requests. The development of a risk assessment and management procedure had a major impact on the quality management system and necessitated changes to procedures including testing, contract review and planning, and requirements control.

A process for developing new procedures had been defined and a template was developed and included in the quality manual to be used for all new procedures.

At the time of the follow-up meeting, the impact of ISO 9000:2000 had not yet been analysed as it was not considered high priority at that time. However, during the retrospective interview it was found that Firm B did gain certification to ISO 9000:2000, being one of the first Queensland IT firms to achieve this milestone.

In relation to configuration management, procedures for Source Safe were updated and dispersed through mentoring. The duties of code librarian were allocated to one staff member on a part-time basis.

4.3. Configuration management

As the development environment depends on the client's requirements, it varies on a project-by-project basis. Therefore it is not possible or desirable to implement a common development environment at Firm B. However, at the time of the follow-up meeting documentation had been improved by compiling registers of hardware and software. It was considered essential to maintain a diverse range of operating systems to provide necessary test environments. Also, a variety of development tools was considered appropriate to suit individual developers and therefore maintain productivity.

Further efforts in this area after the follow-up meeting saw the establishment of registers for loaned equipment, configurations, and documentation. After implementing the RAPID recommendations, the CEO decided that there was little value in further efforts due to the small size of the firm.

4.4. Problem resolution

At the follow-up meeting, the opinion was expressed that the most valuable recommendation from the assessment was the need to develop a global change request and problem resolution system. Consequently, a lot of effort was directed into extending the customer database to include a global change request system and comprehensive document register. Also, a software package had been introduced to help track and manage bugs and issues.

Subsequent to the follow-up meeting, Firm B actually developed a new product for sale as well as for their internal use – Enterprise Client Management (ECM). ECM proved to be extremely successful in the market. It included a project administration tool with change request management and impact analysis.

At the time of the follow-up meeting, Firm B was considering how to collect and analyse measurement data.

Statistics from previous projects were used to produce estimates. Subsequent to the follow-up meeting, the importance of collecting and analysing measurement data was addressed as part of the development of ECM. ECM enabled the extraction of key performance indicators, recorded information about responsiveness to issue resolution and change requests, and facilitated the compilation of comprehensive reports.

5. Discussion

This study is currently in its early stages; we have identified at minimum six of the participants in the original RAPID assessments for long-term evaluation, covering a range of situations in terms of the current status of the companies and the individuals involved. From this initial stage, we can draw some useful preliminary observations in respect of the two companies studied.

Paradoxically, the more successful of the organizations (as judged by its improvement initiative) is no longer in business, as a result of a lifestyle choice by the CEO and improvement sponsor. Firm B had taken up the improvement suggestions resulting from the RAPID assessment, and had strengthened an already effective quality management system. It is noteworthy that the need for effective problem resolution – and the learning environment deriving from this – was a key improvement for this company.

Firm A, on the other hand, has continued to draw upon its key strength – its ability to service effectively a niche market for its products. Within this strategy, improvement issues were less important, and probably gained less management support. However, key risk issues identified through the RAPID assessment continued to be relevant, and the improvement suggestions proved useful in addressing ongoing issues.

When the histories of the two firms are compared, it can be seen that Firm A did not have a culture of improvement, whereas Firm B did. Many of the improvements resulting from the RAPID assessment in Firm A were lost over time, but Firm B built on them. Firm B already had an effective quality system in place when the assessment was done, Firm A did not. Overall, we can judge that in terms of readiness for improvement, Firm A was at lower levels of capability compared to Firm B. The RAPID sponsor at Firm A left the firm at about the time of the follow-up meeting. At Firm B, the CEO was the sponsor and was very committed to process improvement.

In their study of small Italian software firms, Raffa, Zollo and Caponi [27] found that most of the firms they surveyed operated as software developers for three to seven years, and were forced to significantly reduce their

involvement in software development, shifting their strategic focus to the commercialisation of hardware and software, and provision of other information services. In Australia, only 33 percent of all small businesses survive more than 10 years [28]. Firm B is an interesting case in that its closure was not caused by market forces. Its history highlights the critical role of the owner-operator; in effect the future of the firm is dependent upon the whim of the owner.

In the conventional view, small firms aim to develop into large firms; this is similar to the concept of an individual having a 'job for life'. In fact, for many small organizations, their existence is dependent on the motivations of the owner-operator, and their continued existence may depend on lifestyle decisions taken by the owner. Given this, traditional views of 'success' and 'failure' can be seen as not applying to many small firms, and caution should be applied in trying to assign issues of organizational survival to 'failure' to adapt to the business environment.

6. Conclusion

The long-term follow up has shown that changes made in an organization, driven by a framework of model-based improvement, can have long-term impacts even in small organizations. Even where specific initiatives are lost, as a result of failure to effectively institutionalise the changes, the positive impact of change may remain and have a long-term impact on the way that the organization does its business.

We can also see, however, that there is no necessary link between success in implementing improvement and survival of the organization. Firm B in this study was the more successful of the two in implementing improvements, and in using these improvements to satisfy business objectives; but at the end of the day, it is Firm A that is still in business. Concepts of success and failure for small enterprises need to be re-examined, especially where the role of the business owner is active rather than simply the supplier of capital.

The collection of formal return on investment measures is outside the scope of the RAPID method but other studies have quantified benefits resulting from SPI programs [29]. Extension of this research is underway, with further retrospective interviews with the RAPID participants planned – covering both surviving companies and individuals involved in those which have since closed. We believe that the final outcome of this project will provide valuable insights into the long-term impact of process improvement programs in small firms.

7. References

[1] T. P. Rout, A. Tuffley, B. Cahill, and B. Hodgen, "The rapid assessment of software process capability," presented at SPICE 2000 - 1st International Conference on Software Process Improvement and Capability dEtermination, Limerick,2000.

[2] A. P. Cater-Steel, M. A. Toleman, and T. P. Rout, "An evaluation of the RAPID assessment-based process improvement method for small firms.," presented at International Conference on Empirical Assessment in Software Engineering, Keele U.K.,2005.

[3] N. Fenton, S. L. Pfleeger, and R. L. Glass, "Science and substance: a challenge to software engineers," *IEEE Software*, vol. 11, no. 4, pp. 86-95, 1994.

[4] M. Wood, J. Daly, J. Miller, and M. Roper, "Multi-method research: an investigation of object-oriented technology," *Journal of Systems and Software*, vol. 48, no. 1, pp. 13-26, 1999.

[5] E. Mustonen-Ollila and K. Lyytinen, "Why organisations adopt information system process innovations: a longitudinal study using Diffusion of Innovation theory," *Information Systems Journal*, vol. 13, no. 275-297, 2003.

[6] B. L. Johns, W. C. Dunlop, and W. J. Sheehan, *Small Business in Australia: Problems and Prospects*, 3rd ed. Sydney: Allen and Unwin, 1989.

[7] P. Attewell and J. B. Rule, "Survey and other methodologies applied to IT impact research: experiences from a comparative study of business computing," in *The Information Systems Research Challenge: Survey Research Methods*, vol. 3, *Harvard Business School Research Colloquium*, K. Kraemer, Ed., 1991, pp. 299-315.

[8] M. Xydias-Lobo and J. T. Jones, "Quality Initiatives and Business Growth in Australian Manufacturing SMEs: an Exploratory Investigation," Flinders University Research Paper Series: 03-3, 2003.

[9] J. G. Brodman and D. L. Johnson, "A software process improvement approach tailored for small organizations and small projects," in *Proceedings of the International Conference on Software Engineering*. Boston, MA: IEEE CS, 1997, pp. 661-662.

[10] K. Kautz, "Software process improvement in very small enterprises: does it pay off?," *Software Process: Improvement and Practice*, vol. 4, no. 209-226, 1998.

[11] SPIRE, *The Spire Handbook: Better, Faster, Cheaper Software Development in Small Organisations*: Centre for Software Engineering, DCU Campus, Dublin, 1998.

[12] M. Sanders and I. Richardson, "What happened after SPI assistance in Ireland?," presented at 4th International SPICE Conference on Process Assessment and Improvement, Lisbon, Portugal,2004.

[13] M. Sanders and I. Richardson, "Research into long-term improvements in small to medium-sized organisations using SPICE as a framework for standards," Dept of Computer Science and Information Systems, University of Limerick, Limerick, 2005.

[14] R. L. Daft, *Essentials of Organization Theory and Design*. Cincinnati, Ohio: South-Western College Publishing, 1998.

[15] N. O'Regan and A. Ghobadian, "Testing the homogeneity of SMEs: the impact of size on managerial and organisational processes," *European Business Review*, vol. 16, no. 1, pp. 64-77, 2004.

[16] D. J. Storey, *Understanding the Small Business Sector*. London: Routledge, 1994.

[17] P. B. Cragg, "Benchmarking information technology practices in small firms," *European Journal of Information Systems*, vol. 11, no. 4, pp. 267-282, 2002.

[18] W. R. King, "Achieving global strategic advantage," *Information Systems Management*, vol. 13, no. 4, pp. 57-60, 1996.

[19] V. Grover and J. T. C. Teng, "An examination of DBMS adoption and success in American organisations," *Information and Management*, vol. 23, no. 239-248, 1992.

[20] C. Voss, K. L. Blackmon, R. Cagliano, P. Hanson, and F. Wilson, "Made in Europe: small companies," *Business Strategy Review*, vol. 9, no. 4, pp. 1-19, 1998.

[21] H. Mintzberg, *Structure in fives : designing effective organizations*. Englewood Cliffs, N.J. USA: Prentice-Hall, 1983.

[22] I. Richardson, "Software process improvements in very small companies," *Software Quality Professional*, vol. 4, no. 2, pp. 14-22, 2002.

[23] C. Debou and A. Kuntzmann-Combelles, "Linking software process improvement to business strategies: experiences from industry," *Software Process: Improvement and Practice*, vol. 5, no. 55-65, 2000.

[24] P. Abrahamsson, "Rethinking the concept of commitment in software process improvement," *Scandinavian Journal of Information Systems*, vol. 13, no. 69-98, 2001.

[25] K. El Emam, D. R. Goldenson, J. McCurley, and J. Herbsleb, "Success or Failure? Modeling the Likelihood of Software Process Improvement," International Software Engineering Research Network (ISERN) ISERN-98-15, 1998.

[26] D. N. Wilson, T. Hall, and N. Baddoo, "A framework for evaluation and prediction of software process improvement success," *The Journal of Systems and Software*, vol. 59, no. 135-142, 2001.

[27] M. Raffa, G. Zollo, and R. Caponi, "The short but interesting life of small software firms," in *Achieving Quality in Software*, S. Bologna and G. Bucci, Eds. Florence: Chapman and Hall, Great Britain, 1996, pp. 103-117.

[28] ABS, "8127.0 Characteristics of Small Business, Australia", 2004, accessed 1 Dec, 2005, http://www.abs.gov.au/ausstats/abs@.nsf/b06660592430724fca2568b5007b8619/8ceaee35da67c721ca256ff20005a042!OpenDocument

[29] D. R. Goldenson and D. Gibson, "Demonstrating the impact and benefits of CMMI: an update and preliminary results," Software Engineering Institute, Carnegie Mellon University, Pittsburgh CMU/SEI-2003-SR-009, October, 2003.