Low-rigour, Rapid Software Process Assessments for Small Software Development Firms

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Abstract

Rigorous software process improvement (SPI) assessments are considered by many small software development firms to be too expensive. This paper presents the results from a program in which low-rigour, one-day SPI assessments were offered at no cost to 22 small software development firms.

Analysis shows an association between capability levels achieved and staff experience and education level. Also, the process capability of firms varied depending on the industry sectors targeted by firms.

About eight months after the assessment, the firms were contacted to arrange a follow-up meeting to determine the extent to which they had implemented the recommendations. Analysis of the capability levels at the time of assessment and later follow-up meeting reveals that the process improvement program was effective in improving the process capability of many of these small software development firms.

1. Introduction

The Australian Bureau of Statistics (ABS) defines a small business as one that employs less than 20 persons. The ABS recognises three categories within that definition: non-employing businesses (i.e. sole-proprietorships and partnerships without employees); businesses with one to four employees; and businesses with between five and 19 employees. The first two categories are sometimes referred to as very small businesses or micro-businesses. Organisations with 20-199 employees are classed by the ABS as medium sized businesses.

The Australian computer services industry is dominated by small and very small businesses. In 1998, 98 percent employed fewer than 20 staff and 88 percent employ less than five persons [1]. A similar situation exists in the USA; 65 percent of data processing companies have less than five employees [2], and the current software industry in the USA is largely made up of very small teams, many of which comprise less than 10 people for software development [3]. This presents a challenge in terms of devising improvement initiatives that are feasible for these very small organisations.

Software process improvement (SPI) is recognised as having the potential to improve competitiveness by increasing productivity; reducing costs, defect and rework; and improving time to market and customer satisfaction [4].

Although small software development firms recognise that software process assessments play a valuable role in improving a firm's processes and products, most feel that SPI costs too much and takes up resources needed to deliver product [5]. This paper describes a software process improvement program which was funded by SEA Qld and offered at no cost to small software development firms.

After the background and methodology of this study are described, the findings are presented. Firstly, the organisational characteristics of the 22 firms are presented. Then the process capability levels for each of the eight assessed processes are summarised. Comparisons are made between capability levels and organisational characteristics. The final outcomes as determined at the follow-up meetings are then presented. The discussion covers the outcomes in more detail and summarises the factors which enabled and inhibited this software process improvement program. Finally, the conclusion looks at how the results of this study may benefit the software industry in Australia.

2. Background

Over the last 10 years, interest in SPI has increased as evidenced by the growing number of journal articles which include the phrase 'process improvement' in their title or abstract [6]. SPI has attracted the interest of researchers and practitioners. There is a growing number

of publications about SPI in well respected journals such as IEEE Software, Communications of the ACM, Journal of Systems and Software, Empirical Software Engineering Journal, and Software Quality Journal. Additionally, journals dedicated to the topic have appeared and research about software process improvement is reported at international and national conferences. Conferences are also held specifically focused on SPI e.g. International Conference on SPI, European Conference on SPI, SPICE conference.

However, most of the empirical studies on SPI relate to large well-resourced organisations. It has been noted [by 7] that very little is known about the experience of small software development firms in regard to SPI. Kautz urges further work to understand the role of software process assessment and improvement approaches in small organisations, so that more qualified advice can be given to these firms [7].

Over the last thirty years, the U.S. Department of Defense (DoD) contract software development scenario has been the dominant influence for researchers to develop, enhance and promulgate SPI models [2]. But now, mass-market software, much of which is produced by small firms, dominates the software development contract effort. However, issues such as firm size, development mode (contract versus commercial off-the-shelf), development size (program size, shipped volume) and development speed have not been adequately addressed by researchers. In particular, it is believed that start-up firms have special needs which cannot be met by traditional software engineering models [2].

The models underlying traditional SPI programs such as Software CMM were designed for large organizations undertaking extensive projects. However, while these models have been evolving over many years, the software industry has changed dramatically with a large increase in the proportion of small software development firms. Although the customized software market is still substantial, its growth is being outstripped by that for packaged software, with many firms choosing to buy packaged software which they can customize internally, rather than buying a fully bespoke system [8].

In recognition that a full-scale software CMM assessment is expensive and time-consuming and therefore beyond the reach of many small firms, there have been attempts to tailor the CMM for small teams, projects and organisations [9], [10], [11]. Such assessment methods are referred to as mini-assessment methods and are also used by large organisations to provide spot checks or interim assessments between formal assessments. Such assessments are regarded as being less rigorous than a formal evaluation as the purpose is to provide information to help the organisation improve its processes rather than provide evidence of supplier capability for contract selection.

At the same time as the US DoD was investing in the CMM, research in Europe saw the advent of other software assessment methods such as Bootstrap and TickIT. The British Ministry of Defence was responsible for the ImproveIT model which was restructured into a proposal submitted to the Organisation for International Standards (ISO) to request a standard for process assessment. In 1991, ISO established a major international initiative on process assessment to harmonise the various approaches. This working group developed the standard ISO/IEC 15504, known SPICE. SPICE was established as a project to develop draft standards, trial the developing standard and to promote awareness of the developing standard. Many current SPI approaches from researchers and practitioners in over 20 countries have been incorporated to develop a consistent and validated framework for assessment and improvement [12]. The output from the SPICE project team is the emerging international standard on software process assessment ISO/IEC 15504. In 1998, the technical report version (TR) was released and it is currently undergoing extensive validation [13]. The final draft international standard, comprising five parts is expected to be released in the middle of the year 2005 [14].

The ISO/IEC TR 15504 standard [15] sketches out a roadmap for the implementation of best practice in software engineering by defining 40 processes, divided into five categories: customer-supplier; engineering; support; management; and organization. The process capability of each defined process "measures how well each process is managed to achieve its purpose and the organization's objectives for it" [16]. Capability is measured in levels from incomplete (level 0); performed (level 1); managed (level 2); established (level 3); predictable (level 4) to optimising (level 5). SPICE (ISO/IEC TR 15504) was chosen as the basis for the RAPID program reported here as it is the emerging standard on software process assessment and also because qualified SPICE assessors were available from the Software Quality Institute (SQI) to undertake the assessments.

There is growing interest in the emerging 15504 standard for software process assessment: it has been estimated [by 17] that approximately 1260 SPICE-based software process assessments were conducted during the 22 months from September 1996 to June 1998.

The RAPID (Rapid Assessments for Process Improvement for software Development) process improvement program was funded by SEA Qld and involved a total of 24 organisations. Two of the organisations were provided with mentoring through the Showcase program, and are not included in the analysis

presented here. This paper focusses on the 22 firms who had an initial assessment and then a follow-up meeting after about eight months.

3. Methodology

In this section, the SPICE standard is introduced, and the RAPID assessment instrument, which was derived from SPICE, is described. The procedure followed for the RAPID assessments is then detailed.

3.1. International standard for software process asssessment

The RAPID assessment instrument is based on, and conforms with, the technical report (TR) version of 15504 which was released in 1998. The document set for ISO/IEC TR 15504 includes nine parts, as shown in table 1.

Table 1. Structure of ISO/IEC TR 15504 [15]

Part 1	Concepts and introductory guide
Part 2	A reference model for processes and process capability
Part 3	Performing an assessment
Part 4	Guide to performing assessments
Part 5	An assessment model and indicator guidance
Part 6	Guide to competency of assessors
Part 7	Guide to use in process improvement
Part 8	Guide for use in determining supplier process capability
Part 9	Vocabulary

The TR 15504 reference model (part 2) has two dimensions, "one to define the processes to be assessed, the other describes the scale for measurement of capability" [15]. The process dimension is directly aligned to ISO/IEC 12207 (software life cycle processes) and defines the purpose and expected outcomes of each process.

The second dimension of the reference model, the process capability dimension, includes five levels of capability based on nine process attributes. When a process is assessed against these attributes, the achievement of the attribute is rated on a scale from not achieved, partially achieved, largely achieved up to fully achieved. After each process has been rated, then the process capability level can be determined. A capability level is defined by a set of attributes that work together to provide a major enhancement in the capability to perform a process. The levels constitute a rational way of progressing through improvement of the capability of any process [18].

In order to qualify for a capability level, the process attributes related to the level must be rated as largely or fully achieved, and attributes at any lower levels must be fully achieved. Table 2 shows the attributes for each capability level.

Table 2. Process attributes and capability levels

Level 0 – Incomplete	
1.1	Process performance attribute
→ *Level 1 – Performed*	
2.1	Performance management attribute
2.2	Work product management attribute
→ *Level 2 – Managed*	
3.1	Process definition and tailoring attribute
3.2	Process Resource attribute
→ *Level 3 – Established*	
4.1	Process measurement attribute
4.2	Process control attribute
→ *Level 4 – Predictable*	
5.1	Process change attribute
5.2	Continuous improvement attribute
→ *Level 5 – Optimising*	

3.2. RAPID assessment instrument

As the RAPID assessments were restricted to one day each, the scope of the assessment was limited to eight key processes, as listed in table 3. These processes were selected by the PIP project manager on the basis of expert judgement. As well as the primary life cycle processes (relating to requirements and development), project management, quality assurance, configuration management and problem resolution were included as these processes support the achievement of capability level two. Risk management was included as small firms are considered to be sensitive to risk.

The reference model (part 2) of TR 15504 was adapted to create the RAPID assessment model. In terms of the process dimension, the RAPID assessment model included eight processes: requirements elicitation, software development, configuration management, quality assurance, problem resolution, project management, risk management, and process establishment. As shown in table 3, all five process categories of TR 15504 are represented.

The process capability dimension was also constrained to meet the limitation of one day assessment. Although SPICE provides for capability levels from zero (incomplete) to five (optimising), only questions relating to levels one to three were included in the RAPID assessment model, enabling rating levels of level 0 (incomplete), level 1 (performed), level 2 (managed) and level 3 (established). The RAPID method collects evidence only by interview, but participants may

illustrate issues under discussion by reference to documents. It is in this regard that the RAPID method is considered to be less rigorous compared to supplier appraisals which strive for rigid accuracy.

Table 3. RAPID processes and process categories

Process	Process Category	ISO-15504 ID
Requirements Gathering	Customer-Supplier	CUS.3
Software development	Engineering	ENG.1
Project Management	Management	MAN.2
Configuration Management	Support	SUP.2
Quality Assurance	Support	SUP.3
Problem Resolution	Support	SUP.8
Risk Management	Management	MAN.4
Process Establishment	Organisation	ORG.2.1

Two trained SPICE assessors undertook each RAPID assessment, one in the role of team leader and the other as support assessor. A set of procedures and templates was prepared including a demographic questionnaire, assessment plan, assessment instrument, assessment report, feedback form, follow-up meeting and final report.

3.3. RAPID assessment procedure

The assessments were conducted from August to December 1999. Firstly, the assessment team leader contacted the sponsor of the organisation, and sent the demographic questionnaire to the sponsor for completion. Using the demographic information, a plan was compiled jointly by the team leader and the support assessor, and agreed to by the sponsor. The team leader and support assessor conducted on-site interviews with key people involved in managing the software development effort of the organisation. For each of the eight processes examined, the assessors followed the script of the assessment instrument to determine the extent to which the process attributes have been achieved using a four point scale: not achieved; partially achieved; largely achieved; and fully achieved. The capability level (0, 1, 2 or 3) for each of the eight processes was then determined, based on the organisation's achievement of the process attributes.

A draft report was prepared by the team leader and support assessor and forwarded to the sponsor at the organisation to confirm that the assessment team had accurately recorded the information discussed. The report identified strengths, weaknesses, process attribute ratings and capability levels, and recommendations for improvement to the organisation. Any changes suggested by the sponsor were discussed and then the assessment report was submitted to the organisation sponsor and SQI. A feedback form was sent with the assessment report to the sponsor to solicit comments regarding the conduct and value of the assessment. Eight months after the assessment, contact was made to arrange a follow-up meeting, then the final report prepared and submitted.

4. Findings

4.1. Profile of firms

Prior to the initial assessment, the sponsor at each organisation completed a demographic questionnaire. Analysis of the responses provides a summary of the organisational characteristics of the 22 firms. 18 of the 22 firms provided the year founded. Many of the firms were less than five years old, and only 4 firms were more than 10 years old.

Sponsors were asked to identify the industry sector for which their organisation deliver or acquire software. Responses were recoded to conform with the Australian and New Zealand Standard Industry Classification [19]. As shown in table 4, a vast diversity in the range of these application domains was reported. Six firms focussed their efforts on just one application domain, whereas the others developed software for a broader range of business sectors, with communication services attracting the most attention, followed by utilities such as electricity, gas and water, and also property and business services. Only two industry sectors were not represented: accommodation (H) and personal services (Q).

Table 4. Industry codes and sectors of firms' clients

Code	Industry Sector	N
J	Communication services	9
D	Electricity, gas and water	8
L	Property and business services	8
C	Manufacturing	7
M	Government administration & defence	6
K	Finance and Insurance	6
P	Cultural and recreational	6
	Other	6
E	Construction	5
I	Transport & storage	5
G	Retail trade and consumer goods	4
	Total responses	70
Note: 'Other' includes O: Health and community services, B: Mining, N: Education, F: Wholesale, A: Agricultural.		

Overall, the level of formal education of staff employed in the 22 firms is high. Of the total number of 341 staff employed (including full-time, part-time and contract), almost half of all the staff (47%) have post graduate qualifications. However, when the proportion of

staff with post graduate qualifications is examined across all 22 firms, the distribution is far from even: ten of the 22 firms do not have any post-graduate qualified staff, and 12 of the 22 firms reported that all their staff had either graduate or post graduate qualifications. The firm with the lowest level of education reported that seven of the nine staff did not have university qualifications.

Only 2 of the firms responded that they had ISO 9000 certification, although one was in the process of gaining certification. In response to a question about the number of staff with more than five years experience, 15 of the 21 firms which responded stated that more than half of their staff had in excess of 5 years industry experience.

Many of the firms indicated that contract and part-time staff were involved in their business. To compare staffing levels, part-time and contract staff were counted as half an employee and the total staff headcount calculated. 18 of the 22 firms had a headcount of less than 50, the other three between 50 and 60.

To summarise the organisational characteristics, most of the group of 22 were small firms, without ISO 9000 certification, educated to graduate level, with experienced staff and were targeting a wide range of application domains.

4.2. Assessed process capability levels

Overall, there was a wide variation in the capability levels for the 22 firms, as shown in table 5. The requirements elicitation process exhibited higher capability compared to the other processes in almost all cases. 11 of the 22 firms were rated at level 2 (managed) or level 3 (established) for requirements elicitation. On the other hand, the most incomplete process was process establishment, rated as level 0 (incomplete) at 15 of the 22 firms.

Table 5. Capability levels by process

Process	Number of Firms at Level			
	0	**1**	**2**	**3**
Requirements elicitation	1	10	9	2
Software development	1	13	8	0
Configuration management	3	13	4	2
Quality assurance	12	6	3	1
Problem resolution	4	15	1	2
Project management	5	10	6	1
Risk management	11	9	1	1
Process establishment	15	5	2	0
Levels: 0 incomplete, 1 performed, 2 managed, 3 established				

The means of the eight process capability levels were calculated and ranked as shown in table 7. Friedman's test confirmed that a significant difference existed between the means ($p<.05$), as did a parametric ANOVA test.

Table 6. Ranked capability level means

Ranked Order	Capability Level Mean
Requirements Elicitation	1.55^{a}
Software Development	1.32^{ab}
Configuration Management	1.23^{ab}
Project Management	1.14^{b}
Problem Resolution	1.05^{b}
Quality Assurance	0.68^{c}
Risk Management	0.65^{c}
Process Establishment	0.41^{c}
Least significant difference (p=.05)	0.35
Note: means with the same superscript are not significantly different (p<.05).	

A parametric statistical procedure was then applied to group the processes into similar levels of capability. First the means were arranged in order of magnitude, and the standard error (SE) of a treatment (process) mean and the least significant difference (LSD) calculated. If the gap between consecutive (ranked) means is greater than the least significant difference, then it can be concluded that significant differences exist between the means in question. For the capability level means as shown in table 6, the standard error of the mean is 0.13, and the least significant difference is 0.35 (at p=.05). Therefore the analysis revealed three homogeneous groups of processes. Processes within each group show little difference in their capability level means. The group of processes exhibiting the highest capability levels consisted of requirements elicitation, software development and configuration management. In the middle group, similar achievement ratings were found for software development, configuration management, project management and problem resolution processes. The group of processes with the lowest achievement was made up of quality assurance, risk management, and process establishment.

The association between process capability and organisational factors such as headcount, age of firm, education level and experience of staff, and application domain were explored. The capability levels for the eight processes were summed to provide a variable named summed capability level. This has a possible range from zero (all processes at level 0) to 24 (all processes at level 3).

It was expected that larger organisations would exhibit higher levels of capability levels but this was not the case with the firms in this sample, as shown in figure 1. However, analysis did revealed a positive association between the proportion of experienced staff at a firm and

its summed capability levels (Spearman's rho=.498; p<.05).

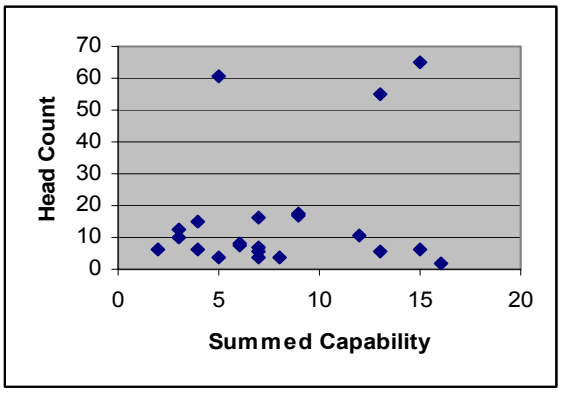

Figure 1. Staff Headcount vs Capability

In a similar way, firms with a higher proportion of graduate or post graduate staff exhibited higher process capability compared to those with less qualified staff (Spearman's rho=.450; p<.05).

The capability of the firms was analysed in respect to the various industry sectors they serve. Table 7 shows the client industry sectors ranked by the median of summed capability levels. It was found that firms focussed on clients in the industry sectors of government and defence, and public utilities had higher capability compared to firms targeting markets such as retail and construction industries. This is not surprising as government and defence contracts are typically of higher value and tend to seek firms with quality management systems (such as ISO 9000).

Table 7. Capability levels grouped by industry sector

Industry sector	N	Min	Max	Median
Government administration & defence	6	4	15	8
Electricity gas and water	8	2	16	8
Cultural and recreational	6	5	12	7
Communication services	9	2	15	7
Manufacturing	7	2	9	7
Property and business services	8	2	15	6.5
Finance and insurance	6	5	12	6.5
Other	6	3	8	6.5
Transport & storage	5	3	9	6
Retail trade and consumer goods	4	3	7	5.5
Construction	5	3	16	4

This finding is consistent with the assertion by Glass [20] who claimed some application domains, such as aerospace, banking, process control, productivity tools and reservation systems exhibit higher capability compared to others.

4.3. Follow-up meetings

About eight months after the initial assessment, the firms were contacted to arrange a follow-up meeting to determine the extent to which they had implemented the recommendations. From the group of 22 companies, nine were formally reassessed, and six of these had improved some of their process capability levels, the other three exhibited improvements, but not enough to gain a higher capability level rating. A further 11 firms participated in the follow-up meetings, but were not formally reassessed. Of this group, six firms reported that they had implemented some of the recommendations. Five firms did not report any improvement, but provided some interesting reasons why the recommendations had not been actioned. Only two organizations withdrew from the program.

5. Discussion

5.1. Process improvement outcomes

To facilitate discussion, the firms are grouped according to the success of the outcomes of the program:

- Gold medal: six firms increased the capability level of at least one of the eight processes;
- Silver medal: three firms reported improvements to some of the eight processes, but did not increase the capability level of any process;
- Bronze medal: six firms reported limited improvements;
- Completed program: 5 firms reported no improvements;
- Withdrawn from program: 2 firms did not have a follow-up meeting.

The six firms in the gold medal group increased in their capability levels, as shown in table 8. The extent of improvement varied from a maximum of six of the eight processes to a minimum of one process. The headcount of these top performing firms ranged from six to 55, and as shown in table 8, the extent of improvement is not related to headcount or their capability rankings at the initial assessment.

The processes showing the greatest extent of improvement were software development, configuration management and project management, although capability level improvement was recorded for all eight processes.

Table 8. Assessed and final capability levels of gold medal firms

Firm	1	2	3	4	5	6	Levels improved for each process
At assessment:							
Summed capability level	13	12	13	4	3	4	
Rank order	4th	6th	4th	18th	20th	18th	
At follow-up meeting:							
Summed capability levels	19	16	16	6	5	5	
Rank order	1st	3rd	3rd	14th	17th	17th	
Headcount	55	10.5	5.5	6	12.5	15	
Requirements Gathering	2→3	3	1→2	1	1	1	2
Software Development	2→3	2→3	2→3	1	0	1	3
Configuration Management	1→2	1→2	3	1	1	1→2	3
Quality Assurance	1→2	2	2	0→1	0	0	2
Problem Resolution	1→2	1	3	1	0→1	1	2
Project Management	2→3	2	2→3	0→1	1	0	3
Risk Management	3	0→1	0	0	0	0	1
Process Establishment	1	1→2	0	0	0→1	0	2
Total number of levels improved for each firm	6	4	3	2	2	1	18
Note: arrows indicate increase in level of capability							

The silver medal group comprised three organisations which recorded improvement to specific processes, but not enough to step up a capability level. These firms had headcounts of 5.5; 17.5 and 60.5. The achievement of attributes improved from partially to largely for quality assurance, configuration management, process establishment and project management processes.

All the firms in the bronze medal group provided positive feedback regarding the value of program. The improvements recorded by the follow-up assessor were not specific to the eight processes, and included the development of templates, assessment and implementation of tools; review of business goals; formalisation of testing procedures, and establishment of measures such as actual effort. The headcount at these three firms ranged from 3.5 to 16 staff.

A further seven firms completed the program but did not report any process improvement. These firms' headcounts varied widely from two to 65 staff. When asked why the recommendations had not been implemented, a wide variety of reasons were provided:

- business problems, such as failure in business partnership, relocation of business, burglary of premises;
- personal problems such as family sickness, marriage break-up of directors;
- high staff turnover including loss of key staff;
- lack of SPI expertise, specifically the need for mentoring.

It was pleasing to note that only two firms withdrew from the program. In one case the follow-up meeting was not held as the firm cancelled its SEA membership after the initial assessment. The other firm could not be contacted as it had ceased to operate prior to the follow-up meeting. It was not surprising that some of the 22 firms had changed the focus of their business, or ceased to operate over the time period from the assessments to the follow-up meetings. In their study of small Italian software firms, Raffa, Zollo and Caponi [21] 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. A study which analysed Australian business changes in ownership and cessations noted that exit rates are higher for smaller businesses, regardless of the age of the business, with around 35 percent of all businesses and small businesses exiting in their first five years of operation [22].

5.2. Critical success factors

A number of factors which inhibited the success of the program were identified by the development staff and also the assessors. Firstly, the assessments were conducted between August and December 1999. As well as being preoccupied with their own year 2000 readiness, many of the firms were concerned with ensuring their delivered product had been adequately tested and distributed. Secondly, the introduction of the Federal Government's Goods and Services Taxation on July 1st 2000 put further pressure on firms, both in terms of their internal systems, and for some, the systems under development for their clients. Due to the volume of

development work and fixed deadlines, an acute shortage of IT staff was suffered. Some of the firms in the program lost key staff, and found it very difficult to obtain replacements. Lack of resources also precluded firms from releasing staff to attend appropriate training on offer from SEA Qld at the time. The final factor which constrained the success of the program relates to the time period from assessment to follow-up. Many firms had started to document and change their processes, but they had not had time to implement the new processes on a project.

On the other hand, factors which contributed to the success of the program were also identified. The availability, at no cost, of external consultants with expertise in software process assessment and improvement was appreciated by the firms concerned. The use of external consultations provided three major advantages to the small firms: firstly, they were too busy to allocate their own staff to address software process improvement; secondly, many firms did not have staff with expertise in SPI; and thirdly, turf wars were avoided as staff are often more accepting of recommendations made by external experts, rather than by workmates. The commitment of the sponsor at each organization also contributed to the success of the project. As well as participating in the assessment, the sponsor reviewed the recommendations and prioritized their implementation. In all cases, the sponsor was a very senior person in the organization, thus giving a clear signal that the process improvement program was supported and valued by senior management. The involvement of the sponsor also ensured that the recommendations were tailored to the business goals.

However, the most motivating aspect of the RAPID program involved the follow-up meetings. The firms understood that their improvement progress would be evaluated after a period of about six months. This provided stimulus for them to act on the recommendations. 15 of the 22 firms assessed reported improvements as a result of the RAPID program. If the follow-up meetings had not been included and the program concluded with the assessment report, it is unlikely that such a successful outcome would have been realised.

6. Conclusions

It has been reported [23] that only 25 per cent of the A$4 billion software sold in Australia each year is developed by local firms. Furthermore, it has been estimated that small-medium enterprises will win a minimal proportion, between five and ten percent, of the $3.5 billion spent by the Federal Government on ICT in 2003 [24]. Large Australian software purchasers, such as the Defence Materiel Organisation (DMO), are moving towards international standards [25]. So in order to gain a greater share of the domestic and international market, small software firms need to adopt standards such as ISO/IEC 15504. Software process assessment proves to investors and customers that the firm is committed to software quality [26].

In terms of future research, there are many issues which deserve consideration. A major issue involves the evolution of ISO/IEC 15504. In response to feedback from the SPICE trials and ballots, the structure of the 15504 standard has undergone a dramatic change from nine parts in Technical Report version, to five parts in the Final Draft International Standard (FDIS) version, with a notable change being the removal of the process dimension. To compensate for this, ISO/IEC 12207 [27] has been amended to include more detail about process objectives and outcomes. When the FDIS version is released, predicted to be in the mid-part of 2005, it is expected that interest in the standard will grow from both software development firms, and from organisations acquiring software. Firms currently using TR 15504 are already planning how they will manage the transition to the FDIS version.

The widespread adoption of the international standard will see increased interest in the value of training courses and mentoring, issues barely addressed in the SPICE trials.

CMMI is also gaining international acceptance in the software engineering community: of the 87 CMMI appraisals performed up to mid 2003, only 39 were carried out in the US [28]. In Australia, the DMO is placing an increasing reliance on CMMI to assess the capability of potential contractors [25]. Mapping between CMMI and SPICE is already available [29] and compliance with one standard affords compliance to the other. For small software firms, the RAPID assessment method provides a gentle introduction to the experience of adopting international standards whilst providing a practical and effective method to assess and improve current processes.

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