LIST OF APPENDICES

Appendix A. List of abbreviations

Table A.1 List of Abbreviations

Abbreviation	Meaning
ABS	Australian Bureau of Statistics
ACS	Australian Computer Society
ANZSIC	Australian and New Zealand Standard Industrial Classification
BSA	Business Software Association
CBA	CMM-based appraisal
CM	Configuration management
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integrated
COTS	Commercial Off-the-Shelf
CSDP	Certified Software Development Professional
EC	European Commission
ESE	Empirical Software Engineering
ESI	European Software Institute
ESSI	European Systems and Software Initiative
FDIS	Final Draft International Standard
FTE	Full Time Equivalent
GST	Australian Government Goods and Service Taxation legislation
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IIB	Information Industries Board
IPI	Internal Process Improvement
ISBSG	International Software Benchmarking Standards Group
IS	Information Systems
ISO	International Organisation for Standardization
MIS	Management Information Systems
M-W U	Mann-Whitney U test
NIIP	National Industry Improvement Program
PA	Process attribute
PDTR	Proposed Draft Technical Report
PE	Process establishment
PIE	Process Improvement Experiment
PIP	Process Improvement Program
PM	Project management
PR	Problem resolution
PSM	Practical Software Measurement
QA	Quality assurance
Qld	Queensland
RAPID	Rapid Assessments for Process Improvement for software Development
RE	Requirements elicitation
RM	Risk management
SADT	Structured Analysis and Design Techniques
SBPQ	Software Best Practices Questionnaire
SCAMPI	Standard CMMI SM Appraisal Method for Process Improvement
SCE	Software Capability Evaluation
SD	Software development
SE	Software Engineering

SEA	Software Engineering Australia
SEAQ	Software Engineering Australia – Queensland Branch
SEI	Software Engineering Institute
SME	Small Medium Enterprise
SPA	Software Process Assessment
SPC	Statistical Process Control
SPI	Software Process Improvement
SPICE	Software Process Improvement and Capability dEtermination
SQA	Software Quality Assurance
SQI	Software Quality Institute
TR	Technical Report
VASIE	Value Added Software Information for Europe

Appendix B. Glossary of statistical tests and terminology

Data scale types. The statistical operations allowable on a given set of scores are dependent on the level of measurement achieved. The four levels of measurement are as follows: nominal (qualitative; categorical observations), ordinal (ranked categorical), interval (quantitative), and ratio (has true zero point) (Selvanathan et al. 2000, pp. 14-6; Siegel 1956).

***p*-value** is the 'probability that the observed data or data more extreme, given that the null hypothesis is true, and the sampling was done randomly' (Miller 2004, p. 185) and is referred in the statistical tables as *p*. The *p*-value is compared to the significance criterion α. In this study, α is set at 0.05. The null hypothesis is rejected if the p-value is less than α.

Independent groups t-test is used to confirm if interval or ratio data represents two populations. The t-test is a parametric test, and assumes the data is drawn from two independent groups and that the two populations have equal variances. Levene's test is used to compare the variances of the two populations.

Normality is a prerequisite for some statistical tests. To test if the data arise from a normal distribution, the Shapiro-Wilks W-statistic is used if the sample size is <=50, and the Kolmogorov D statistic if the sample size is > 50 (Bonate 2000, p. 58; Coakes & Steed 1996).

An **Outlier** is an observation that is unusually small or unusually large (Selvanathan et al. 2000, p. 662). Observations with values between 1.5 and 3 box lengths from the upper or lower edge of the box are referred to as outliers. The box length is the interquartile range. **Extremes** are observations with values more than 3 box lengths from the upper or lower edge of the box. Source: SPSS Help (SPSS Inc. 2004)

The **One-Way ANOVA** procedure produces a one-way analysis of variance for a quantitative dependent variable by a single factor (independent) variable. Analysis of variance is used to test the hypothesis that several means are equal. This technique is an extension of the two-sample t test. In addition to determining that differences exist among the means, this test can identify which means differ. There are two types of tests for comparing means: a priori contrasts and post hoc tests. Contrasts are tests set up before running the experiment, and post hoc tests are run after the experiment has been conducted. Source: SPSS Help (SPSS Inc. 2004)

ANOVA was used to compare the adoption level of organisations within each industry sector. As population normality is a prerequisite assumption for analysis of variance, the calculation was performed separately for the non-COTS developers and for the COTS developers. As the second assumption for the ANOVA test is homogeneity of variance, Levene's test was performed in each case.

Friedman test is the nonparametric equivalent of a one-sample repeated measures design or a two-way analysis of variance with one observation per cell. Friedman tests the null hypothesis that k related variables come from the same population. For each case, the k variables are ranked from 1 to k. The test statistic is based on these ranks. Kendall's W is a normalization of the Friedman statistic. Kendall's W is interpretable

as the coefficient of concordance, which is a measure of agreement among raters. Each case is a judge or rater and each variable is an item or person being judged. For each variable, the sum of ranks is computed. Kendall's W ranges between 0 (no agreement) and 1 (complete agreement). Source: SPSS Help (SPSS Inc. 2004).

Wilcoxon signed ranks test is a paired-sample test. It is the non-parametric equivalent to the paired samples t-test. The only assumption is that the sample distributions are symmetric about the median and the number of tied ranks is small. The test involves calculating the difference scores from high to low, affixing the sign of each difference to the corresponding rank. In the case of tied ranks, the mean of the rank which would have been assigned to those observations had they not been tied, is used (Bonate 2000, p. 58; Selvanathan et al. 2000, p. 443). The Wilcoxon pretest/posttest was used for pair-wise comparisons to determine if a statistical difference exists between the capability levels at assessment and follow-up meeting.

The **Mann-Whitney U test** is used to determine whether two independent samples (groups) come from the same population. It is the most popular of the two-independent-samples tests. It is equivalent to the Wilcoxon rank sum test and the Kruskal-Wallis test for two groups. Mann-Whitney tests that two sampled populations are equivalent in location. The observations from both groups are combined and ranked, with the average rank assigned in the case of ties. The number of ties should be small relative to the total number of observations. If the populations are identical in location, the ranks should be randomly mixed between the two samples. The number of times a score from group 1 precedes a score from group 2 and the number of times a score from group 2 precedes a score from group 1 are calculated. The Mann-Whitney U statistic is the smaller of these two numbers. The Wilcoxon rank sum W statistic, also displayed, is the rank sum of the smaller sample. If both samples have the same number of observations, W is the rank sum of the group named. From SPSS Help (SPSS Inc. 2004). In some of the tables in this study, referred to as M-W U.

Pearson coefficient of correlation (also known as Pearson product-moment correlation) is a parametric test to measure the strength of association between two variables (Selvanathan et al. 2000) . The prerequisites are that the data must be collected from related pairs; the scale of measurement should be interval or ratio; scores within each variable should be normally distributed; the relationship between the 2 variables must be linear; the variability in scores for the variables is roughly the same (Coakes & Steed 1996, p. 49-50).

Spearman rank correlation coefficient (rho) is used to measure and test if a relationship exists between two variables (Selvanathan et al. 2000, p. 653). It is the non-parametric alternative to the parametric bivariate correlation (Pearson's r) (Coakes & Steed 1996, p. 166). In this study, the Spearman rank correlation coefficient (rho) is labelled r_s.

Kruskall-Wallis test is a non-parametric equivalent of independent-samples single-factor analysis of variance. The K-W test can be applied when the problem objective is to compare two or more populations; the data are either ranked or quantitative but non-normal; the samples are independent (Selvanathan et al. 2000, p. 564). It is used in this study to compare process capability according to target business sector.

Discriminate function analysis is used to determine which continuous variables discriminate between two or more naturally occurring groups. It answers the question: can a combination of variables be used to predict group membership? In discriminant analysis, the independent variables are the predictors and the dependent variables are the groups. Usually, several variables are included in a study to see which ones contribute to the discrimination between groups. Wilks' lambda is used in an ANOVA (F) test of mean differences in discriminant analysis, such that the smaller the lambda for an independent variable, the more that variable contributes to the discriminant function. Lambda varies from 0 to 1, with 0 meaning group means differ (thus the more the variable differentiates the groups), and 1 meaning all group means are the same. The F test of Wilks' lambda shows which variables' contributions are significant. Variables should be continuous and normally distributed (Poulsen & French 2002).

Fisher's exact probability test is useful for analysing either nominal or ordinal discrete data when the two independent samples are small in size. The test determines whether the two groups differ in the proportion with which they fall into the two classifications. Fisher's exact test if used in this research to compare responses of high and low adopters.

Bonferroni correction method. The probability of committing a Type I error (falsely reject H_0) increases with the number of tests. To overcome this risk, the Bonferroni correction method provides a simple corrective procedure by dividing the desired α level by the number of tests involved (Miller 2004, p. 184).

Appendix C. Timeframe of study

Table C.1 List of research activities with start and end dates

Activity	From date	To date
Literature Review	Jul 1998	Nov 2004
Modify Questionnaire	Sep 1998	Jan 1999
Pre-test, pilot test	Dec 1998	Jan 1999
Mail out questionnaire	Jan 1999	Jan 1999
Preliminary analysis of survey responses	Feb 1999	Mar 1999
Prepare preliminary report for SEA'99	Apr 1999	
Further survey analysis	Jan 2000	Mar 2000
Prepare ASWEC paper	Mar 2000	April 2000
Participate in PIP assessments	Oct 1999	Dec 1999
Prepare PIP assessment reports	Jan 2000	Mar 2000
Plan and conduct follow-up meetings	June 2000	Aug 2000
Prepare final reports	Aug 2000	Sep 2000
Preliminary analysis of four PIP firms	Sep 2000	Dec 2000
Further analysis of survey data	Jan 2001	Nov 2004
Further analysis of PIP reports	Jan 2001	Nov 2004
Comparison survey and PIP results	Jan 2001	Nov 2004
Write and review thesis	Jan 2003	Dec 2004

Timeframe of study

Appendix D. Mappings related to survey

Table D.1 Mapping of Best Practice Survey Questions to ESI Questionnaire

ESSI	ESI question	ESI section		New question for this research	New section	
	Organisation Type	General Information		Deleted		
	Country	General Information		Deleted		
	Number of Employees	General Information		A4	Your Organisation	A
	Number of Employees involved in Software Engineering	General Information		A5	Your Organisation	A
	Organisation primary involvement in software industry	General Information		A3	Your Organisation	A
	Industrial Sector	General Information		A2	Your Organisation	A
	Community of Interest	General Information		Deleted		
				A1 Contact information	Your Organisation	A
				A6	Your Organisation	A
				A7	Your Organisation	A
1.1	1.1 Does each software project have a nominated software project manager?	Organisational Issues	1	5.1	Project Management & Training	5
1.2	1.2 Does the software project manager report to a business project manager responsible for the overall benefit of the project to the business?	Organisational Issues	1	5.2	Project Management & Training	5
1.3	1.3 Does a Software Quality Assurance (SQA) function exist within an independent reporting line from software development project management?	Organisational Issues	1	5.3 Does a Software Quality Assurance (SQA) function exist? If YES, does the SQA function have an independent reporting	Project Management & Training	5

ESSI	ESI question	ESI section		New question for this research	New section	
				line from the software development project management?		
1.4	1.4 Is a change control function established for each software project?	Organisational Issues	1	3.1	Configuration Management	5
1.5	1.5 Is there a required training programme for all newly-appointed software managers which is designed to familiarise them with in-house software project management procedures?	Organisational Issues	1	5.9	Project Management & Training	5
1.6	1.6 Is there a procedure for maintaining awareness of the state-of-the-art in CASE or software engineering technology?	Organisational Issues	1	5.10	Project Management & Training	5
1.7	1.7 Is there a procedure for ensuring that appropriate levels of user/customer/marketing input is made throughout the project?	Organisational Issues	1	1.1	Requirements and Design	1
1.8	(1.8) Where other non-software resources are critical to the success of the project is there a procedure for ensuring their availability according to plan?	Organisational Issues	1	4.9	Estimates and Schedules	4
2.01	2.1 Do management formally assess the benefits, viability, and risk of each software project prior to making contractual (or internal) commitments?	Standards and Procedures	2	5.4	Project management & Training	5
2.02	2.2 Do management formally conduct periodic reviews of the status of each software project?	Standards and Procedures	2	5.6	Project Management & Training	5
2.03	(2.3) Are there procedures to ensure that external software subcontracting organisations, if any, follow a disciplined software development process?	Standards and Procedures	2	(5.5)	Project Management & Training	5
2.04	2.4 For each project, are independent audits (such as inspections or walkthroughs) conducted for each major stage in the software development process?	Standards and Procedures	2	5.7	Project Management & Training	5
2.05	2.5 Are common coding standards applied to each software	Standards and	2	2.4	Code and Test	2

ESSI	ESI question	ESI section		New question for this research	New section	
	project?	Procedures				
2.06	2.6 Is there a documented procedure for estimating software size (such as 'Lines of Source Code') and thus for using productivity measures?	Standards and Procedures	2	4.1	Estimates and Schedules	4
2.07	2.7 Is a formal procedure used to produce software development effort, schedule, and cost estimates?	Standards and Procedures	2	4.2	Estimates and Schedules	4
2.08	2.8 Is a formal procedure (such as a review or handover with sign-off) used whenever a deliverable (such as a user statement of requirements or system requirements) is passed from one discrete group to another (e.g. user to analyst to designer) to ensure it is properly understood?	Standards and Procedures	2	5.8	Project Management & Training	5
2.09	(2.9) Is there a procedure to ensure that the systems projects selected for development qualitatively or quantitatively support/alleviate the organisation's business objective/problems?	Standards and Procedures	2	(1.2)	Requirements and Design	1
2.10	(2.10) Are there procedures to ensure that the functionality, strengths, and weaknesses of the 'system' which the software is replacing are formally reviewed?	Standards and Procedures	2	1.4	Requirements and Design	1
2.11	2.11 Does test planning commence prior to programming beginning based on the user requirements and high-level design documents?	Standards and Procedures	2	2.2	Code and Test	2
2.12	2.12 Is independent testing conducted by users (or appropriate representatives) under the guidance of Software Quality Assurance before any system or enhancement goes live?	Standards and Procedures	2	2.5 Is independent testing conducted by users (or appropriate representatives) before any system or enhancement goes live? If YES, is it under the guidance of Software Quality Assurance?	Code and Test	2
2.13	2.13 Is there a procedure to check that the system configuration (i.e. the programs and any data) passing user acceptance testing is the same as that which is implemented	Standards and Procedures	2	2.6 Is there a procedure to check that the system configuration (i.e. the programs and any data)	Code and Test	2

ESSI	ESI question	ESI section		New question for this research	New section	
	for live operation and that no changes are made directly to a 'live' version of any system (other than through modification to its development version)?			passing user acceptance testing is the same as that which is implemented for live operation? Is there a procedure to check that no changes are made directly to a 'live' version of any system (other than through modification to its development version)?		
3.1	3.1 Are records of actual project resourcing and timescales versus estimates maintained (at individual resource/resource-type level) and regularly analysed/fed-back into the estimating and scheduling procedures?	Metrics	3	4.3	Estimates and Schedules	4
3.2	(3.2) Are records of software size maintained for each software configuration item, over time, and fed-back into the estimating process?	Metrics	3	(4.4)	Estimates and Schedules	4
3.3	3.3 Are statistics on the sources of errors in software code gathered and analysed for their cause, detection and avoidance measures?	Metrics	3	2.12	Code and Test	2
3.4	3.4 Are statistics on test efficiency (% of errors actually detected by an activity against the maximum theoretically possible) gathered and analysed for all testing stages in the development process?	Metrics	3	2.9 Are statistics on test efficiency (**eg.** % of errors actually detected by an activity against the maximum theoretically possible) gathered and analysed for all testing stages in the development process?	Code and Test	2
3.5	3.5 Is project tracking (e.g. earned value) used throughout the software development process (actual versus planned deliverables analyses, designed, unit tested, system tested, acceptance tested over time) to monitor project progress?	Metrics	3	4.5	Estimates and Schedules	4
3.6	(3.6) Are estimates made and compared with actuals for target computer performance (e.g. memory utilisation,	Metrics	3	(2.8)	Code & Test	2

ESSI	ESI question	ESI section		New question for this research	New section	
	processor throughput and file/channel I/O and disk usage)?					
3.7	3.7 Are post-implementation software problem reports logged and their resolution effectively tracked and analysed?	Metrics	3	2.10	Code and Test	2
3.8	3.8 Do records exist from which (and requiring nothing extra) all current versions and variants of software systems and their components can be quickly and accurately reconstructed in the development environment?	Metrics	3	2.11	Code and Test	2
4.1	4.1 Are estimates, schedules and subsequent changes produced only by the project managers who directly control the project resources and are fully aware of their abilities and availabilities?	Control of the Development Process	4	4.6	Estimates and Schedules	4
4.2	4.2 Does the overall business project manager gain agreement and sign-off from all parties who have produced detailed estimates and schedules before publishing or revising a consolidated project plan?	Control of the Development Process	4	4.8	Estimates and Schedules	4
4.3	4.3 Is there a procedure for controlling changes to the software requirements, designs and accompanying documentation?	Control of the Development Process	4	3.2	Configuration Management	3
4.4	4.4 Is there a procedure for controlling changes to the code and specifications?	Control of the Development Process	4	3.3	Configuration Management	3
4.5	4.5 Is there a procedure for assuring that regression testing (i.e. the forced re-run of all previous tests prior to any new tests) is routinely performed during and after initial implementation?	Control of the Development Process	4	2.7	Code and Test	2
4.6	4.6 Do procedures exist to ensure that every required function is tested/verified?	Control of the Development Process	4	2.13	Code and Test	2
5.1	5.1 Are software tools used to assist in forwards and/or backwards tracing of software requirements to software	Tools and Technology	5	3.4	Configuration Management	3

ESSI	ESI question	ESI section		New question for this research	New section	
	designs through to code?					
5.2	5.2 Are design notations such as Structured Analysis and Design Technique used in program design?	Tools and Technology	5	1.3	Requirements and Design	1
5.3	5.3 Are automated testing tools used (for example for capturing and replaying tests, or for ensuring logic paths coverage)?	Tools and Technology	5	Included in new Q 2.3	Code and Test	2
5.4	5.4 Are software tools used for tracking and reporting the status of the software/subroutines in the software development library?	Tools and Technology	5	3.5 Are software tools used for tracking and reporting the status (eg. reviewed, tested, released) of the software/subroutines in the software development library?	Configuration Management	3
5.5	5.5 Are prototyping methods used in ensuring the requirements elements of the software?	Tools and Technology	5	1.5	Requirements and Design	1
5.6	(5.6) Is a data dictionary available for controlling and storing details of all data files and their fields?	Tools and Technology	5	(1.6)	Requirements and Design	1
5.7	5.7 Are software tools used for project planning, estimating, scheduling, and critical path analysis?	Tools and Technology	5	4.7	Estimates & Schedules	4
				2.1 Programming languages used	Code & Test	2
				2.3 Development tools used	Code & Test	2
				6.1 Which aspects of your software development activities have the most for improvement?	How can we help you?	6
				6.2 How can SEA help you achieve those improvements?	How can we help you?	6

Note: ESI survey questions sourced from ESI (1995)

Table D.2 Mapping of ANZSIC division codes to industry sectors used by ESI

ANZSIC Code	ANZSIC Division	ESI Industry sectors
A	Agriculture, forestry & fishing	Agriculture & forestry
		Fishing
B	Mining	Mining & quarrying
C	Manufacturing	17 manufacturing industries
D	Electricity, gas & water supply	Energy production & distribution; gas & water supply
E	Construction	Construction & building
F	Wholesale trade	Wholesale & retail trade; repair of goods
G	Retail trade	
H	Accommodation, cafes & restaurants	Lodging & restaurants
I	Transport & storage	Transportation services
J	Communication services	Post & telecommunications
		Publishing, printing and reproduction of recorded media
K	Finance & insurance	Finance & insurance
L	Property & business services	Business, legal and management consultancy; holdings
		Real estate activities
		Renting & leasing
M	Government administration & defence	
N	Education	Education
O	Health & community services	Community service activities
		Health & social work
P	Cultural & recreational services	Recreational, cultural and sporting activities
Q	Personal & other services	
		6 IT activities
		Technical testing & analysis
		Recycling
		Electrical engineering and related technical consultancy
		Mechanical engineering and related technical consultancy

Table D.3 Mapping of Best Practice Survey to ISO/IEC TR 15504 and RAPID model

Section 1—Requirements and Design	ISO/IEC 15504	RAPID
1.1 Is there a procedure for ensuring that appropriate levels of user/customer/marketing input are made throughout the project?	CUS.3 Requirements elicitation	RE
1.2 Is there a procedure to ensure that the systems projects selected for development qualitatively or quantitatively support/alleviate the organisation's business objective/problems?	CUS.1.1 Acquisition preparation	No
1.3 Are design notations such as Structured Analysis and Design Technique used in program design?	ENG.1.3 Software design	SD
1.4 Are there procedures to ensure that the functionality, strengths, and weaknesses of the 'system' which the software is replacing are formally reviewed?	No	No
1.5 Are prototyping methods used in ensuring the requirements elements of the software?	ENG.1.1 Systems requirements analysis and design	SD
1.6 Is a data dictionary available for controlling and storing details of all data files and their fields?	ENG.1.3 Software design	SD
Section 2—Code and Test	ISO/IEC 15504	RAPID
2.2 Does test planning commence prior to programming beginning based on the user requirements and high-level design documents?	ENG.1.6 Software testing	SD
2.4 Are common coding standards applied to each software project?	ENG.1.4 Software construction	SD
2.5a Is independent testing conducted by users (or appropriate representatives) before any system or enhancement goes live?	ENG.1.5 Software integration	SD
2.5b If YES, is it under the guidance of Software Quality Assurance?	SUP.3 Quality assurance	QA
2.6a Is there a procedure to check that the system configuration (i.e. the programs and any data) passing user acceptance testing is the same as that which is implemented for live operation?	SUP.2 Configuration management	CM
2.6b Is there a procedure to check that no changes are made directly to a 'live' version of any system (other than through modification to its development version)?	SUP.2 Configuration management	CM
2.7 Is there a procedure for assuring that regression testing (i.e. the forced re-run of all previous tests prior to any new tests) is routinely performed during and after initial implementation?	ENG.1.6 Software testing	SD
2.8 Are estimates made and compared with actuals for target computer performance (e.g. memory utilisation, processor throughput and file/channel I/O and disk usage)?	MAN.3 Quality management	No
2.9 Are statistics on test efficiency (eg. % of errors actually detected by an activity against the maximum theoretically possible) gathered and analysed for all testing stages in the development process?	ENG.1.6 Software testing	SD

Section 2—Code and Test (continued)	ISO/IEC 15504	RAPID
2.10 Are post-implementation software problem reports logged and their resolution effectively tracked and analysed?	SUP.8 Problem resolution	PR
2.11 Do records exist from which (and requiring nothing extra) all current versions and variants of software systems and their components can be quickly and accurately reconstructed in the development environment?	SUP.2 Configuration management	CM
2.12 Are statistics on the sources of errors in software code gathered and analysed for their cause, detection and avoidance measures?	SUP.4 Verification	No
2.13 Do procedures exist to ensure that every required function is tested/verified?	SUP.4 Verification	No
Section 3—Configuration Management	ISO/IEC 15504	RAPID
3.1 Is a change control function established for each software project?	SUP.2 Configuration management	CM
3.2 Is there a procedure for controlling changes to the software requirements, designs and accompanying documentation?	SUP.2 Configuration management	CM
3.3 Is there a procedure for controlling changes to the code and specifications?	SUP.2 Configuration management	CM
3.4 Are software tools used to assist in forwards and/or backwards tracing of software requirements to software designs through to code?	ENG.1 Development	SD
3.5 Are software tools used for tracking and reporting the status (eg. reviewed, tested, released) of the software/subroutines in the software development library?	SUP.2 but not software tools	CM
Section 4—Estimates and Schedules	ISO/IEC 15504	RAPID
4.1 Is there a documented procedure for estimating software size (such as 'Lines of Source Code') and thus for using productivity measures?	MAN.2 Project management	PM
4.2 Is a formal procedure used to produce software development effort, schedule, and cost estimates?	MAN.2 Project management	PM
4.3 Are records of actual project resourcing and timescales versus estimates maintained (at individual resource/resource-type level) and regularly analysed/fed-back into the estimating and scheduling procedures?	MAN.2 Project management – first part	PM
4.4 Are records of software size maintained for each software configuration item, over time, and fed-back into the estimating process?	SUP.2 Configuration management	CM
4.5 Is project tracking (e.g. earned value) used throughout the software development process (actual versus planned deliverables analyses, designed, unit tested, system tested, acceptance tested over time) to monitor project progress?	MAN.2 Project management	PM
4.6 Are estimates, schedules and subsequent changes produced only by the project managers who directly control the project resources and are fully aware of their abilities and availabilities?	MAN.2 Project management	PM

Section 4—Estimates and Schedules (continued)	ISO/IEC 15504	RAPID
4.7 Are software tools used for project planning, estimating, scheduling, and critical path analysis?	MAN.2 Project management	PM
4.8 Does the overall business project manager gain agreement and sign-off from all parties who have produced detailed estimates and schedules before publishing or revising a consolidated project plan?	MAN.2 Project management	PM
4.9 Where other non-software resources are critical to the success of the project is there a procedure for ensuring their availability according to plan?	MAN.2 Project management	PM
Section 5—Project Management & Training	ISO/IEC 15504	RAPID
5.1 Does each software project have a nominated software project manager?	MAN.2 Project management	PM
5.2 Does the software project manager report to a business project manager responsible for the overall benefit of the project to the business?	MAN.2 Project management	PM
5.3a Does a Software Quality Assurance (SQA) function exist?	SUP.3 Quality assurance	QA
5.3b If YES, does the SQA function have an independent reporting line from software development project management?	SUP.3 Quality assurance	QA
5.4 Do management formally assess the benefits, viability, and risk of each software project prior to making contractual (or internal) commitments?	MAN.2 Project management	PM
5.5 Are there procedures to ensure that external software subcontracting organisations, if any, follow a disciplined software development process?	CUS.1.3 Supplier monitoring	No
5.6 Do management formally conduct periodic reviews of the status of each software project?	MAN.2 Project management	PM
5.7 For each project, are independent audits (such as inspections or walkthroughs) conducted for each major stage in the software development process?	SUP.3 Quality assurance	QA
5.8 Is a formal procedure (such as a review or handover with sign-off) used whenever a deliverable (such as a user statement of requirements or system requirements) is passed from one discrete group to another (e.g. *user* to *analyst* to *designer*) to ensure it is properly understood?	SUP.3 Quality assurance	QA
5.9 Is there a required training programme for all newly-appointed software managers which is designed to familiarise them with in-house software project management procedures?	ORG.3 Human resource management	No
5.10 Is there a procedure for maintaining awareness of the state-of-the-art in CASE or software engineering technology?	ORG.4 Infrastructure	No

Table D.4 ISO/IEC 15504 Processes

Process group	Basic processes	Component processes
Primary life cycle processes		
Customer	CUS.1 Acquisition	CUS 1.1 Acquisition preparation
		CUS 1.2 Supplier selection
		CUS 1.3 Supplier monitoring
		CUS 1.4 Customer acceptance
	CUS.2 Supply	
	CUS.3 Requirements elicitation	
	CUS.4 Operation	CUS 4.1 Operational use
		CUS 4.2 Customer support
Engineering	ENG.1 Development	ENG 1.1 System requirements analysis and design
		ENG 1.2 Software requirements analysis
		ENG 1.3 Software design
		ENG 1.4 Software construction
		ENG 1.5 Software integration
		ENG 1.6 Software testing
		ENG 1.7 System integration and testing
	ENG.2 System and software maintenance	
Supporting life cycle processes		
Support	SUP.1 Documentation	
	SUP.2 Configuration management	
	SUP.3 Quality assurance	
	SUP.4 Verification	
	SUP.5 Validation	
	SUP.6 Joint review	
	SUP.7 Audit	
	SUP.8 Problem resolution	
Organisational life cycle processes		
Management	MAN.1 Management	
	MAN.2 Project management	
	MAN.3 Quality management	
	MAN.4 Risk management	
Organisation	ORG.1 Organisational alignment	
	ORG.2 Improvement	ORG 2.1 Process establishment
		ORG 2.2 Process assessment
		ORG 2.3 Process improvement
	ORG.3 Human resource management	
	ORG.4 Infrastructure	
	ORG.5 Measurement	
	ORG.6 Reuse	

Note: There are 24 basic processes and 16 component processes, arranged in a 4 level hierarchy. At the top level, the three principal groupings are defined in ISO/IEC 12207 as primary, supporting and organisational life cycle processes.
Sourced from figure 1 (ISO/IEC TR 15504-2 1998, p. 5).

Appendix E. Survey Cover Letter and Questionnaire

Software Development Manager
Company
Street
Suburb
State Postcode

Dear Sir/Madam

Software Engineering Australia is undertaking an industry improvement program for the software industry. The goal of the initiative is to improve the capability and competitiveness of the Australian software development industry. In the first phase of the program, the level of use of widely-recognised best practices in the software industry will be established through the use of the accompanying survey. The survey, developed by the European Software Institute has been adapted for use in Australia to enable us to tailor the program to industry's needs. Analysis of the survey results will enable a comparison of local industry with international developers, and the identification of potential candidates for improvement projects.

I would appreciate it if you could use a small amount of your valuable time to respond to the survey. The survey is being sent to all commercial software developers and the large organisations involved in software development in Queensland. Total confidentiality is assured. The results will be summarised; individual responses will not be published. After the responses have been analysed, a summary report will be mailed to all respondents.

The survey has been designed to minimise the time demands on participants, and mostly requires indicating a response by placing a tick in the appropriate box. It should take around 10 minutes to fill out. I would appreciate your completing the survey and returning it in the reply-paid envelope by 30 January 1999.

Should you have any queries about this survey, please do not hesitate to contact me on (07) 3236 1111.

Thank you for your participation.

Phil Scanlan
Chief Executive Officer

Software Survey (adapted from ESSI)

Part A: Your Organisation

This section is related to the type and size of your organisation (that is the Queensland-based division or business unit that you belong to).

A1. Contact Information: *please complete or attach a business card.*

Your name

Organisation Name

Postal Address

Postcode Phone Fax

Email Address

A2. Is your organisation a software development company?

- ☐ Yes
- ☐ No

If not, which industry sector does your organisation operate in? *(Please tick one box)*

- ☐ Agriculture, Forestry & Fishing
- ☐ Mining
- ☐ Manufacturing
- ☐ Utilities - Electricity, Gas & Water
- ☐ Construction
- ☐ Retail & Wholesale
- ☐ Accommodation, Cafes & Restaurants
- ☐ Transport & Storage
- ☐ Communication Services & Media
- ☐ Finance & Insurance
- ☐ Property & Business Services
- ☐ Government Administration & Defence
- ☐ Education
- ☐ Health & Community Services
- ☐ Cultural & Recreational Services
- ☐ Personal & Other Services
- ☐ Tourism & Hospitality
- ☐ Information Technology
- ☐ Other (please state):

A3. Organisation primary involvement in software industry *(please tick appropriate box(es))*

- ☐ Software user (developed in-house)
- ☐ Software user (developed by a 3rd party)
- ☐ Software developer (producing off-the-shelf systems)
- ☐ Software developer (producing custom software systems)
- ☐ Research & Development institute or university
- ☐ Interest Group (e.g. professional society or standards body)
- ☐ Other *(please specify)*:

A4. Number of Employees _____

A5. Number of Employees involved in Software Development or Maintenance _____

A6. Would your organisation be interested in participating in the Software Engineering Australia improvement program? *(Please tick one box)*

- ☐ Yes
- ☐ No

A7. Does your organisation develop or maintain software? *(Please tick one box)*

- ☐ Yes
- ☐ No

If the answer to question A7 is 'no', then no further answers are required; please return the survey in the reply paid envelope.

Part B: Software Practices

Guidelines

1. Please attempt to answer ALL questions either YES, NO, or N.A. (Not Applicable). N.A. may be a valid response for those questions which are applicable for only certain types of developer. Questions of this type are indicated by brackets around the number of the question, e.g.(1.8), and by an "Applies to" comment set with italics.
2. "Don't know" or "don't understand the question" responses should be reflected as a NO.
3. Please answer according to normal organisational practice - not ideal practice or according to unimplemented standards.

Section 1 - Requirements and Design

1.1 Is there a procedure for ensuring that appropriate levels of user/customer/marketing input is made throughout the project?

- ☐ Yes
- ☐ No

Comments:

(1.2) Is there a procedure to ensure that the systems projects selected for development qualitatively or quantitatively support/alleviate the organisation's business objective/ problems?

- ☐ Yes
- ☐ No
- ☐ N.A.

Applies to: those organisations where all software projects do not have to be funded externally such as In-House systems and Package development. In an end-user organisation this discipline is often called Information Systems Planning.

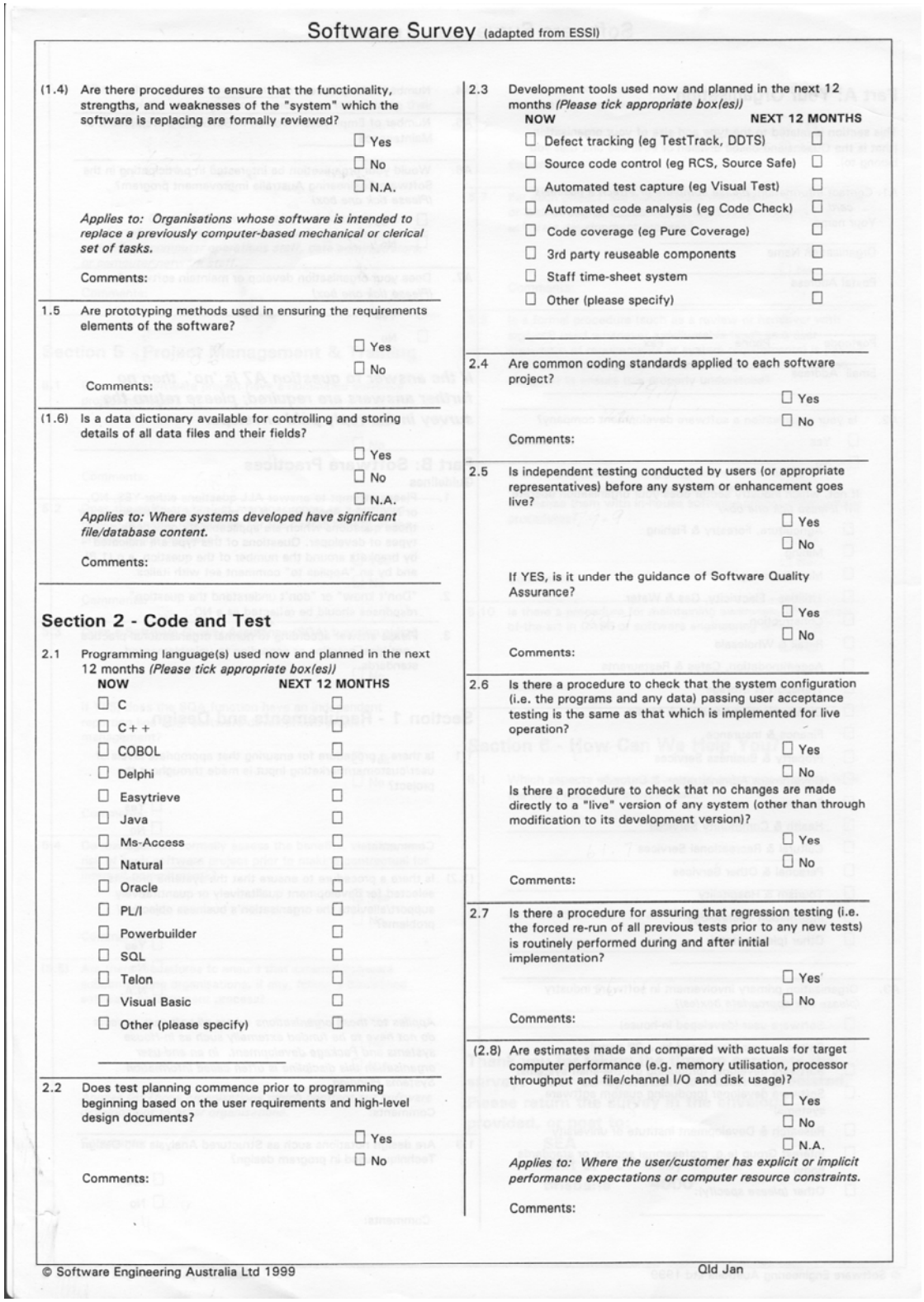
Comments:

1.3 Are design notations such as Structured Analysis and Design Technique used in program design?

- ☐ Yes
- ☐ No

Comments:

Qld Jan



Software Survey (adapted from ESSI)

(1.4) Are there procedures to ensure that the functionality, strengths, and weaknesses of the "system" which the software is replacing are formally reviewed?

☐ Yes
☐ No
☐ N.A.

Applies to: Organisations whose software is intended to replace a previously computer-based mechanical or clerical set of tasks.

Comments:

1.5 Are prototyping methods used in ensuring the requirements elements of the software?

☐ Yes
☐ No

Comments:

(1.6) Is a data dictionary available for controlling and storing details of all data files and their fields?

☐ Yes
☐ No
☐ N.A.

Applies to: Where systems developed have significant file/database content.

Comments:

Section 2 - Code and Test

2.1 Programming language(s) used now and planned in the next 12 months *(Please tick appropriate box(es))*

	NOW	NEXT 12 MONTHS
C	☐	☐
C++	☐	☐
COBOL	☐	☐
Delphi	☐	☐
Easytrieve	☐	☐
Java	☐	☐
Ms-Access	☐	☐
Natural	☐	☐
Oracle	☐	☐
PL/I	☐	☐
Powerbuilder	☐	☐
SQL	☐	☐
Telon	☐	☐
Visual Basic	☐	☐
Other (please specify)	☐	☐

2.2 Does test planning commence prior to programming beginning based on the user requirements and high-level design documents?

☐ Yes
☐ No

Comments:

2.3 Development tools used now and planned in the next 12 months *(Please tick appropriate box(es))*

	NOW	NEXT 12 MONTHS
Defect tracking (eg TestTrack, DDTS)	☐	☐
Source code control (eg RCS, Source Safe)	☐	☐
Automated test capture (eg Visual Test)	☐	☐
Automated code analysis (eg Code Check)	☐	☐
Code coverage (eg Pure Coverage)	☐	☐
3rd party reuseable components	☐	☐
Staff time-sheet system	☐	☐
Other (please specify)	☐	☐

2.4 Are common coding standards applied to each software project?

☐ Yes
☐ No

Comments:

2.5 Is independent testing conducted by users (or appropriate representatives) before any system or enhancement goes live?

☐ Yes
☐ No

If YES, is it under the guidance of Software Quality Assurance?

☐ Yes
☐ No

Comments:

2.6 Is there a procedure to check that the system configuration (i.e. the programs and any data) passing user acceptance testing is the same as that which is implemented for live operation?

☐ Yes
☐ No

Is there a procedure to check that no changes are made directly to a "live" version of any system (other than through modification to its development version)?

☐ Yes
☐ No

Comments:

2.7 Is there a procedure for assuring that regression testing (i.e. the forced re-run of all previous tests prior to any new tests) is routinely performed during and after initial implementation?

☐ Yes
☐ No

Comments:

(2.8) Are estimates made and compared with actuals for target computer performance (e.g. memory utilisation, processor throughput and file/channel I/O and disk usage)?

☐ Yes
☐ No
☐ N.A.

Applies to: Where the user/customer has explicit or implicit performance expectations or computer resource constraints.

Comments:

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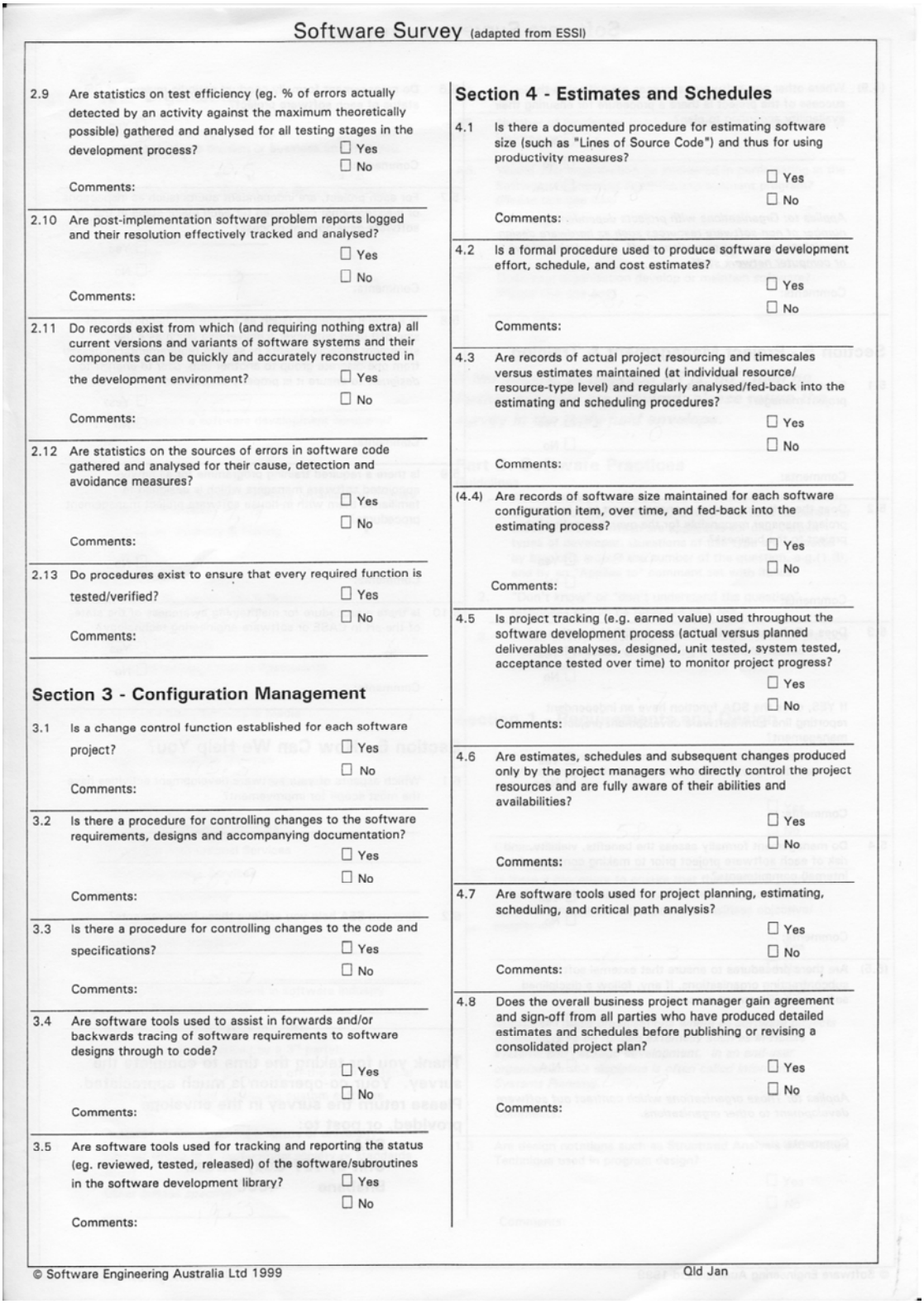

Software Survey (adapted from ESSI)

2.9 Are statistics on test efficiency (eg. % of errors actually detected by an activity against the maximum theoretically possible) gathered and analysed for all testing stages in the development process? ☐ Yes ☐ No

Comments:

2.10 Are post-implementation software problem reports logged and their resolution effectively tracked and analysed? ☐ Yes ☐ No

Comments:

2.11 Do records exist from which (and requiring nothing extra) all current versions and variants of software systems and their components can be quickly and accurately reconstructed in the development environment? ☐ Yes ☐ No

Comments:

2.12 Are statistics on the sources of errors in software code gathered and analysed for their cause, detection and avoidance measures? ☐ Yes ☐ No

Comments:

2.13 Do procedures exist to ensure that every required function is tested/verified? ☐ Yes ☐ No

Comments:

Section 3 - Configuration Management

3.1 Is a change control function established for each software project? ☐ Yes ☐ No

Comments:

3.2 Is there a procedure for controlling changes to the software requirements, designs and accompanying documentation? ☐ Yes ☐ No

Comments:

3.3 Is there a procedure for controlling changes to the code and specifications? ☐ Yes ☐ No

Comments:

3.4 Are software tools used to assist in forwards and/or backwards tracing of software requirements to software designs through to code? ☐ Yes ☐ No

Comments:

3.5 Are software tools used for tracking and reporting the status (eg. reviewed, tested, released) of the software/subroutines in the software development library? ☐ Yes ☐ No

Comments:

Section 4 - Estimates and Schedules

4.1 Is there a documented procedure for estimating software size (such as "Lines of Source Code") and thus for using productivity measures? ☐ Yes ☐ No

Comments:

4.2 Is a formal procedure used to produce software development effort, schedule, and cost estimates? ☐ Yes ☐ No

Comments:

4.3 Are records of actual project resourcing and timescales versus estimates maintained (at individual resource/ resource-type level) and regularly analysed/fed-back into the estimating and scheduling procedures? ☐ Yes ☐ No

Comments:

(4.4) Are records of software size maintained for each software configuration item, over time, and fed-back into the estimating process? ☐ Yes ☐ No

Comments:

4.5 Is project tracking (e.g. earned value) used throughout the software development process (actual versus planned deliverables analyses, designed, unit tested, system tested, acceptance tested over time) to monitor project progress? ☐ Yes ☐ No

Comments:

4.6 Are estimates, schedules and subsequent changes produced only by the project managers who directly control the project resources and are fully aware of their abilities and availabilities? ☐ Yes ☐ No

Comments:

4.7 Are software tools used for project planning, estimating, scheduling, and critical path analysis? ☐ Yes ☐ No

Comments:

4.8 Does the overall business project manager gain agreement and sign-off from all parties who have produced detailed estimates and schedules before publishing or revising a consolidated project plan? ☐ Yes ☐ No

Comments:

 Qld Jan

Software Survey (adapted from ESSI)

(4.9) Where other non-software resources are critical to the success of the project is there a procedure for ensuring their availability according to plan?

☐ Yes
☐ No
☐ N.A.

Applies to: Organisations with projects dependent on a number of non-software resources such as hardware design specialists, computer operations staff, data administrators, or computer network staff.

Comments:

Section 5 - Project Management & Training

5.1 Does each software project have a nominated software project manager?

☐ Yes
☐ No

Comments:

5.2 Does the software project manager report to a business project manager responsible for the overall benefit of the project to the business?

☐ Yes
☐ No

Comments:

5.3 Does a Software Quality Assurance (SQA) function exist?

☐ Yes
☐ No

If YES, does the SQA function have an independent reporting line from software development project management?

☐ Yes
☐ No

Comments:

5.4 Do management formally assess the benefits, viability, and risk of each software project prior to making contractual (or internal) commitments?

☐ Yes
☐ No

Comments:

(5.5) Are there procedures to ensure that external software subcontracting organisations, if any, follow a disciplined software development process?

☐ Yes
☐ No
☐ N.A.

Applies to: Those organisations which contract out software development to other organisations.

Comments:

5.6 Do management formally conduct periodic reviews of the status of each software project?

☐ Yes
☐ No

Comments:

5.7 For each project, are independent audits (such as inspections or walkthroughs) conducted for each major stage in the software development process?

☐ Yes
☐ No

Comments:

5.8 Is a formal procedure (such as a review or handover with sign-off) used whenever a deliverable (such as a user statement of requirements or system requirements) is passed from one discrete group to another (e.g. *user* to *analyst* to *designer*) to ensure it is properly understood?

☐ Yes
☐ No

Comments:

5.9 Is there a required training programme for all newly-appointed software managers which is designed to familiarise them with in-house software project management procedures?

☐ Yes
☐ No

Comments:

5.10 Is there a procedure for maintaining awareness of the state-of-the-art in CASE or software engineering technology?

☐ Yes
☐ No

Comments:

Section 6 - How Can We Help You?

6.1 Which aspects of your software development activities have the most scope for improvement?

_____
_____
_____

6.2 How can SEA help you achieve those improvements?

_____
_____
_____

Thank you for taking the time to complete the survey. Your co-operation is much appreciated. Please return the survey in the envelope provided, or post to:

SEA
Unit 3, 107 Quay Street,
Brisbane 4000

Qld Jan

Appendix F. Analysis of best practice survey data

Table F.1 Industry sectors of respondent organisations

Sector name	Sector code	Frequency	Percent
Software development	0	156	76.8
Agriculture, forestry & fishing	1	2	1.0
Mining	2	2	1.0
Manufacturing	3	5	2.5
Utilities	4	5	2.5
Construction	5	1	.5
Retail & wholesale	6	1	.5
Accommodation, cafes & restaurants	7	0	0
Transport & storage	8	0	0
Communication services & media	9	2	1.0
Finance & insurance	10	2	1.0
Property & business services	11	1	.5
Government, Administration & Defence	12	5	2.5
Education	13	7	3.4
Health & community service	14	3	1.5
Cultural & recreational services	15	1	.5
Personal & other services	16	0	0
Tourism & hospitality	17	0	0
Information technology	18	10	4.9
Total		203	100.0

Table F.2 Programming languages used now and planned for future

Language	Now		Next 12 months		Trend
	Frequency	%	Frequency	%	%
VB	87	42.9	74	36.5	-6
Ms-Access	74	36.5	57	28.1	-8
Other	68	33.5	33	16.3	-17
C++	64	31.5	54	26.6	-5
SQL	64	31.5	53	26.1	-5
C	47	23.2	32	15.8	-7
Java	35	17.2	53	26.1	9
Delphi	32	15.8	22	10.8	-5
Oracle	31	15.3	24	11.8	-3
COBOL	14	6.9	9	4.4	-2
Powerbuild	10	4.9	4	2.0	-3
PL/I	2	1.0	0	0.0	-1

Note: Languages not used: Telon, Easytrieve & Natural

Table F.3 Other programming languages in use

Programming language or tool	Frequency	Percent
Assembler	6	2.9%
Autodesk Autocad ARX or Lisp	3	1.5%
CA Visual Objects	6	2.9%
Centura	2	1.0%
Clarion	5	2.4%
Clipper	2	1.0%
Fortran	2	1.0%
FoxPro and/or Visual FoxPro	5	2.4%
Informix	4	2.0%
Perl	6	2.9%
RPG	2	1.0%
Paradox	2	1.0%
CA Open Road	2	1.0%
Progress	3	1.5%
Dbase III or IV	3	1.5%
Director Lingo	2	1.0%
MapBasic	2	1.0%
Dataflex	2	1.0%
Pascal	2	1.0%
ABAP/4	2	1.0%
ASP-Jscript	2	1.0%
HTML, MTML, DHTML	3	1.5%
Advanced Revelation and OpenInsight	2	1.0%
MS-Basic & QBasic	2	1.0%
Various un-named	2	1.0%
The following languages were each reported by 1 respondent: 4th Dimension (www.4d.com); Abane IV; Asymetrix Toolbook (www.asymetrix.com); Excel, FilePro; FilemakerPro; Forth (www.forth.com); How; Ingres; Interbase PL/SQL; Javascript; Lotus Notes; Modula Embedded; Paxus RT86; Sybase Power++; Pick; RolePlaying Game (RPG) Director (Macromedia); SQLWindows; TCL?TK; GE Smallworld Magik.		
Note: Respondents were invited to record any other programming languages used now and expected to be used in the next 12 months. Although many respondents chose to record the names of the programming language, they did not consistently tick the check boxes to indicate if usage was current or planned for the future. Therefore, interpretation of the use of these languages in 12 months time is not possible.		

Table F.4 Development tools used now and planned to use in the next 12 months

Tools	Now		Next 12 Months		Trend
	Frequency	%	Frequency	%	
Staff time-sheet system	69	34.0	38	18.7	-15
Source code control	51	25.1	54	26.6	1
3rd party reusable components	49	24.1	35	17.2	-7
Defect tracking	24	11.8	20	9.9	-2
Other	21	10.3	8	3.9	-6
Auto code analysis	12	5.9	13	6.4	0
Automated test capture	5	2.5	11	5.4	3
Code coverage	2	1.0	5	2.5	1

Table F.5 Development tools – recorded comments for 'other' response

Development Tool - Other	Timeframe	Frequency	Percent
No response		180	88.7%
CA visual objects	Now	1	.5
Case Tools (Rat. Rose)	Now	1	.5
Compiling Only	Now	1	.5
Developer 2000	Now	1	.5
Fractal Analysis	Now	1	.5
How	Now & in 12 months	1	.5
In house developed systems ...		1	.5
In house paper-based system	Now	1	.5
In-house software for Pro/Manag	Now	1	.5
Interdev/visual studio	In 12 months	1	.5
Lint	Now & in 12 months	1	.5
Memory checks (eg Purity)	Now	1	.5
Mfch v5-0	Now	1	.5
Ms-Access-Issues register	Now	1	.5
MS Developer Library	Now & in 12 months	1	.5
Own methods used		1	.5
Personal attention	Now	1	.5
Profiling	Now	1	.5
PVCS	In 12 months	1	.5
Rad in magic	Now & in 12 months	1	.5
Source code generation objects	Now	1	.5
Time tracking of tasks	Now	1	.5
User requirements	Now	1	.5
Total		203	100.0

There were 26 responses with comments for 'other' development tools.

Table F.6 Mean adoption level and number of responses for each practice

Question item	Yes	No	Not applicable	Missing	Mean Practice Adoption Level
Section 1—Requirements and Design					
1.1 Is there a procedure for ensuring that appropriate levels of user/ customer/ marketing input is made throughout the project?	169	32	0	2	84.08%
1.2 Is there a procedure to ensure that the systems projects selected for development qualitatively or quantitatively support/alleviate the organisation's business objective/problems?	117	34	47	52	77.48%
1.3 Are design notations such as Structured Analysis and Design Technique used in program design?	101	98	0	4	50.75%
1.4 Are there procedures to ensure that the functionality, strengths, and weaknesses of the 'system' which the software is replacing are formally reviewed?	96	57	46	50	62.75%
1.5 Are prototyping methods used in ensuring the requirements elements of the software?	154	43	0	6	78.17%
1.6 Is a data dictionary available for controlling and storing details of all data files and their fields?	116	55	26	32	67.84%
Section 2—Code and Test					
2.2 Does test planning commence prior to programming beginning based on the user requirements and high-level design documents?	86	111	0	6	43.65%
2.4 Are common coding standards applied to each software project?	157	40	0	6	79.70%
2.5a Is independent testing conducted by users (or appropriate representatives) before any system or enhancement goes live?	162	40	0	1	80.20%
2.5b If YES, is it under the guidance of Software Quality Assurance?	35	118	0	50	22.88%
2.6a Is there a procedure to check that the system configuration (i.e. the programs and any data) passing user acceptance testing is the same as that which is implemented for live operation?	124	74	0	5	62.63%
2.6b Is there a procedure to check that no changes are made directly to a 'live' version of any system (other than through modification to its development version)?	117	74	0	12	61.26%
2.7 Is there a procedure for assuring that regression testing (i.e. the forced re-run of all previous tests prior to any new tests) is routinely performed during and after initial implementation?	53	146	0	4	26.63%

Question item	Yes	No	Not applicable	Missing	Mean Practice Adoption Level
2.8 Are estimates made and compared with actuals for target computer performance (e.g. memory utilisation, processor throughput and file/channel I/O and disk usage)?	47	86	69	70	35.34%
2.9 Are statistics on test efficiency (eg. % of errors actually detected by an activity against the maximum theoretically possible) gathered and analysed for all testing stages in the development process?	21	177	0	5	10.61%
2.10 Are post-implementation software problem reports logged and their resolution effectively tracked and analysed?	153	48	0	2	76.12%
2.11 Do records exist from which (and requiring nothing extra) all current versions and variants of software systems and their components can be quickly and accurately reconstructed in the development environment?	130	69	0	4	65.33%
2.12 Are statistics on the sources of errors in software code gathered and analysed for their cause, detection and avoidance measures?	36	163	0	4	18.09%
2.13 Do procedures exist to ensure that every required function is tested/verified?	107	91	0	5	54.04%
Section 3—Configuration Management					
3.1 Is a change control function established for each software project?	91	109	0	3	45.50%
3.2 Is there a procedure for controlling changes to the software requirements, designs and accompanying documentation?	116	86	0	1	57.43%
3.3 Is there a procedure for controlling changes to the code and specifications?	117	82	0	4	58.79%
3.4 Are software tools used to assist in forwards and/or backwards tracing of software requirements to software designs through to code?	40	160	0	3	20.00%
3.5 Are software tools used for tracking and reporting the status (eg. reviewed, tested, released) of the software/subroutines in the software development library?	39	161	0	3	19.50%
Section 4—Estimates and Schedules					
4.1 Is there a documented procedure for estimating software size (such as 'Lines of Source Code') and thus for using productivity measures?	24	177	0	2	11.94%
4.2 Is a formal procedure used to produce software development effort, schedule, and cost estimates?	77	125	0	1	38.12%
4.3 Are records of actual project resourcing and timescales versus estimates maintained (at individual resource/resource-type level) and regularly analysed/fed-back into the estimating	67	134	0	2	33.33%

Question item	Yes	No	Not applicable	Missing	Mean Practice Adoption Level
and scheduling procedures?					
4.4 Are records of software size maintained for each software configuration item, over time, and fed-back into the estimating process?	24	175	0	4	12.06%
4.5 Is project tracking (e.g. earned value) used throughout the software development process (actual versus planned deliverables analyses, designed, unit tested, system tested, acceptance tested over time) to monitor project progress?	66	134	0	3	33.00%
4.6 Are estimates, schedules and subsequent changes produced only by the project managers who directly control the project resources and are fully aware of their abilities and availabilities?	117	83	0	3	58.50%
4.7 Are software tools used for project planning, estimating, scheduling, and critical path analysis?	87	114	0	2	43.28%
4.8 Does the overall business project manager gain agreement and sign-off from all parties who have produced detailed estimates and schedules before publishing or revising a consolidated project plan?	80	116	0	7	40.82%
4.9 Where other non-software resources are critical to the success of the project is there a procedure for ensuring their availability according to plan?	65	42	92	96	60.75%
Section 5—Project Management & Training					
5.1 Does each software project have a nominated software project manager?	175	26	0	2	87.06%
5.2 Does the software project manager report to a business project manager responsible for the overall benefit of the project to the business?	110	88	0	5	55.56%
5.3 Does a Software Quality Assurance (SQA) function exist?	47	154	0	2	23.38%
5.3 b If 5.3 YES, does the SQA function have an independent reporting line from software development project management?	14	29	0	160	32.56%
5.4 Do management formally assess the benefits, viability, and risk of each software project prior to making contractual (or internal) commitments?	138	63	0	2	68.66%
5.5 Are there procedures to ensure that external software subcontracting organisations, if any, follow a disciplined software development process?	52	42	108	109	55.32%
5.6 Do management formally conduct periodic reviews of the status of each software project?	151	52	0	0	74.38%
5.7 For each project, are independent audits (such as inspections or walkthroughs) conducted	70	132	0	1	34.65%

Question item	Yes	No	Not applicable	Missing	Mean Practice Adoption Level
for each major stage in the software development process?					
5.8 Is a formal procedure (such as a review or handover with sign-off) used whenever a deliverable (such as a user statement of requirements or system requirements) is passed from one discrete group to another (e.g. user to analyst to designer) to ensure it is properly understood?	77	123	0	3	38.50%
5.9 Is there a required training programme for all newly-appointed software managers which is designed to familiarise them with in-house software project management procedures?	42	154	0	7	21.43%
5.10 Is there a procedure for maintaining awareness of the state-of-the-art in CASE or software engineering technology?	42	158	0	3	21.00%
Total of 44 questions	3909	4275	388	748	47.76%
203 responses x 44 questions =8932 responses	43.76%	47.86%	3.78%	8.37%	

Table F.7 Adoption level of each practice – characteristics of distribution

Statistics		Value	Std. Error
Mean		47.7970	3.36379
95% Confidence interval for mean	Lower bound	41.0133	
	Upper bound	54.5808	
5% Trimmed mean		47.7507	
Median		48.1250	
Variance		497.863	
Standard deviation		22.31284	
Minimum		10.61	
Maximum		87.06	
Range		76.45	
Interquartile range		36.5725	
Skewness		.004	.357
Kurtosis		-1.167	.702

Table F.8 Adoption level of each practice - tests of normality

	Kolmogorov-Smirnov(a)			Shapiro-Wilks		
	Statistic	df	*p*	Statistic	df	*p*
Practice Adoption Level	.090	44	.200(*)	.955	44	.083

* This is a lower bound of the true significance.
a Lilliefors Significance Correction

Table F.9 Extent of adoption of each practice ranked in descending order

Practices adopted by 75-100% of organisations	N	%
Each software project has a nominated software project manager	201	87.06
There a procedure for ensuring that appropriate levels of user/customer/marketing input is made throughout the project	201	84.08
Independent testing is conducted by users before any system or enhancement goes live	202	80.20
Common coding standards are applied to each software project	197	79.70
Prototyping methods are used in ensuring the requirements elements of the software	197	78.17
There a procedure to ensure that the systems projects selected for development qualitatively or quantitatively support/alleviate the organisation's business objective/problems	151	77.48
Post-implementation software problem reports are logged and their resolution effectively tracked and analysed	201	76.12
Practices adopted by 50-74.9% of organisations	N	%
Management formally conducts periodic reviews of the status of each software project	203	74.38
Management formally assesses the benefits, viability, and risk of each software project prior to making contractual (or internal) commitments	201	68.66
A data dictionary available for controlling and storing details of all data files and their fields	171	67.84
Records exist from which (and requiring nothing extra) all current versions and variants of software systems and their components can be quickly and accurately reconstructed in the development environment	199	65.33
Procedures exist to ensure that the functionality, strengths, and weaknesses of the 'system' which the software is replacing are formally reviewed	153	62.75
There is a procedure to check that the system configuration (i.e. the programs and any data) passing user acceptance testing is the same as that which is implemented for live operation	198	62.63
There is a procedure to check that no changes are made directly to a 'live' version of any system (other than through modification to its development version)	191	61.26
Where other non-software resources are critical to the success of the project, there is a procedure for ensuring their availability according to plan	107	60.75
There is a procedure for controlling changes to the code and specifications	199	58.79
Estimates, schedules and subsequent changes are produced only by the project managers who directly control the project resources and are fully aware of their abilities and availabilities	200	58.50
There is a procedure for controlling changes to the software requirements, designs and accompanying documentation	202	57.43
The software project manager reports to a business project manager responsible for the overall benefit of the project to the business	198	55.56
There are procedures to ensure that external software subcontracting organisations, if any, follow a disciplined software development process	94	55.32
Procedures exist to ensure that every required function is tested/verified	198	54.04
Design notations such as Structured Analysis and Design Technique are used in program design	199	50.75

Practices adopted by 25-50% of organisations	N	%
A change control function is established for each software project	200	45.50
Test planning commences prior to programming beginning based on the user requirements and high-level design documents	197	43.65
Software tools used for project planning, estimating, scheduling, and critical path analysis	201	43.28
The overall business project manager gains agreement and sign-off from all parties who have produced detailed estimates and schedules before publishing or revising a consolidated project plan	196	40.82
A formal procedure (such as a review or handover with sign-off) is used whenever a deliverable (such as a user statement of requirements or system requirements) is passed from one discrete group to another (e.g. *user* to *analyst* to *designer*) to ensure it is properly understood	200	38.50
A formal procedure is used to produce software development effort, schedule, and cost estimates	202	38.12
Estimates are made and compared with actuals for target computer performance (memory utilisation, processor throughput and file/channel I/O and disk usage)	133	35.34
For each project, independent audits (such as inspections or walkthroughs) are conducted for each major stage in the software development process	202	34.65
Records of actual project resourcing and timescales versus estimates maintained (at individual resource/resource-type level) and regularly analysed/fed-back into the estimating and scheduling procedures	201	33.33
Project tracking (e.g. earned value) is used throughout the software development process (actual versus planned deliverables analyses, designed, unit tested, system tested, acceptance tested over time) to monitor project progress	200	33.00
The SQA function has an independent reporting line from software development project management	43	32.56
There is a procedure for assuring that regression testing (i.e. the forced re-run of all previous tests prior to any new tests) is routinely performed during and after initial implementation	199	26.63
Practices adopted by 0-25% of organisations	N	%
A Software Quality Assurance (SQA) function exists	201	23.38
Independent testing is under the guidance of Software Quality Assurance	153	22.88
There is a required training programme for all newly-appointed software managers which is designed to familiarise them with in-house software project management procedures	196	21.43
There a procedure for maintaining awareness of the state-of-the-art in CASE or software engineering technology	200	21.00
Software tools used to assist in forwards and/or backwards tracing of software requirements to software designs through to code	200	20.00
Software tools are used for tracking and reporting the status (reviewed, tested, released) of the software/subroutines in the software development library	200	19.50
Statistics on the sources of errors in software code gathered and analysed for their cause, detection and avoidance measures	199	18.09
Records of software size are maintained for each software configuration item, over time, and fed-back into the estimating process	199	12.06
There is a documented procedure for estimating software size (such as 'Lines of Source Code') and thus for using productivity measures	201	11.94
Statistics on test efficiency (eg. % of errors actually detected by an activity against the maximum theoretically possible) are gathered and analysed for all testing stages in the development process	198	10.61

Table F.10 Comparison of adoption of primary life cycle practices compared to organisation/support practices

Life cycle group	N	Mean	Std. deviation	Std. error mean
Primary	13	56.7062	24.94557	6.91866
Organisation/support	31	44.0610	20.39296	3.66268

Table F.11 Adoption of primary life cycle practices compared to support/ organisational practices - independent samples test

Levene's test for equality of variances		t-test for equality of means						
F	*p*	t	df	*p* (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
Equal variances assumed							Lower	Upper
.739	.395	1.756	42	.086	12.6452	7.20030	-1.88561	27.17598
Equal variances not assumed								
		1.615	19.07	.123	12.6452	7.82835	-3.73569	29.02607

Table F.12 Organisation adoption level - skewness and kurtosis

Developer Group	Skewness	Kurtosis
Does not develop COTS	.18	-.55
COTS software developer	.11	-.89
Note: values for skewness and kurtosis are zero if the observed distribution is exactly normal.		

Table F.13 Comparison adoption level of COTS and non-COTS developers - test of homogeneity of variance

Adoption level	Levene statistic	df1	df2	*p*
Based on mean	.493	1	201	.483
Based on median	.478	1	201	.490
Based on median and with adjusted df	.478	1	200.827	.490
Based on trimmed mean	.509	1	201	.477

Table F.14 Adoption level of COTS developers compared to non-COTS developers

COTS developer	N	Mean	Std. deviation	Std. error mean
No-0	116	44.1789	20.18038	1.87370
Yes-1	87	52.1740	21.33042	2.28686

Table F.15 Independent samples test comparing adoption level of COTS with non-COTS developers

Levene's test for equality of variances		t-test for equality of means						
F	*p*	t	df	*p* (2-tail)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Equal variances assumed							Lower	Upper
.493	.483	-2.726	201	.007	-7.9952	2.93302	-13.77860	-2.21172
Equal variances not assumed								
		-2.704	179.67	.008	-7.9952	2.95643	-13.82895	-2.16136

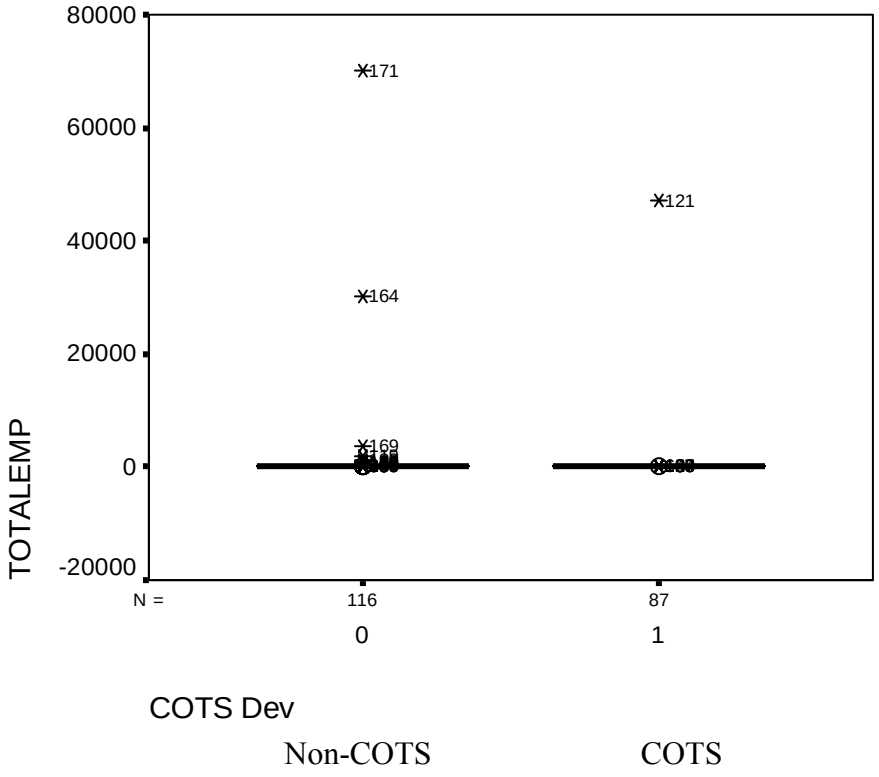

Figure F-1 Box plot comparison of number of employees for non-COTS and COTS developers

Table F.16 Correlation: total number of employees and adoption level

Statistic	All responses	Non-COTS total employees			COTS total employees
	All cases	All cases	Excluding 2 outliers	All cases	Excluding 1 outlier
Pearson correlation	.060	.060	.112	.060	.254(**)
p (1-tailed)	.262	.262	.117	.292	.009
N	116	116	114	87	86

** Correlation is significant at the 0.01 level (1-tailed).

Table F.17 Correlation: adoption level and total number of employees excluding software users (in-house or 3rd party)

	Non-COTS total employees	COTS total employees
Pearson correlation	.211(*)	.337(**)
p (1-tailed)	.042	.002
N	68	74

* Correlation is significant at the 0.05 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).

Table F.18 Correlation: adoption level and total number of employees for software users (in-house or 3rd party)

	Non COTS total employees	COTS total employees
Pearson correlation	.119	.086
p (1-tailed)	.210	.390
N	48	13

Table F.19 Correlation: adoption level and number of software developers

	Non-COTS number of developers	COTS number of developers
Pearson correlation	.253(**)	.302(**)
p (1-tailed)	.003	.002
N	116	87

** Correlation is significant at the 0.01 level (1-tailed).

Table F.20 Adoption by sector comparison of non-COTS and COTS developers

Sector name	Sector code	Total	Not COTS Developer		COTS Developers	
		N	N	Mean adoption	N	Mean adoption
Software development	0	133	78	45.7%	78	52.9%
Agriculture, forestry & fishing	1	2	1	73.8%	1	51.2%
Mining	2	2	2	22.3%		
Manufacturing	3	5	3	42.5%	2	27.3%
Utilities	4	5	4	58.0%	1	35.7%
Construction	5	1			1	15.8%
Retail & wholesale	6	1	1	28.6%		
Accommodation, cafes, restaurants	7	0				
Transport & storage	8	0				
Communication services & media	9	2	2	27.6%		
Finance & insurance	10	2	2	64.2%		
Property & business services	11	1	1	50.0%		
Government admin & defence	12	5	5	50.0%		
Education	13	7	5	16.1%	2	62.0%
Health & community service	14	3	2	36.8%	1	63.4%
Cultural & recreational services	15	1	1	61.4%		
Personal & other services	16	0				
Tourism & hospitality	17	0				
Information technology	18	10	9	39.1%	1	70.7%
Total		203	116		87	

Table F.21 Non-COTS Developers: adoption level by sector
Test of homogeneity of variances

Levene Statistic	df1	df2	p
1.363(a)	9	102	.215

a Groups with only one case are ignored in computing the test of homogeneity of variance for adoption level (4 sectors were ignored).

Table F.22 Non-COTS Developers: Comparison of adoption levels by sector

One-Way ANOVA	Sum of squares	df	Mean square	F	*p*
Between groups	9174.639	13	705.741	1.912	.037
Within groups	37658.858	102	369.204		
Total	46833.497	115			

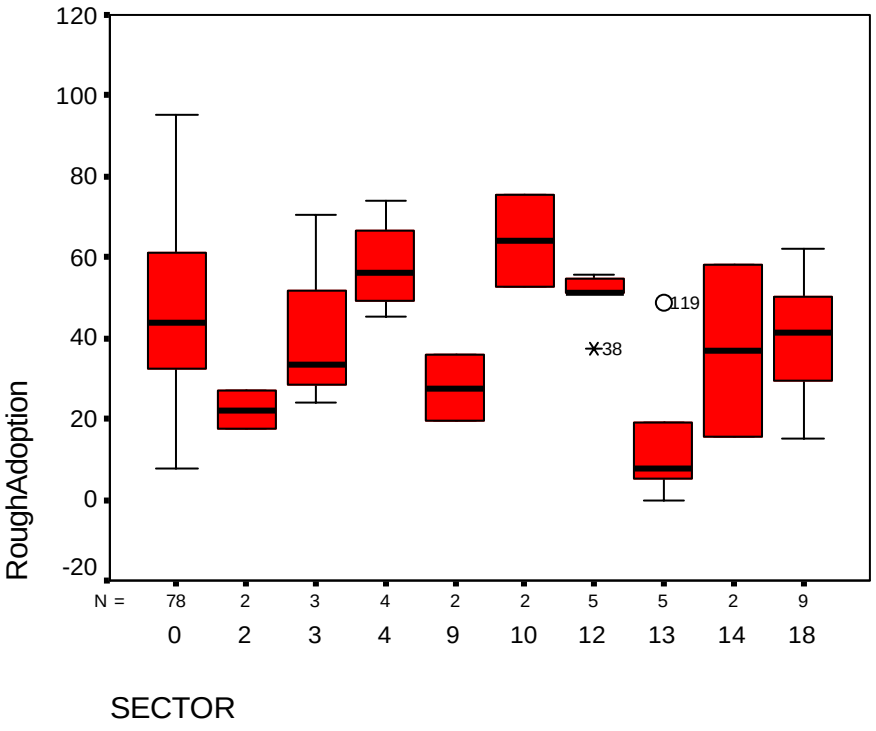

Figure F-2 Boxplot showing Comparison of mean adoption by sector for non-COTS

Table F.23 Non-COTS developers: summary of significant differences from multiple comparisons

Sectors Compared	Mean Difference	Std. Error	*p*	95% Confidence Interval	
				Lower Bound	Upper Bound
Software development-Education	29.6583(*)	8.86421	.001	12.0762	47.2405
Mining-Utilities	-35.6973(*)	16.64041	.034	-68.7035	-2.6911
Mining-Finance & insurance	-41.9303(*)	19.21469	.031	-80.0425	-3.8180
Utilities – Education	41.8840(*)	12.88961	.002	16.3175	67.4504
Finance & insurance – Education	48.1169(*)	16.07617	.003	16.2299	80.0039
Govt admin & defence-Education	33.9133(*)	12.15244	.006	9.8090	58.0176
Education –IT	-23.0583(*)	10.71744	.034	-44.3163	-1.8003

* The mean difference is significant at the .05 level.

Table F.24 COTS Developers: adoption level by sector
Test of homogeneity of variances

Levene statistic	df1	df2	*p*
1.758(a)	2	79	.179

a Groups with only one case are ignored in computing the test of homogeneity of variance for Adoption. (5 sectors ignored)

Table F.25 COTS Developer: Adoption level by sector - comparison of means
One-way ANOVA - Adoption level

	Sum of squares	df	Mean square	F	*p*
Between groups	3533.168	7	504.738	1.120	.359
Within groups	35595.714	79	450.579		
Total	39128.882	86			

Appendix G. PIP Sample Documents

Section 1 Organisation Context Questionnaire

SOFTWARE QUALITY INSTITUTE

PROCESS IMPROVEMENT PROJECT

ORGANIZATION CONTEXT INFORMATION

1. Company Data

Company Name:

Department:

Address:

Contact Person:

Phone:

Fax:

Email:

Year of Foundation:

2. Employees

Number of Employees:

Full Time: ____
Pat Time: ____
Contract: ____
Total: ____

Education:

Postgraduate: ____
Graduate: ____
Other: ____

Function:

Technical: ____

Support/Admin: ____

Experience:

More than 5 years: ____

Less than 5 years: ____

3. Market Segment

Application Domain:

For which business sector does your organization deliver/acquire software? (please select all that apply)

- ❑ Finance (excluding banking)
- ❑ Insurance
- ❑ Banking
- ❑ Petroleum
- ❑ Automotive
- ❑ Public Utilities (Gas, Water, Electricity)
- ❑ Aerospace
- ❑ Telecommunications
- ❑ Public Administration
- ❑ Consumer Goods
- ❑ Retail
- ❑ Defence
- ❑ Information Technology/Software
- ❑ Health and Pharmaceutical
- ❑ Leisure and Tourism
- ❑ Manufacturing
- ❑ Construction
- ❑ Travel
- ❑ Media (Television, Radio)
- ❑ Education
- ❑ Distribution/Logistics
- ❑ Other (*Please Specify)*

Applied Technologies:

- ❑ OO
- ❑ 4GL
- ❑ Scripting
- ❑ Real Time
- ❑ Internet
- ❑ AI
- ❑ Client Server
- ❑ Other (*Please Specify)*

_____

4. Projects

No. of projects as Work in Progress: _____

Typical no. of employees per project: _____

Typical duration to final delivery: _____

Average cost overrun (as a percentage); _____

5. ISO 9001

Does your organisation have ISO9001 certification?

Please circle: Yes/No

If yes, on which date was the ISO 9001 certification awarded?

(mm/yyyy) __/____

6. ISO 9001

How would you best **characterize** your organization's ... *(please select one in each row)*

	Excellent	Good	Fair	Poor	Don't Know
Ability to meet budget commitments?					
Ability to meet schedule commitments?					
Ability to achieve high customer satisfaction?					
Ability to meet specified and implied requirements?					
Staff productivity?					
Staff morale/job satisfaction?					

How **important** are the following performance measures to your organization? *(please select one in each row)*

	Very Important	Important	Somewhat Important	Not Important
Ability to meet budget commitments?				
Ability to meet schedule commitments?				
Ability to achieve high customer satisfaction?				
Ability to meet specified and implied requirements?				
Staff productivity?				
Staff morale/job satisfaction?				

Thank you for taking the time to complete this questionnaire.

Please return this questionnaire by email to sqi@sqi.gu.edu.au or alternatively we will collect it during your assessment.

Section 2 Sample of assessment template (requirements elicitation)

Requirements gathering: How do you gather requirements from customers and potential users?

PA 1.1 - Process Performance: Is the requirements gathering process performed, at least informally?		
Does the process for gathering requirements as implemented in this organization achieve its expected outcomes?	Refer specific outcomes on next page	
Do the company personnel understand the scope of the requirements gathering process?		
Are there identifiable input work products for requirements gathering? Identify.	List identified inputs	
Are there identifiable output work products from requirements gathering? Identify.	List identified outputs	
Comments		

Has your company established continuing communications with your key customers?	Newsletter Web Page User Group	
Do you have a clear understanding of the customer's requirements for each project?	Functions Quality Characteristics Safety Security	
Is there a means for identifying new customer needs and reflecting this in the requirements?	Environmental scanning Changes in business domain	
Do you monitor the needs of your customers on a continuous basis?	Surveys Market research Customer satisfaction	
Can your customers readily establish the status of their requests?	Web page	
Do you have a program for ongoing enhancement of your products?	Release Policy	

PA 2.1 - Performance Management: Is the performance of the requirements gathering process managed?		
Do you identify your objectives for requirements gathering?	Quality Cost Schedule	
Do you develop a plan for your requirements gathering activities?	Scope Schedule Work breakdown	
Do you assign specific responsibilities and authorities for developing work products associated with requirements gathering?	Roles Responsible individuals Approvals	
Do you track and monitor the requirements gathering activities, and re-plan when needed?	Status reports Team meetings	
Comments:		

PA 2.2 – Work Product Management: Are the work products of the requirements gathering process managed?		
Do you specify requirements for the work products associated with requirements gathering?	Documentation Standards Control requirements Timing	
Do you manage the documentation and change control for the work products associated with requirements gathering?	Version control Baseline definition	
Have you identified and defined any dependencies between the work products associated with requirements gathering?	Relationships between work products Sequencing	
Do you evaluate and where necessary take corrective action to ensure the quality of the work products associated with requirements gathering?	Reviews Records of defects found Traceability of correction	
Comments		

PA 3.1 - Process Definition: Is the requirements gathering process defined?		
Do you have a standard process for requirements gathering, and does it provides guidance on implementation and tailoring?	Policies Procedures Standards	
Do you implement or tailor the standard process for requirements gathering to obtain a defined process appropriate to the project or product?	Common approach to tailoring for individual projects	
Do you collect performance data about requirements gathering so that the behaviour of your defined process can be understood?	Suitability of measures	
Do you establish and refine your understanding of the behaviour of the requirements gathering process by using relevant performance data?	Use of measures	
Do you refine the standard process for requirements gathering?	Improvement suggestions Change requests	
Comments		

PA 3.2 - Process Resource: Are suitable resources provided for the requirements gathering process?		
Do you identify and document the roles, responsibilities and competencies required to support the implementation of your defined process for requirements gathering?	Job descriptions Skills matrix	
Do you provide the human resources needed to support the performance of the defined process for requirements gathering? Are these resources allocated and used?	Training needs Training records Recruitment policy	
Do you identify and document the infrastructure requirements to support the implementation of the defined process for requirements gathering?	Is the infrastructure adequate Tools Environment	
Is the identified process infrastructure provided to support the performance of the defined requirements gathering process? Is this infrastructure allocated and used?	Upgrading development tools Hardware improvements Furnishings	
Comments		

Section 3 List of questions: generic and base practice questions

Generic Practice Questions (these are tailored and used for each process):

PA 1.1 - Process Performance: Is the requirements gathering process performed, at least informally?
Does the process for gathering requirements as implemented in this organization achieve its expected outcomes? Do the company personnel understand the scope of the requirements gathering process? Are there identifiable input work products for requirements gathering? - Identify Are there identifiable output work products from requirements gathering? – Identify
PA 2.1 - Performance Management: Is the performance of the requirements gathering process managed?
Do you identify your objectives for requirements gathering? Do you develop a plan for your requirements gathering activities? Do you assign specific responsibilities and authorities for developing work products associated with requirements gathering? Do you track and monitor the requirements gathering activities, and re-plan when needed?
PA 2.2 – Work Product Management: Are the work products of the requirements gathering process managed?
Do you specify requirements for the work products associated with requirements gathering? Do you manage the documentation and change control for the work products associated with requirements gathering? Have you identified and defined any dependencies between the work products associated with requirements gathering? Do you evaluate and where necessary take corrective action to ensure the quality of the work products associated with requirements gathering?
PA 3.1 - Process Definition: Is the requirements gathering process defined?
Do you have a standard process for requirements gathering, and does it provides guidance on implementation and tailoring? Do you implement or tailor the standard process for requirements gathering to obtain a defined process appropriate to the project or product? Do you collect performance data about requirements gathering so that the behaviour of your defined process can be understood? Do you establish and refine your understanding of the behaviour of the requirements gathering process by using relevant performance data? Do you refine the standard process for requirements gathering?
PA 3.2 - Process Resource: Are suitable resources provided for the requirements gathering process?
Do you identify and document the roles, responsibilities and competencies required to support the implementation of your defined process for requirements gathering? Do you provide the human resources needed to support the performance of the defined process for requirements gathering? Are these resources allocated and used? Do you identify and document the infrastructure requirements to support the implementation of the defined process for requirements gathering? Is the identified process infrastructure provided to support the performance of the defined requirements gathering process? Is this infrastructure allocated and used?

Base Practice Questions

The following questions are included with the PA 1.1 - Process Performance questions and are specific to the particular process

Requirements elicitation:
Has your company established continuing communications with your key customers? Do you have a clear understanding of the customer's requirements for each project? Is there a means for identifying new customer needs and reflecting this in the requirements? Do you monitor the needs of your customers on a continuous basis? Can your customers readily establish the status of their requests? Do you have a program for ongoing enhancement of your products?
Software development
In the course of developing your products do you generate intermediate products such as: Requirements specification; Design description; Report on integration testing; System test report; Other(s)? Do you take steps in software development to ensure that all of the requirements are addressed in the design? Can you demonstrate from results (such as from testing) that the product developed meets the initial requirements? Do you have a mechanism for formal acceptance of the product by the customer?
Configuration management
Do you have a strategy for configuration management? Are all items generated by your project identified, defined and baselined? Are there controls in place for modifications and releases of your products? Do you record and report on the status of the individual products and requests for modification? Do you ensure that modifications and new releases to your product are complete and consistent? Do you control the storage, handling and delivery of the modifications and new releases to your product?
Quality Assurance
Have you developed and implemented a strategy for performing software quality assurance? Do you record and store evidence of your software quality assurance activities? Do you identify problems or non-conformances with contract requirements? Can you demonstrate that your software products processes and activities conform to relevant standards, procedures and requirements?
Problem resolution
Do you have a defined way to ensure that all discovered problems are analysed and resolved? Do you prepare problem reports upon detection of problems (including non-conformances) in a software product or activity? Do you have a mechanism for recognizing and acting on trends in problems identified?
Project management
Do you define and document the scope of the work for the project, over both requirements gathering and software development? Do you evaluate the feasibility of achieving the goals of the project within available resources and constraints? Have the tasks and resources necessary to complete the work been sized and estimated? Have the interfaces between the project, and other projects and departments, been identified and are they monitored? Have plans for the project been developed and implemented? Has the progress of the project been monitored and reported? Do you take actions to correct deviations from the plan and to prevent recurrence of problems identified in the project, when targets are not achieved?

Risk Management
Have you defined and determined the scope of the risk management to be performed for the project? Have you defined and implemented appropriate risk management strategies? Are risks to the project identified in the project plan, and as they develop during the conduct of the project? Do you analyse risks and use the results to prioritise the resources to monitor these risks? Have you defined measures of risk, and then applied these to assess the risk status of your project? Do you take actions to correct or avoid the impact of risk?
Process establishment
Do you have a standard set of policies and methods for projects approved for use in your company? Are the plans and procedures for your projects based upon these standards? Do your standards include descriptions of the common tasks and activities to be followed in every project? Do you modify the standard methods for each project you undertake? Do you retain and use documents and data from previous projects conducted in the organisation?

Section 4 Questions on PIP feedback forms

Feedback: about the assessors
11 forms analysed (2 types of response forms), frequencies calculated.
The first 7 questions were answered on a 4 point Likert scale (almost always, more often than not, sometimes, rarely if ever):
Was it clear why the information was requested during the assessment?
In your judgement, was the information provided by the assessees during the assessment within the scope of the assessment?
Were you concerned during the assessment about possible breaches of confidentiality by the assessors?
Did the assessors appear to have any biases during the assessment?
Did the assessors demonstrate understanding of the processes being assessed?
Did the assessors demonstrate an adequate understanding of the OU and its business?
In your judgement, did the assessors behave in a professional manner during the assessment? 4 point Likert scale: excellent, good, fair, poor).
In your judgement, how would you characterize the competence of the assessors who conducted the assessment?

The following questions were only on type A forms (release date 23 June 1999)
4 responses analysed
Did you verify the competence of the assessor? (yes/no)
How was competence verified? (4 options)

The following questions were only on type B forms - eg. SQI-PIP-RA13-FB ver 0.3 2 Dec 1999
6 responses analysed
How closely did the assessment meet your expectations? (4 point Likert scale: totally, largely, partially, not at all)
To what extent did the final report reflect the understanding reached at the site visit? (4 point Likert scale: totally, largely, partially, not at all)
How closely do the findings from this assessment reflect your own understanding of your organization's capabilities? (4 point Likert scale: totally, largely, partially, not at all)
Comments

Value of assessment
Overall, how would you characterize your understanding of the assessment process and its results? (Excellent, good fair, poor)
Was the process profile produced by the assessment clearly stated and easy to understand? (5 point Likert scale)
To what extent did you understand the purpose of the activities that took place as part of the assessment? (5 point Likert scale)
To the best of your knowledge, within the scope of the assessment, how accurately did the process profile indicate the OU's major problems? (3 point Likert scale)
Did the process fail to identify any problems within the scope of the assessment? (yes/no)
Did the process wrongly identify anything as a problem? (Yes/no)
To the best of your knowledge, how well did the assessment results characterize the OU's strong points? (3 point Likert scale)

Do you believe that the assessment was worth the expense and time expended? (3 point Likert scale)

Statements about the usefulness of the assessment. 5 point Likert scale (strongly agree, agree, disagree, strongly disagree, don't know).
The assessment provided valuable direction about priorities for process improvement within the OU.
The assessment helped us better understand what needs to be improved.
We still need more guidance about how to go about process improvement
The assessment improved awareness, buy-in, and support for PI among the technical staff in the OU
The assessment was impractical; it took too long and cost too much
The wrong people or projects were selected to participate in the assessment (e.g. people that were interviewed or those who filled up questionnaires)
People weren't fully honest with the assessment team
It was easy to understand the processes followed by the OU in terms of the Assessment Model that was used
The assessment Model that was used provides real direction for long-term software process improvement
There are important areas that the Assessment Model that was used does not address.

Appendix H. Summary of PIP assessment and final reports

Firm No.1

Summary of strengths/weaknesses at initial assessment

Firm #1 showed higher capabilities in the areas of customer requirements gathering and the management of risk, with the software development process maturing as the product matured. All the processes evaluated were performed by competent and effective staff. The Managing Director was actively involved with the day-to-day running of the business. The software design for one of the software products was stable and ready to be documented, thereby reducing the risk of further maintenance activities. An adaptation of the Evolutionary Rapid Development process was in use and a check-list could provide more visibility to management. The configuration management activities could benefit from a support tool, and code analysers could help improve the consistency of style, commenting and layout of programs.

In order to promote standardisation for new developers, standards for style, comments, and layout for each language was recommended. Assessors noted the need for a classification system and bug-tracking tool for classing and recording the severity and priority of problems and bugs. A work break down structure and schedule for the next project could incorporate lessons learned, and provide visibility of progress to all, including management. It was suggested that the software development sample in MS Project could be adapted to the needs of Firm #1.

Summary of follow-up meeting

Since the initial assessment, the company sold the distribution rights to its core software to another company and consequently, the number of full time employees had dropped to two, and the focus of firm #1 had changed to technology development, particularly in the security systems area. The focus changed to defining and developing technology demonstrators that can be packaged and marketed internationally.

The assessment helped the business owner to prioritise the business goals and reassess the business direction, in particular addressing staff issues. Two of the recommendations were implemented, the creation of a baseline plan, and the introduction of configuration management tools.

The change in focus to research and develop new technologies for the company product range had altered the priorities for the Owner. Based on his personal international contacts, he was actively pursuing new opportunities in the access security and control domain.
[Information summarised and adapted from SQI-PIP-FR01-01.doc]

Firm No.2

Summary of strengths/weaknesses

Firm #2 had developed strong relationships with its clients, and documents the results of client discussions to arrive at concrete and agreed requirements for its projects. The process of software development was reasonably documented with good records of system design. A strong emphasis was placed on portability and potential for reuse in the designs and implementation. Firm #2 provided total support for their clients, adopting a ‘whole system’ support approach that entrenches

client loyalty. The company had a reputation for on-time delivery of products that generally meet the client's expectations, and managed the projects to maintain this reputation, and invested strongly in identification and mitigation of risks associated with the development activities.

However, there was no formal system for configuration management with a resulting threat to ongoing product integrity. Existing manual systems were largely enforced through professional discipline and could prove difficult to maintain as the company grows. Records of product validation, through internal testing and client-based beta testing, were limited and did not provide adequate assurance of product quality.

The existing program of informal reviews was not documented and little 'corporate knowledge' was captured in any documented form. Furthermore, records of process performance were limited, resulting in problems with project estimation and risk monitoring. Also, no mechanisms existed to ensure that the existing (informal) high standards in place in the organization were adopted by contractors or potential new staff. The assessors also noted that there was no formal process in place to ensure that the current 'good intentions' to improve the existing set of policies and procedures were followed up in a timely and effective manner.

Summary of follow-up meeting

The follow-up assessor's efforts to contact Firm #2 by telephone and email during August 2000 were unsuccessful. Firm #2 was no longer registered in local telephone directories or on the Software Engineering Australia contact directories. It was therefore concluded that Firm #2 had ceased to operate.

[Information summarised and adapted from SQI-PIP-FR02-01 PAT.doc]

Firm No.3

Summary of strengths/weaknesses

Firm#3 had a strategy to build, market and maintain software products to industries that operate and manage capital-intensive assets. The company employed competent, experienced people who recognised the need for process development alongside product development, but the lack of available additional competent people had limited the rate of development. This had exacerbated the need for the company to invest in sound processes, as contractors may be required for future work.

At firm #3, requirements' gathering was well developed; excellent interaction with clients to ensured that the needs of the market were well understood. The development process was well documented, with evidence to confirm that the documented requirements had been implemented in the delivered product. Generally, configuration management was well practiced ensuring high confidence in the integrity of the delivered software. A sound process for recording and resolving problems was in place, with good monitoring of progress. A detailed quality manual had been produced providing sound policies and procedures for many aspects of software development activities.

However, it was noted that documentation was incomplete in some areas in software development, notably in the definition and execution of testing. No formal approach existed for estimating the size of the work to be performed. Tasks outside of fundamental development activities were not identified and scheduled as part of the

planning process. While risks are identified at the beginning of a project, no mechanism existed to monitor them on an ongoing basis. Although the basic elements of a quality assurance system were defined, the system had not been effectively implemented. No regular reports were produced for either monitoring or performance enhancement purposes for either configuration management or problem resolution. No mechanism was in place to ensure the structured development and implementation of an effective set of process assets.

Summary of follow-up meeting

Since the assessment, firm #3 had adopted a new development methodology that allowed a more appropriate model to be used throughout the development environment, rather than adhering to traditional Waterfall model. This had enabled firm #3 to introduce more considered approach to software design and advanced project management techniques. Work had also commenced on the adoption of a more thorough configuration management practice, which could be tailored to individual site installations.

No re-evaluation of any of the processes was performed during the follow-up contact, as the interviewee indicated that the newly established processes were immature at this stage. Firm #3 confirmed that the Assessment afforded considerable value to their company, not only in providing an objective opinion of their current development environment, but in providing legitimatisation of the established development activities. The SQI's role in the assessment was also viewed as providing an initial point for creating a 'mentoring' role in implementing selected improvement activities.

New procedures had been put in place to formalise the documentation of testing activities. Consideration had been given to establishing checklists and other methods to assist the validation of the requirements gathering process. A more detailed WBS was in use by the project manager for resourcing and task allocation, also recording all task efforts. New configuration management practices were adopted to monitor all items of development work in progress, and control and manage them through to testing and release. Basic templates have been established to enable standardisation across the environment. New practices for problem management were in place to enable problems to be raised, prioritised, traced, and consequently managed through formal change request forms.
[Information summarised and adapted from SQI- PIP-FR03-02.doc]

Firm No.4

Summary of strengths/weaknesses

In the context of the initial development of its principal software product, firm #4 demonstrated good capabilities in most processes, particularly configuration management and problem resolution, with risk management and process establishment the only weak processes identified. The key strength of the company was the in-depth experience and knowledge of the development team. Once a customer base was established, potential risks could arise, particularly in configuration management and risk management. Opportunity existed to establish the management and definition of the processes assessed before acquiring the customer base. This would enable firm #4 to grow, whilst maintaining and improving its current process capabilities demonstrated during the initial development phase.

The most striking factor for this organisation was the strong management control applied to the project. With limited resources, and a lot of will-power a product had been developed that was ready to market. Critical work products such as work breakdown structure, milestones and schedules, problem recording and reporting, configuration management files, requirements traceability tables and user testing were all evident. The adaptation of the Booch method for OO development was also noteworthy.

Summary of follow-up meeting
No actions have been reported for Firm #4 since the Assessment had been performed. No re-evaluation of process capability had been performed. The assessment sponsor had reduced his involvement in the firm due to family illness.
[Information summarised and adapted from SQI-PIP-FR04-01pat.doc]

Firm No.5
Summary of Strengths/Weaknesses
Firm #5 had a generally informal process for development of software that was supported by excellent tool selection, leading to high confidence in the integrity of the delivered software. The firm placed significance on the service and support of its customer base. Considerable effort had been invested in the development of user requirements for the core product.

The informality in the development processes was seen as constituting significant risks for the firm in an environment of system and market growth. There was a need to adopt a more formal and structured approach to both technical and management issues. It was recommended that more attention should be paid to aspects of software development, in particular testing, and also to the establishment of a coherent strategy for project management.

Summary of follow-up meeting
Since the assessment, firm #5 had relocated to new offices, and the staffing profile had changed slightly, with additional domain expertise and fewer part-time staff. The firm had been reorganized, with the aim of reducing the managerial load on the senior manager. There had been noticeable growth in business opportunities, with a major contract under negotiation.

The development process had been formalised. Project plans, containing a detailed statement of scope for the work to be performed, were now produced for all work, which was still monitored using the requests and defects system. A specification of requirements, based upon IEEE Std 830, had been introduced. The requests and defects system had been improved and was now used as a key driver for all work in the firm. Formal projects were linked to existing requests, and corrective maintenance was managed using the requests and defects system.

New procedures had been introduced in relation to the control of report generation routines, where a major problem with consistency and integrity had been found. The range of application of the configuration management system had been expanded, partly in response to this problem. Individual projects were now defined and the scope of work was clearly documented. The project plan supported better decisions

on feasibility, which was reinforced by more effective contract reviews. The firm had documented and disseminated a quality policy, and a variety of quality records were now identified and retained.
Risks were now routinely identified for all projects, and mitigation strategies were defined. There had been significant activity in the development of new and revised procedures for software development and project management. However, the process for establishing these additional process assets remained largely ad-hoc and uncontrolled.

With increased awareness of the importance of measurement, a number of relevant data items were now collected on a routine basis, and some of the key systems in the firm, including the requests and defects system, have been modified to improve data collection. A timesheet system had been introduced for recording effort, with work breakdown codes in use. Although there was much more data being collected, there was very limited analysis of the data, and the impact of the added data on actual project performance was minimal.
[Information summarised and adapted from SQI-PIP-FR05-10.doc]

Firm No.7
Summary of Strengths/Weaknesses
At Firm #7, the strong project management focus and a technically competent workforce were identified as major strengths. The business needs and the desire to maintain a good reputation for software and software development drove the risk management process effectively. Requirements gathering, software development, configuration management, and process establishment were sound, but have areas where improvements would be possible. The assessors noted that the directors searched out good ideas and adapted them to their own environment, for example, the use of the material from NASA, and the IEEE.

At firm #7, it was recognised that the importance of the quality assurance process would increase as additional staff or contractors were hired. The need to identify the standards to be used, and verify that they have been applied effectively was a critical factor in ISO 9001 certification. It was also labour intensive. The problem resolution process and the issue management system were labour intensive and needed an effective automated system to facilitate analysis of trends. It was noted that the demands of one major client had the potential to impact on the business goals of firm #7, resulting in the unavailability of critical resources for product development. Also, if management's attention was diverted to process improvement activities, then revenue-generating activities may suffer. Rather than introduce improvement targets to improve productivity, the assessors considered it more helpful to focus on training, infrastructure support, and effective tools.

Summary of follow-up meeting
Since the initial assessment, firm #7 had relocated to larger premises. Major development work was planned for an upgraded user interface, to provide a consistent look and feel for the product. The company had consolidated its business and was extending the product to a wider, more generic market. Also, opportunities in the Defence market had been identified. No changes to any of the target processes were identified at the follow-up meeting. However, a repository of measures to be collected from projects had been identified and would be incorporated in the new

product. Firm #7 had hoped to participate in the SEA showcase program, and when that that did not eventuate, firm #7 addressed the process improvement process on an ad hoc basis, and this was interrupted by the relocation.
[Information summarised and adapted from SQI-PIP-FR07-01.doc]

Firm No.8
Summary of Strengths/Weaknesses
The assessment identified strengths in the software development capability of firm #8 in the areas of risk management, quality assurance and quality management, focus on customer satisfaction, project management, and the use of CASE tools. However, loss of key personnel in a very competitive market was seen as a constant risk. Human resource management was a key issue for the company.

There appeared to be incomplete processes and shortcuts in the development process: it was very easy to do a code-compile-test cycle without placing the code under configuration control. Unless the configuration management system was integrated with the CASE tool, and used consistently, development would become difficult to manage. Definition and formalisation of validation and verification processes (especially time estimation and resource allocation) could help reduce the costs of service and on-site maintenance. A project characteristics profile could help to identify which processes are most critical for specific projects.

Incorporation of a measurement plan in the project plan could help management get better visibility of performance, and progress, and make decisions about the project in time to influence the outcome. Maintaining the mentoring program for developers, and extending it to project managers could provide incentives to reduce staff turnover. Configuration control using tools can be used for software code and documentation, but are most effective when integrated with the CASE tools. Also, an effective problem tracking system would provide visibility to managers on the status of work and progress (to do lists), as well as problem management and resolution.

Summary of follow-up meeting
The requirements gathering process had been strengthened by making use of the IEEE Software Engineering Standards for Software Requirement Specifications (SRS), to establish the defined company process. In addition, requirements were identified and prioritised as mandatory, desirable, or optional. The ARM95 tool from NASA had been successfully trialled and implemented.

The software development process for the company was defined, based on the IEEE Software Engineering Standards. The company still used the waterfall model, but was actively evaluating Rational's UML as a complement to Oracle CASE tools. The company had significantly improved their testing processes and had defined and started to use company procedures for test plans and testing. Also, formal reviews had been trialled successfully on a project with additional training planned. Configuration management had been significantly improved with the installation of Visual Source Safe. MS Word revision control was used to control documents, and a MS Access database created for a company document register. A separate testing environment has been set up to validate the software configuration before use by internal staff.

Software quality assurance was improved by the introduction of the IEEE Software Engineering Standards as the company-default process. The project breathalyser was available for use, and the draft audit guidebook due for release. Problem resolution was addressed formally, and an issues tracking database developed for use within firm #8, and available to all projects and staff.

The project management process was improved by an updated version of the project manager's handbook, incorporating details of all associated plans, based on the IEEE Software Engineering Standards. The Project Plan standard IEEE1058.1 had also been adapted as part of the company defined process for project management. Sample plans and details in the project management handbook provided basic guidance on tailoring for specific projects.

The risk management process was updated and revised, and incorporated in the project management handbook. The Practical Software Management course had been attended by staff and firm #8 intend to identify measures and indicators to help provide greater management visibility on new projects. Process establishment process was improved by the use of the IEEE Software Engineering Standards as models for the company to adapt.

All of the eight processes were re-evaluated based on observations, feedback, and limited document inspections. Basically, all of the attribute 3.1 capabilities had improved, as a direct result of the work performed since the original assessment. There were further activities to be performed, which would consolidate the gains already made. No new measurement program had been established, but the Quality Manager had implemented a more formal project post mortem process, to capture lessons learned and compare planned versus actual performance.
[Information summarised and adapted from SQI-PIP-FR08-01.doc]

Firm No.9
Summary of Strengths/Weaknesses
At firm #9, a primary strength identified was the use of automated tools which drive development within this organisation. These tools support the processes assessed and provides a basis for improving process capability in the future. Use of short, focused releases gave the team specific goals to aim for and a guide that the whole team understood and worked towards.

Source Safe and Test Track were the foundation of configuration management within the organisation and provided a solid consistent process. The schedule was used as the guide for the project to ensure that goals were reached and defined the process for development within the team.

Within projects, firm #9 allocated time for technical investigation. As well as allowing for staff to gain required skills, scheduling and product development proceeded with fewer surprises. The configuration management tool was integrated into the development environment. Also, all team members were aware of the processes used within the development of the product and were able to identify the processes and products used within the software development environment.

Performance data was being collected during the requirements elicitation process, however this data was not being used to measure performance. Requirements elicitation was not formalised but was evident in the use of storyboarding. However, this was not documented and the use of tools such as an electronic whiteboard was suggested to help with formalising the process. Defining and refining of the requirements elicitation process was conducted within the organisation. However this was very informal and not documented.

There was a standard, but undocumented process for software development. The standard process had come about through the ad hoc review of the development process.

Summary of follow-up meeting

The requirements elicitation process had been documented as part of the requirements management process. The two page standard process document followed a newly designed process definition template and was supported by a comprehensive checklist. This process was tailored and applied in the last two release cycles and feedback from customers was positive. As part of the new process, risks had been identified, tracked and monitored by assigned individuals where the risk to the next release was significant. Customers were kept informed of the status of new features and fixes by newsletter and direct contact.

Risks were identified and managed by exception, and basic measures of plan versus actual were used to monitor progress. Overall, the company placed a high priority on improving internal processes, and the effort was effective in lifting both their performance and their capability profile. The Assessment was seen as a useful mechanism to provide a focus on key areas at a time that it was critical to the company. At the time of the Follow-up meeting, firm #9 had survived a break-in at their premises, which had caused some disruption to their operations.
[Information summarised and adapted from SQI-PIP-FR09-01.doc]

Firm No.11

Summary of Strengths/Weaknesses

Firm #11's strong commitment to customer service, and focussed, tightly knit work force, enabled them to be well positioned to continue building their client base and would see them actively seeking vertical markets not currently addressed by their products. In particular the practice of requirements gathering and customer related activities were well performed, with many of these activities planned and scheduled over the course of the year using 3rd party software. While the 'front office' process of sales and marketing, and associated support services, were well performed, a coherent, end-to-end understanding of software development processes (including formalised quality assurance) was not present. These 'back office' processes were needed to form the foundation upon which the company's sales and marketing efforts were based.

Improved development capability would improve profitability by reducing time spent on development and fixing defects. At firm #11, strengths were identified in the degree of customer focus and ability to identify and track customer requirements, and the focus on developing staff competencies and building strong staff morale. Also, a coherent tool environment had been adopted to support resource allocation, work

product identification and overall project management, and there existed an overall level of awareness of the business environment and of effective strategies to maintain position in the market.

However, an overall view of the product or project life cycle as a consolidating view for management was lacking, as was an effective planning of product testing, evaluation and acceptance. The absence of an effective system for assurance of quality in products or processes was also noted, and weaknesses in the system for maintaining overall integrity of the software products were recorded. There was no program for measurement of progress or risk monitoring.

Summary of follow-up meeting
Firm #11 had undergone significant internal changes in the previous 12 months that included a restructuring of senior management, and a re-statement of business goals towards new markets. Staff turnover of 70% had been recorded, with only 3 of the original 13 personnel remaining since the initial Assessment was conducted. This had significantly reduced the opportunity for implementation of initiatives that were suggested as outcomes of the Assessment. Consequently, no further actions have been undertaken by Firm #11 since the Assessment was performed, and no re-evaluation of processes was performed at the follow-up interview.
[Information summarised and adapted from SQI-PIP-FR11-01 PAT.doc]

Firm No.12
Summary of Strengths/Weaknesses
The strengths of Firm #12 lay in the professionalism of the staff and their ability to utilise innovative technologies. This firm depended on developing innovative solutions to customer problems; they derived their technologies on a detailed understanding of the application domain, and had been able to depend on their technical strengths to overcome any weaknesses in project or product management. As they become more dependent on a commercial product line rather than on time and materials contracting, these weaknesses would become more critical.

Firm #12 had the opportunity to build upon its current market strengths by developing its capability for project management, applicable both to its commercial contracting and to its product development activities. The firm's experience in operating within the methods and systems of other prime contractors demonstrated that the necessary competencies exist; it was now up to the organization to develop these capabilities internally. The organisation was aware that there was a need to introduce standard procedures across the development life cycle. The assessors noted the strengths of the domain expertise held by key personnel; the ability to define innovative solutions to customer's problems; the fact that financial risks were controlled through 'time and materials' contracting; and the control of software components through use of an effective toolset and defined procedures for configuration management. There was no effective approach to project management, and the traceability of customer requirements through the software development process was very limited. Also, in-house testing was not adequately documented and quality assurance was performed on an ad hoc and uncontrolled basis.

Configuration management was limited to source code and did not extend to other documents, and the recording of resolution of customer-reported problems was very

limited. Overall, there were few assets identified that would serve to support a common 'way of doing business' within firm #11.

Summary of follow-up meeting
Firm #12 reported that, due to the impact of Y2K and GST, it did not have time to implement any of the recommendations from the assessment.
[Information summarised and adapted from SQI-PIP-FR12-01 PAT.doc]

Firm No.13
Summary of Strengths/Weaknesses
Firm #13's processes that had been tailored over time to suit its business environment, but did not have high achievements of capability, making the company highly dependent on the skills and competencies of individual personnel. At firm #13 there was a strong program for building staff competence, particularly using early induction training, and through extensive use of informal mentoring; there was a focus on developing a 'people focus' in the staff. Recruitment of new staff posed particular problems for the company. The emphasis on managing customer expectations encouraged development of a supportive customer base.

Because of the limited process capability, the company had limited capacity to respond to significant changes in the environment, whether these were technical or commercial. Market growth, significant changes in user requirements or changes in operating systems all had the potential to place stress on the informal processes employed. Because of the generally strong corporate culture and the level of collection of useable performance data, the firm was well placed to implement successful improvements.

The processes employed by firm #13 were simple and not of high capability. However, they were well suited to the normal business operations. Firm #13 had a stable, mature product, which had good reliability in the standard configuration. This reduced the extent of rework required, limiting it to problems arising as a result of specific tailoring. Also, firm #13's policies emphasised managing the expectations of their customers, and this had resulted in a strong market position.

There were significant changes required in the future, involving both GST and the likely adoption of a GUI, and these could impact on the current maturity. Also, there was significant potential for configuration problems to occur, particularly as customer numbers increase. There was scope for the use of an appropriate configuration management tool. The company was heavily dependent on the competency and professionalism of individual staff. There was little real visibility in the development process, and limited assurance that defined requirements were achieved. Also, firm #13 recorded and stored significant data on performance, but made very limited ongoing use of this information. At a minimum, the potential existed for better estimation of project size and cost.

Summary of follow-up meeting
The focus of process change to firm #13's development environment was in the allocation of documentary notes to job number, indicating relevance to design and other specification issues, in the development and maintenance process. This had the

added benefit of being able to formalise a more accurate approach to the collection of certain measurement data, for management and defect prevention.

The development environment had a number of checklists in place for requirements management and risk management that had since been utilised for the collection of data to 'capture the experience' of existing practices, on a monthly basis. The checklists also provided opportunities to introduce traceability in the formal approach to testing, by using the requirements checklists in the testing of new updates, therefore providing assurance that the agreed requirements have been effectively implemented.

Higher levels of capability in both problem resolution and process establishment were achieved. In the problem resolution process, all customer reports were classified against product codes and job numbers to both co-ordinate grouping of defects and to provide a mechanism for monthly reviews and customer feedback.

The Y2K project required firm #13 to understand the effectiveness of a number of processes, and both problem resolution and process establishment improved. Data collected on job numbers and timesheets were cross-referenced and used to review accuracy of estimates of effort, and all problem resolution reports were analysed and reviewed on a monthly basis for grouping of defects within the product and to support future product design. The software product developed by firm #13 had to undergo significant revision, to satisfy legislative changes for both Y2K and GST implementations.

Comments from the feedback meeting conveyed firm #13's success in being able to initially satisfy all Y2K requirements, and be able to transfer that comprehensive understanding of the development environment and its technologies, into a more rapid resolution of GST requirements. This was reflected in the relatively short duration time of 5 months to prepare and successfully implement all known GST modifications for all current customers. Overall, this understanding allowed firm #13 to undergo rapid product changes across multiple tailored installations, whilst maintaining high levels of customer satisfaction.
[Information summarised and adapted from SQI-PIP-FR13-01 PAT.doc]

Firm No.14
Summary of Strengths/Weaknesses
Overall, firm #14 demonstrated strong process capability due to the organizational culture of the company. This was particularly reflected in software development, problem resolution and project management. There was good capability reflected in the requirements gathering process based around the strong relationships developed with the clients. Configuration management and risk management demonstrated a reasonable capability. The main area of opportunity was to formally document the existing processes. The noted strengths included long term and strong relationship with clients; strong organisational culture, fostered through staff shareholding in the company and resulting in low staff turnover; frequent and regular interaction with clients which can address concerns before they become problems; Help Desk to track problems; attention to specification, design and testing during software development; and project tracking to monitor schedule and cost slippage.

However, risks were noted: loss of key staff; growth of business leading to increase in span of control of managers and a lack of opportunity to foster the organisational culture; the current configuration management system had an exposure in change control and did not cater for documentation. Also, as quality assurance was informally performed with mental checks, firm #14 was exposed to a dependence on one person. Identification of risks associated with projects was informal and not documented, and opportunity existed to document the informal procedures and practices to allow less dependence on individuals.

Summary of follow-up meeting

Firm #14 decided to produce comprehensive implementation templates to ensure that all processes were 'canvassed' and inappropriate items deleted from an implementation. The establishment of these formal documentation procedures had commenced. Project management templates had been formalised so that there were formal documents for the three main software implementations. It was felt that due to the varied nature of the three software products that each software product should have its own template. These documents were tailored according to the software modules to be implemented.

No review of process capability was performed in the follow up process. However, it was apparent that a number of process areas had improved, for example, quality assurance with the documentation of all stated development procedures; and process establishment by the creation of standard development procedures.

Firm #14 suggested that the overall value of the Assessment was that it made them very aware of documenting all stated actions that are assumed to be performed. This would help create a standard development process, which in the past often relied on the project leaders and Managing Director to guide activities. These benefits could then be extended with the ability to tailor the development processes to suit specific needs.

While the assessment generally confirmed that firm #14's methodologies were sound, stronger documentation would stabilise the current software processes, and allow them to be supported and maintained. The add-on effect was that the firm could then see improvement opportunities arise from the enhanced knowledge acquired from understanding their own processes. Firm #14 also saw this as providing opportunities for more rapid growth in the company.

The Assessment demonstrated to firm #14 a means of linking all of the relevant processes together, to formulate a comprehensive overview of project completion—not just in product delivery. Firm #14 stated that this would ensure client satisfaction was maintained at its important level, and would ensure that projects were comprehensively completed and that client satisfaction was maintained.
[Information summarised and adapted from SQI-PIP-FR14-01 PAT.doc]

Firm No.15

Summary of Strengths/Weaknesses

The firm had successfully implemented variations of its principal product line in several organisations. The domain knowledge incorporated in the product allowed a high level of re-use, but also demanded comprehensive product knowledge to effectively market and implement the system.

Firm #15 was moving to a more market-driven environment, and this was impacting the internal product development culture that created the original product. The main product line was sold by contract, due to the extensive tailoring, data conversion and file take-up activities associated with successful implementation. The marketing company was performing the role of the de facto client. The management of customer expectations and the establishment of quantifiable quality and performance criteria were essential deliverables from the marketing organisations, and their absence was causing an adverse chain reaction in the development, implementation and support of the main product line.

Project management skills and the development of repeatable processes were two areas where the company needed to improve in order to capitalise on business opportunities. The product line approach appeared to offer a powerful engine to drive e-Commerce systems, and collaboration with a strategic business partner could provide the leverage needed to break into that market.

The firm had survived a number of major set-backs and problems. The principal product was maturing, and the development team appeared competent and motivated. The main product had many features that could address the needs of e-Commerce traders. Also, it may be necessary to protect the main software product by patent, as some of the algorithms used in the product line would need that level of protection.

Development of a generic project plan would help to standardise the planning process. A separate project plan was not documented for each project, but details were incorporated in the requirements specifications and contract. This was adequate for product development, but inadequate for providing visibility to all stakeholders in contracted projects. Proliferation of product family could be achieved by providing shrink-wrap versions of the product.

Summary of follow-up meeting

No process improvement changes were reported for any of the stated actions listed from the initial Assessment report, consequently, no re-evaluation of processes was performed. Although no process changes had been recorded in the development environment, discussion with the interviewee suggested the Assessment was very accurate in its appraisal of the company and its development processes. It was evident to some staff that some form of ‘objective mentoring’ was required to establish and formalise new development practices, discussed as part of the Assessment action report. It was considered appropriate to recognise some form of ‘change agent’ to effect the level of change and support required to be successful. The difficulty in ‘unfreezing’ the organisation from established development practices was recognised.

[Information summarised and adapted from SQI-PIP-FR15-01pat.doc]

Firm No.16

Summary of Strengths/Weaknesses

For the size and age of the organisation, firm #16 had already established a good level of documentation for projects and were aware of the requirement to document and define the various processes associated with software development to reduce the dependency on the Managing Director. Requirements gathering was the strongest process in the organisation probably due to the billable nature of the process and the basis on which the organisation had been founded. Risk management and project management were both performed competently. In project management there were good breakdowns and estimations of tasks and close monitoring and tracking. In risk management there was a good evaluation and documentation of project risk and ongoing monitoring and weekly evaluation. Weaknesses existed in the configuration management and quality assurance processes.

The building of a number of procedures and policies for establishment of various development processes was a definite strength. This would benefit the company long term economically, aside from articulating a quality culture. Also, a very good requirements gathering process existed that integrated risk management strategies built on a customer focus. The development environment was moving towards a conceptual framework and approach (employing Rational Methodology) that would reflect proven methods and techniques towards best practice.

Good project management practices were in place, breaking down project tasks with estimation and tracking of effort. However, a lack configuration management of all work products associated with projects exposed Firm #16 to the risk of incomplete baselines. Also, an absence of contractual signoff of requirements to ensure delivery of acceptance criteria could lead to financial problems. This needed to be taken into account for establishing better testing procedures.

The lack of an identified quality assurance strategy could have immediate impacts on Firm #16's business objectives, either through decreased customer confidence or in maintaining high quality attributes in delivered performance of the product. Problem reports needed to be tracked through to completion, to ensure that all problems are rectified. Establishment of processes, though being performed, presented an opportunity to actually plan for this establishment to ensure that it doesn't slip and to establish it as a project. Measures of quality in terms of defects, problems, faults, etc would help to establish and monitor the quality goals and targets of the products and form part of the organisational culture. There was no structured approach to risk identification and management, and this provided an exposure to unforseen events.

Summary of follow-up meeting

Firm #16 had seen a significant increase in activity the previous past 12 months, both in projects undertaken and the release of an internally developed software product suite. This had put enormous pressure on the company to build and maintain a development architecture that was suitable and stable for the purposes of their work. This meant the company had been under constant change to improve their technologies and development ideas, to maintain their competitive advantage.

New technologies have been introduced to advance the development environment from what they referred to as their 1st generation architecture, to a 2nd generation architecture, to a current 3rd generation architecture. The focus of their efforts was in

re-use of design, components and technology in E-commerce application developments.

Although this inhibited firm #16's opportunities to review previously stated Assessment actions, it was indicative of the firm's philosophy, that it will manage and improve its own development infrastructure in conjunction with its current growth. The enhanced understanding of its current software processes and inter-related business activities was reflective of the management support and commitment to improving their business, whilst setting relevant and realistic objectives for process improvement.

No review of process capability was undertaken for this follow up. However, efforts have been initiated in quality assurance and configuration management that may lead to further advancement to Level 1 in these processes in the near future, when these efforts have been fully documented. Data collection measures have been initiated in testing and code reviews to record the number of defects in generated code. Firm #16 found the Assessment to be of considerable value, in providing an objective view of their current development status, and to offer relevant improvement initiatives. The Assessment program was seen as offering an opportune way for Firm #16 to explore and discuss the success factors that contribute to process improvement, for example, being able to provide a change agent or opinion leader to initiate change, and through to the ability of the Assessment to identify opportunities for the tailoring of development processes to satisfy basic capability level ratings.
[Information summarised and adapted from SQI-PIP-FR16-01 PAT.doc]

Firm No.17
Summary of Strengths/Weaknesses
Firm #17 concentrated its development on a single product. The product had a high reputation, and the firm had developed good relationships with all of its client groups. The firm followed a reasonable planning process to establish the scope of major releases of the product, though activities to achieve the plans were tracked only informally. Sound configuration management practices were in place to ensure the integrity of the product. A stable environment helped to control the risks associated with processes that did not demonstrate adequate capability.

Product development was weakened by the lack of any structured approach to system testing. In addition, the process for tracking customer-reported problems was informal and not controlled effectively. Tracking of activities was limited, and no records of the effort, costs or duration of tasks were kept, so that estimating for new releases lacked credibility. No effective processes existed for quality assurance or risk management, and while some assets to support process performance existed, there was no mechanism to identify or develop additional assets.

Summary of follow-up meeting
GST had a major impact on Firm #17's clients. To cope with the huge increase in product sales and subsequent training and support, the total number of staff had increased by 70 percent. The chief programmer had resigned (and had not yet been replaced) and a full-time tester had been appointed. As a result of the assessment, Firm #17 had commenced a SPI project to document and formalise the software development processes. To address recognised risks regarding testing, a tester had

been appointed, test plans were formulated and test logs and incidents recorded. Furthermore, Firm #17's workflow management system had been extended to integrate client registration, automated problem tracking, help desk and despatches. This system was being integrated with the development systems. This project and others were being tracked with Microsoft Outlook at the task level.

As Firm #17 had just commenced its SPI project, the capability of the target processes was not formally re-evaluated. Details relating to size of released product were being collected. Also, tasks associated with six projects were being tracked in Outlook. Firm #17 considered the assessment to be of great benefit. The proposals for action in the assessment report provided the impetus to develop a SPI program by enabling the firm to focus on a set of tasks. As well as providing a practical approach, the involvement of the 3rd party assessors provided a measure of accountability: staff were motivated to get the SPI program underway prior to the follow-up meeting.

Firm #17's SPI program was not as advanced as it hoped, however, the improvements in the testing procedures have resulted in Firm #17 being more confident in releasing products. Also, there was more confidence to expand the development effort. The SPI program had already shown value by reducing the disruption resulting from staff turnover. On the whole, Firm #17 found the assessment provided value in motivating improvement actions. Due to phenomenal sales and support activity (due to GST introduction) and the loss of key staff, Firm #17 was not very advanced with the improvement actions taken since the assessment. However, Firm #17 was convinced the actions taken have already resulted in improvements in its product and processes.
[Information summarised and adapted from SQI-PIP-FR17-01.doc]

Firm No.18
Summary of Strengths/Weaknesses
The assessment revealed that Firm #18 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 #18 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 #18 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 #18 also needed to take more advantage of its strengths by developing effective measures for monitoring performance in terms of both productivity and product quality.

Summary of follow-up meeting
The firm's methodology had been reviewed subsequently updated. In particular, modeling had been extended to include Object Oriented and Unified Modeling

Language concepts. All templates were updated to reflect changes. To ensure all staff became familiar with the changes, a workshop was developed and delivered. Procedures for the use of a configuration management tool were updated and dispersed through mentoring. A staff member had been given the duties of code librarian. An Enterprise-wide change request system had been designed and was in the process of being developed. Also, a software package had been introduced to help track and manage bugs and issues.

A risk assessment and management procedure had been developed. This project 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 had been developed and included in the quality manual to be used for all new procedures.

The changes implemented by Firm #18 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.

Firm #18 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 #18 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 #18 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.
[Information summarised and adapted from SQI-PIP-FR18-04.doc]

Firm No.19
Summary of Strengths/Weaknesses
At firm #19, requirements gathering and analysis was performed well by experienced qualified engineers. The software development, problem resolution and risk management processes were sound. Also, software configuration management was well done. The major risks for the company related to the business development and the winning of new development orders or contracts. Another risk identified was the reluctance of clients to invest in quality assurance. Also, it was noted that software development in web time required evolutionary development with high visibility to and participation by the client. Significant investment was required to update technology to stay current or ahead of the competition. Finally, it was recognised that software development with significant re-use was a key to meeting market demands for faster availability and lower cost.

Summary of follow-up meeting
Summary of events/improvements since initial assessment
Firm #19 identified business development as a critical issue, and in the absence of a business developer resource, the company had reduced its full time staff to one, and was actively pursuing development projects. At the time of the planned follow-up meeting, firm #19 was repairing damage to servers, and external communication links resulting from a break-in at the premises. No changes to the target processes were identified at the meeting. PSP based measures were collected as part of the contract work. No repository, or formal measurement program, was in operation.

The Assessment identified the need for active business development, and a Statement of Capabilities would have been a major advantage. With contract work, the sponsor was heavily committed to revenue generating activities, but had started to document the Development Practices Guide required for the company.

Firm #19 decided to include factory testing as a milestone/deliverable in future contracts and also to use configuration audits as part of the regular internal maintenance procedures. Plans were also in place to introduce a formal system for Bug Tracking, and managing individual 'to-do' lists.
[Information summarised and adapted from SQI-PIP-FR19-01.doc]

Firm No.21
Summary of Strengths/Weaknesses
Requirement gathering was performed by experienced, competent senior people. Software developers were experienced, and the Software Manager was able to take a 'hands-on' role in monitoring and coaching the development team. Visibility within the company was adequate.

Configuration management was performed with tool support, and was based on separate guidelines for development and maintenance. The software manager was currently in a position to monitor the system. Problem resolution was managed with tool support. The software manager was close enough to the problems to enable identification of trends and repeat problems.

The major risk identified in the assessment was the dependence upon the software manager to provide the necessary oversight of the performance. This situation could provide a risk to the company if holidays or illness resulted in a lengthy absence. The weekly planning and scheduling approach was adequate for the small team now, but would cause problems for a larger team with a longer schedule. There were a number of current projects that have resources relocated according to priorities that may change from time to time. Internal R&D projects were usually the ones that had their resources moved.

The reliance on a few key personnel meant that the technical aspects of a project may exceed most of the team's capabilities. It could also lead to overwork by key personnel, with resultant low morale, exhaustion, burnout, attrition and delays in decision-making and reviews.

Summary of follow-up meeting
The staff work long hours already, on the revenue generating tasks, and without additional resources, SPI progress was limited. Based on the examples shown to the follow-up assessor, the configuration management ratings were re-assessed at level 2. Since the assessment, limited measures of plan versus actual were recorded.
[Information summarised and adapted from SQI-PIP-FR21-01.doc]

Firm No.22
Summary of Strengths/Weaknesses
Firm #22 had a mature and disciplined approach to software development. Processes employed were for the main part well documented, and their practice was institutionalised. There was an excellent understanding in qualitative terms of the mechanisms and tools employed, and projects were well planned and effectively managed. A comprehensive quality assurance system was in place, tailored to the specific business needs of the company.

There were some specific weaknesses in the recording, tracking and resolution of problems, which was not performed in a consistent way across all projects. Measures collected for monitoring or performance evaluation were limited, and little detailed analysis of data was performed. This limited the firm's ability to encapsulate its experiences, and profit from them. The identification and prioritisation of risks was informal, though identified risks were effectively managed. The basis for the ongoing refinement and expansion of the set of process assets tended also to be informal.

The company had a strong, documented and well institutionalised process for identifying and developing business opportunities, leading to a thorough understanding of customer requirements for any individual project. Project management was effectively implemented, and was based upon documented processes and a well understood organisational culture. Good practice in software development was followed, with a focus on the architecture of the system. Designs were documented, and comprehensive system test plans developed. Software quality assurance was effective, and tailored to deliver effective outcomes based upon identified business needs. There was a reasonable process for developing, implementing and maintaining required process assets, and resources were provided for this purpose.

However, while a system for problem tracking and management existed, it was not used consistently across all projects. While identified risks were addressed in the planning process, there was no common approach to the identification and prioritisation of risks in new projects. Also, tracking and monitoring was limited to measures of effort, cost and schedule. Estimation was based primarily on moderated expert opinion, with very limited use made of historical data. Finally, opportunities for the company to learn from experience were limited to some extent, though the post project reviews helped to capture some useful information.

Summary of follow-up meeting
Communication from members of Firm #22 suggested that no follow up actions have resulted from the Assessment program. No re-evaluation of processes was performed in this follow up interview. Furthermore, comments from Firm #22 personnel

contacted for the follow-up report, suggested that no 'real benefits' had been gained from the Assessment performed, as the communication received from the RA discussion and report was limited. It was believed that the one-day assessment had highlighted minimal improvement initiatives, and was too brief to be of any value. [Information summarised and adapted from SQI-PIP-FR22-01pat.doc]

Firm No.23

Summary of Strengths/Weaknesses

Software development in Firm #23 was generally performed so as to achieve the purpose of the processes employed. There was however considerable inconsistency across the organization in process implementation. This problem was accentuated by the distributed nature of Firm #23's organization, with development activities spread across several locations in different regions. This problem had been addressed by emphasising the professionalism and competency of staff, and there had been significant investment in staff development.

Most of the challenges faced by Firm #23 derived from the distributed nature of the organization. With project tasks being performed in multiple locations, project management was more difficult, particularly for monitoring and recording progress. Configuration management posed particular problems, while difficulties were found in quality assurance and problem resolution. The development of a consistent approach to process performance across the organization would help to address many of these issues.

Summary of follow-up meeting

An internet-based document control system had been set up but was not well supported within the firm. The level of Internet access varied considerably between the different firm locations, and this had been a major factor hindering implementation. A more formal system for approval of projects had been established, involving approval by the relevant Business Unit, with overall coordination and monitoring through a new control unit. A workflow management system was being developed but it had not yet been implemented at the time of the follow-up meeting. Difficulties had been encountered in the development and deployment of an effective problem management system. The distribution of functions across the different sites of the firm was partly responsible for these difficulties; problems were often reported in terms that were not easily understood by the group responsible for addressing them.

The establishment of a control unit had resulted in clarification of responsibilities for risk management within Firm #23. Risk management was still seen mainly as the responsibility of top-level management, and the process for managing risk remained informal. The additional control steps introduced through the establishment of the control unit and the revised project approval process addressed some of the weaknesses in the project management process.

The development of a common approach to systems development remained the principal focus of attempts to improve overall effectiveness. Until more progress was made towards the more effective integration of the whole enterprise, simple process improvement efforts may have limited success. Nonetheless, useful progress had

been made towards addressing some of the identified risk areas, and further actions were planned.
[Information summarised and adapted from SQI-PIP-FR23-01.doc]

Firm No.24
Summary of Strengths/Weaknesses
Because of its role in developing integrated, embedded software as part of a defined product, the company takes a systems engineering perspective rather than seeing itself as simply a software developer. Firm #24's sister company had ISO9001 accreditation which allowed it to operate in a culture which was quality orientated. Because much of the activity of requirements gathering and testing were located in the sister company, the firm could focus on a limited portion of the development lifecycle concerning design, implementation and unit test. The unit apparently had the strong support of the marketing group in resisting schedule pressure, thereby allowing it to concentrate on the quality of the products.

Some opportunities for changes were identified. A defined, formalised risk assessment and management process was a high priority and would allow early consideration of strategies and development of contingency plans. The capability to track project progress against defined milestones was poorly developed but simple changes in the way that the existing software tools were used would provide a cheap and effective increase in management oversight and could easily provide regular, standardised reports. There was a reported desire to change the typical project cycle time but it was apparent that the dynamics of the current four month regime was not fully understood. Again the use of the existing tools could provide data to produce a model of the current processes and a foundation for studying proposed changes. Clearly defined, the process for team leaders to follow would allow expansion and rapid training for new team leaders. Similarly, a policy of development staff acquisition that allowed some overlap in skills would afford some protection against unplanned absences and enable short-term transfers between teams.

Summary of follow-up meeting
There was no follow-up meeting as Firm #24 did not continue with their SEA membership.
[Information summarised and adapted from SQI-PIP-RA24-AR-10.doc]

Firm No.25
Summary of Strengths/Weaknesses
Firm #25 had an effective process for requirements gathering, due to the expertise and domain knowledge of the managing director. The process establishment process was also done well, with process documentation and standards in place for work products, but this was generally only applied to the software development processes and the assessors considered it should be applied across other processes.

Whilst software development was very strong, it was noted that implementation of proper testing procedures and traceability procedures, together with actual implementation of the defined process would improve this process. Project management could be improved with adequate tracking. Configuration management could be improved with proper planning. Problem resolution relied heavily on an

organisational developed tool, and by managing this process its capability would improve.

The two weak areas were quality assurance and risk management. There was a basis and a culture for quality assurance within firm #25 with informal reviews and checklists in place. Implementation of the checklists and proper recording of the QA activities would improve this process. Risk management could be improved by formalising, planning, documenting and monitoring the risks involved with projects.

Without proper tracking of actual effort on project tasks, there was no early warning of any potential schedule slippage or cost overrun. There was a lack of planning and definition in configuration management activities, and the informal risk management exposed firm #25 to risks in relation to the offered warranty. Testing procedures were not formalised, and there was little traceability between specifications, design and implementation. The quality assurance checklists needed to be used within a large project in order to reduce the risk of implementation problems. This also enabled Firm #25 to evaluate the usefulness of the checklists. There was an opportunity to define and document additional processes apart from software development.

Summary of follow-up meeting

The follow-up meeting revealed that some of the assessment recommendations had been implemented, but a formal reassessment was not carried out. An initial proposal for action put forward in the Assessment was to track actual task effort for all project activities to enable an early warning system for cost and scheduling variations. This was implemented by allocating specific work task category codes to individual timesheets, which could also be tracked in parallel, through the use of actual project task monitoring using MS Project. New quality assurance checklists were established in the testing phase. No re-evaluation of process capability was performed at the follow up stage. However, several new processes with the potential for collecting measures have been implemented in the development areas at Firm #25. This included the tracking of estimated against actual task efforts and the number of defects recorded in testing. Firm #25 acknowledged the significance of formalising the testing process before any release to the clients.

Feedback from Firm #25 suggested that the Assessment provided very beneficial assistance to their development environment. Aside from providing confirmation of their current development processes, the assessment team conveyed potential benefits in the tailoring of improvement initiatives towards the strengths and weaknesses of the organisation. An example of this was to encourage the adoption of their quality assurance review checklists in testing across all projects, which not only helped verify the underlying QA process but also formalised the establishment of the testing procedures and offered an opportunity to collect test measures. It was also evident that Firm #25 had initiated change to their development processes by setting relevant and realistic objectives that could be achieved and would contribute to the future success of the organisation. It was clear from the discussion that management support for change to occur was pivotal in the degree of success that was obtained and that the improvement initiative was seen as a project itself with effective planning and control measures in place.

[Information summarised and adapted from SQI-PIP-FR25-01 PAT.doc]

Appendix I. Statistical tests relating to PIP field experiments

Table I.1 Schedule of assessments, assessors and follow-up meetings

Experiment #	Assessment date	Lead assessor	Support assessor	Follow-up date	Follow-up assessor
1	Aug 1999	A1	A3	Nov 2000	A3
2	Aug 1999	A1	A2	Not done	A5
3	Aug 1999	A3	A1	Dec 2000	A5
4	Aug 1999	A3	A2	Dec 2000	A3
5	Sep 1999	A1	A5	Apr 2000	A1
6 Not in this study – Showcase participant					
7	Sep 1999	A3	A9	Sep 2000	A3
8	Sep 1999	A3	A6	July 2000	A3
9	Sep 1999	A3	A7	July 2000	A3
10 Not in this study – Showcase participant					
11	Oct 1999	A1	A8	Nov 2000	A5
12	Oct 1999	A1	A9	Dec 2000	A5
13	Nov 1999	A1	A8	Oct 2000	A5
14	Sep 1999	A2	A6	Nov 2000	A5
15	Nov 1999	A6	A3	Dec 2000	A5
16	Nov 1999	A2	A5	Dec 2000	A5
17	Nov 1999	A1	A4	Aug 2000	A4
18	Oct 1999	A1	A4	July 2000	A4
19	Nov 1999	A3	A8	Oct 2000	A3
20 Outside scope and funding of SEAQ PIP					
21	Nov 1999	A3	A5	Nov 2000	A3
22	Nov 1999	A1	A5	Dec 2000	A5
23	Dec 1999	A1	A2	Nov 2000	A1
24	Nov 1999	A6	A4	Not done	-----
25	Nov 1999	A2	A8	Nov 2000	A5

Table I.2 List of organisational characteristics

	Year	Number of staff – employment status			Number of staff – formal education			Number of staff – role		Number of staff – experience		ISO 9001
Org #	Founded	Full time	Part time	Contract	PG	Grad	Other	Technical	Support/ admin	< 5 years	>5 years	
1	1990	7	2	0	1	1	7	3	6	2	7	No
2	1996	2	2	2	0	3	3	4	2	5	1	No
3	1990	14	2	2	4	5	9	7	11	16	2	No
4	1998	1	2	0	1	2	0	2	1	3	0	No
5	1997	4	3	1	0	7	1	4	4	6	2	No
7	1992	4	0	5	0	6	3	8	1	8	1	No
8	1990	40	30	0	50	20	0	60	10	56	14	Yes
9	1997	5	0	1	0	5	0	4	1	3	2	No
11	1996	7	0	0	3	2	2	4	3	3	4	No
12	1993	4	0	4	0	8	0	5	2	3	5	No
13	1985	12	0	1	0	9	0	10	2	7	5	No
14	1986	9	0	17	0	2	0	21	5	20	1	No
15	1994	4	4	3	1	3	0	7	4	3	8	No
16	.	5	1	0	0	5	1	4	1	1	5	No
17	1984	10	0	0	0	4	0	4	6	6	4	No
18	1992	10	0	1	6	5	0	10	1	8	3	No
19	1994	3	1	0	0	3	0	3	1	4	0	No
21	.	14	0	2	3	4	9	4	4	2	2	No
22	1987	60	2	8	70	0	0	56	14	.	.	Yes
23	1994	60	1	0	15	42	4	56	5	35	26	No
24	.	17	0	0	4	12	1	17	0	11	6	No
25	.	2	2	1	1	4	0	4	1	3	2	No

Table I.3 Target business sector frequencies

Industry Sector	Number of responses
Finance (excluding banking)	5
Insurance	2
Banking	2
Petroleum	3
Automotive	2
Public Utilities (Gas Water Electricity)	8
Aerospace	1
Telecommunications	8
Public administration	5
Consumer Goods	2
Retail	4
Distribution/Logistics	5
Defence	4
Information Technology/software	9
Health and Pharmaceutical	2
Leisure and Tourism	6
Manufacturing	6
Construction	5
Travel	1
Media (TV radio)	1
Education	2
*Mining	2
*Agriculture	1
Total	88
Note * denotes new sectors added to list by researcher during analysis of data	

Table I.4 Other target business sector responses recoded to listed sectors

Target business sector recorded by sponsor	Recoding by researcher
Security Systems	Defence
Knowledge management	IT/software
Wholesale, transport, general business	Sponsor had also selected distribution/logistics
Fleet management, bespoke software	Sponsor had also selected distribution/logistics
Internet - industry services	IT/software
Agriculture	Agriculture (new sector added to list of sectors)
Mining (2 responses)	Mining (new sector added to list of sectors)

Table I.5 List of project characteristics for each firm – actual responses

Org #	Projects in progress	Staff/project	Project duration	Cost overrun
1	3	2	6 mth/release	20.00%
2	3	2	8weeks	0%
3	1	5	2 years	
4	2	1full- time,2 part-time	18 mths	
5	4	4	90 days	20.00%
7	2	5	6mths	0
8	5-10	5-10	6-24 mths	10.00%
9	1	5	5 years so far	
11	4	3	3-6 mths	40.00%
12	3	2	2-3 mths	
13	20-50	<1	.5-15 man days	-10 to 20%
14	10	1-3	2-4 mths	1-10%
15	5	2	30 days +	100%
16	7	2	3 mths	
17	2	2-3	6 mths	Development not required to submit or work to a budget
18	5-6	2-3	12-18 mths	
19	2-3	5	6-12 mths	50
21	4	1-2	1-12 mths	?
22				
23	5	10	1-3 yrs	0
24	3	2	16 weeks	40%
25	5	1-2	2 wks-12 ,mths	~10%

Table I.6 Firm headcount, process capability level and attribute achievement for each process at assessment

Firm		Process capability levels								Process attribute achievement							
Id#	Staff FTE	RE	SD	CM	QA	PR	PM	RM	PE	RE	SD	CM	QA	PR	PM	RM	PE
1	8	2	1	1	0	1	0	1	0	7	4	4	2	3	3	6	1
2	4	1	1	0	0	1	1	1	0	6	7	1	1	3	4	3	0
3	16	2	1	1	1	1	1	0	0	9	8	8	4	10	4	4	6
4	2	2	2	3	2	3	2	1	1	11	13	14	13	14	12	9	7
5	6	1	1	1	0	1	0	0	0	5	6	2	0	2	1	0	0
7	6.5	2	2	2	1	1	3	2	2	10	10	12	10	10	14	11	10
8	55	2	2	1	1	1	2	3	1	11	10	10	11	12	12	13	11
9	5.5	1	2	3	0	3	2	0	0	8	11	14	1	13	12	1	3
11	7	2	1	1	0	0	1	1	0	12	6	3	0	1	6	4	2
12	6	0	1	1	0	0	0	0	0	2	5	2	0	0	1	1	1
13	12.5	1	0	1	0	0	1	0	0	4	5	5	3	1	5	0	1
14	17.5	1	2	1	0	2	2	1	0	7	10	6	1	8	10	4	1
15	7.5	1	1	1	0	1	1	1	0	5	5	4	1	6	4	2	1
16	5.5	2	1	0	0	1	1	1	1	9	8	2	1	8	6	5	5
17	10	1	1	1	0	0	0	0	0	5	6	2	0	1	1	0	0
18	10.5	3	2	1	2	1	2	0	1	14	12	8	11	6	13	3	6
19	3.5	1	1	2	0	1	1	1	0	6	8	10	2	7	6	6	5
21	15	1	1	1	0	1	1	0	0	7	7	5	0	7	2	2	1
22	65	3	2	2	3	1	2	1	1	13	11	9	14	6	11	7	9
23	60.5	1	1	0	1	1	1	0	0	6	7	1	4	2	5	1	1
24	17	2	2	2	1	1	1	0	0	11	8	10	8	7	2	0	0
25	3.5	2	1	1	1	0	1	0	2	8	10	3	0	2	3	1	9

Table I.7 Tests of normality for capability levels at assessment and follow-up meeting, and attribute achievement at assessment and follow-up meeting

Variable	Process	Kolmogorov-Smirnov(a)			Shapiro-Wilks		
		Statistic	df	*p*	Statistic	df	*p*
Capability level at assessment	RE	.270	22	.000	.846	22	.003
	SD	.349	22	.000	.732	22	.000
	CM	.337	22	.000	.821	22	.001
	QA	.346	22	.000	.720	22	.000
	PR	.364	22	.000	.745	22	.000
	PM	.272	22	.000	.862	22	.006
	RM	.290	22	.000	.740	22	.000
	PE	.412	22	.000	.647	22	.000
Capability level at follow-up meeting	RE	.244	22	.001	.861	22	.005
	SD	.351	22	.000	.789	22	.000
	CM	.257	22	.001	.877	22	.011
	QA	.299	22	.000	.790	22	.000
	PR	.379	22	.000	.748	22	.000
	PM	.321	22	.000	.836	22	.002
	RM	.253	22	.001	.795	22	.000
	PE	.364	22	.000	.699	22	.000
Attribute achievement at assessment	RE	.126	22	.200(*)	.975	22	.814
	SD	.145	22	.200(*)	.954	22	.377
	CM	.152	22	.200(*)	.909	22	.045
	QA	.249	22	.001	.782	22	.000
	PR	.162	22	.138	.934	22	.148
	PM	.203	22	.019	.884	22	.014
	RM	.157	22	.168	.882	22	.013
	PE	.264	22	.000	.845	22	.003
Attribute achievement at follow-up meeting	RE	.137	22	.200(*)	.967	22	.640
	SD	.180	22	.062	.911	22	.050
	CM	.169	22	.104	.918	22	.070
	QA	.243	22	.002	.825	22	.001
	PR	.167	22	.110	.927	22	.108
	PM	.219	22	.008	.875	22	.010
	RM	.156	22	.178	.910	22	.047
	PE	.250	22	.001	.851	22	.004

a Lilliefors Significance Correction

* indicates distribution is normal (p>.05)

Table I.8 Frequency of capability levels by process at initial assessment

Process	Capability 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	13	6	2	1
Problem resolution	5	14	1	2
Project management	4	11	6	1
Risk management	11	9	1	1
Process establishment	15	5	2	0
Total	53	81	33	9
Percent	30.11%	46.02%	18.75%	5.11%
Levels: 0 incomplete, 1 performed, 2 managed, 3 established				

Table I.9 Comparison of process capability levels and attribute achievement

Friedman K related samples

Measure	Process	Mean rank
Capability level at assessment	RE	6.27
	SD	5.64
	CM	5.23
	QA	3.16
	PR	4.48
	PM	5.11
	RM	3.48
	PE	2.64
Friedman test statistics for capability levels	N	22
	χ^2	54.663
	df	7
	p	.000
Attribute achievement	RE	6.18
	SD	6.32
	CM	5.05
	QA	2.80
	PR	4.73
	PM	5.11
	RM	3.20
	PE	2.61
Friedman test statistics attribute achievement	N	22
	χ^2	57.692
	df	7
	p	.000

Table I.10 Wilcoxon signed ranks test of process capability levels

Process pair	*Z*	*p* (2-tailed)	Group
SD – RE	-1.508	0.132	a
CM – RE	-1.431	0.152	a
PM – RE	-2.000	0.046	*
PR – RE	-2.125	0.034	*
RM – RE	-3.337	0.001	*
QA – RE	-4.001	0.000	*
PE – RE	-3.987	0.000	*
CM – SD	-0.632	0.527	b
PM – SD	-1.134	0.257	b
PR – SD	-2.111	0.035	*
RM – SD	-3.095	0.002	*
QA – SD	-3.398	0.001	*
PE – SD	-3.750	0.000	*
PM – CM	-0.258	0.796	c
PR – CM	-1.387	0.166	c
RM – CM	-2.231	0.026	*
QA – CM	-2.707	0.007	*
PE – CM	-3.124	0.002	*
PM – PR	-1.069	0.285	c
RM – PM	-2.676	0.007	*
PM – QA	-2.804	0.005	*
PE – PM	-3.532	0.000	*
RM – PR	-1.524	0.128	d
PR – QA	-1.696	0.090	d
PE – PR	-2.295	0.022	*
RM – QA	-0.166	0.868	d
PE – RM	-1.249	0.212	e
PE – QA	-1.155	0.248	e

* significant difference at p=0.05
Note: pairs with the same group letter are not significantly different

Table I.11 Wilcoxon signed ranks test of process attribute achievement

Process pair	*Z*	*p* (2-tailed)	Group
SD – RE	-0.346	0.729	a
PM – SD	-2.625	0.009	*
CM – SD	-2.625	0.009	*
PR – SD	-2.691	0.007	*
RM – SD	-3.792	0.000	*
QA – SD	-3.551	0.000	*
PE – SD	-3.978	0.000	*
PM – RE	-2.273	0.023	*
CM – RE	-2.163	0.031	*
PR – RE	-2.326	0.020	*
RM – RE	-3.798	0.000	*
QA – RE	-3.724	0.000	*
PE – RE	-3.857	0.000	*
PM – CM	-0.445	0.656	b
PM – PR	-0.405	0.686	b
RM – PM	-3.127	0.002	*
PM – QA	-2.813	0.005	*
PE – PM	-3.109	0.002	*
PR – CM	-0.721	0.471	b
RM – CM	-2.539	0.011	*
QA – CM	-2.431	0.015	*
PE – CM	-2.790	0.005	*
RM – PR	-2.475	0.013	*
PR – QA	-1.933	0.053	*
PE – PR	-2.525	0.012	*
RM – QA	-0.153	0.878	d
PE – RM	-0.548	0.583	d
PE – QA	-0.363	0.716	d

* significant difference at p=0.05
Note: pairs with the same group letter are not significantly different

Table I.12 Ranking of sector groups by capability levels and attribute achievement

Process	Sector #	Sector Group	Capability level		Attribute achievement	
			N	Mean Rank	N	Mean Rank
RE	1	Manufacturing, automotive, dist/logistics	8	23.81	8	24.69
	2	Public utilities and public administration	12	39.21	12	38.21
	3	Construction, mining, petroleum, agricult.	7	30.71	7	28.21
	4	Telecommunications, media	8	40.56	8	39.81
	5	Finance, insurance, banking	6	34.17	6	36.42
	6	Consumer goods and retail	4	29.75	4	26.63
	7	Defence, aerospace	4	46.50	4	39.38
	8	Information Technology, software	9	32.61	9	33.44
	9	Education, health, pharmaceutical	3	23.00	3	34.67
	10	Leisure and tourism, travel	6	34.17	6	36.42
SD	1	Manufacturing, automotive, dist/logistics	8	25.69	8	26.75
	2	Public utilities and public administration	12	40.75	12	41.79
	3	Construction, mining, petroleum, agricult.	7	30.50	7	33.86
	4	Telecommunications, media	8	40.75	8	37.38
	5	Finance, insurance, banking	6	35.33	6	35.50
	6	Consumer goods and retail	4	24.50	4	22.38
	7	Defence, aerospace	4	32.63	4	29.25
	8	Information Technology, software	9	35.33	9	38.83
	9	Education, health, pharmaceutical	3	24.50	3	11.67
	10	Leisure and tourism, travel	6	35.33	6	37.08
CM	1	Manufacturing, automotive, dist/logistics	8	32.50	8	30.69
	2	Public utilities and public administration	12	42.17	12	41.75
	3	Construction, mining, petroleum, agricult.	7	37.29	7	39.57
	4	Telecommunications, media	8	35.94	8	37.00
	5	Finance, insurance, banking	6	23.33	6	25.25
	6	Consumer goods and retail	4	25.63	4	16.63
	7	Defence, aerospace	4	32.50	4	39.75
	8	Information Technology, software	9	33.17	9	32.83
	9	Education, health, pharmaceutical	3	32.50	3	26.33
	10	Leisure and tourism, travel	6	32.50	6	34.50
QA	1	Manufacturing, automotive, dist/logistics	8	23.00	8	25.00
	2	Public utilities and public administration	12	42.17	12	36.54
	3	Construction, mining, petroleum, agricult.	7	32.36	7	33.36
	4	Telecommunications, media	8	40.06	8	39.19
	5	Finance, insurance, banking	6	33.92	6	33.83
	6	Consumer goods and retail	4	23.00	4	18.75
	7	Defence, aerospace	4	39.38	4	44.75
	8	Information Technology, software	9	35.06	9	37.72
	9	Education, health, pharmaceutical	3	23.00	3	26.50
	10	Leisure and tourism, travel	6	33.92	6	36.08
PR	1	Manufacturing, automotive, dist/logistics	8	29.50	8	29.25
	2	Public utilities and public administration	12	34.54	12	39.92
	3	Construction, mining, petroleum, agricult.	7	40.86	7	42.07

Process	Sector #	Sector Group	Capability level		Attribute achievement	
			N	Mean Rank	N	Mean Rank
	4	Telecommunications, media	8	30.13	8	33.50
	5	Finance, insurance, banking	6	36.67	6	29.50
	6	Consumer goods and retail	4	22.75	4	19.50
	7	Defence, aerospace	4	37.50	4	39.00
	8	Information Technology, software	9	37.39	9	35.56
	9	Education, health, pharmaceutical	3	27.67	3	22.83
	10	Leisure and tourism, travel	6	36.67	6	33.83
PM	1	Manufacturing, automotive, dist/logistics	8	29.06	8	28.81
	2	Public utilities and public administration	12	37.08	12	31.46
	3	Construction, mining, petroleum, agricult.	7	33.14	7	29.00
	4	Telecommunications, media	8	40.81	8	41.75
	5	Finance, insurance, banking	6	37.83	6	39.50
	6	Consumer goods and retail	4	22.63	4	23.38
	7	Defence, aerospace	4	29.63	4	30.63
	8	Information Technology, software	9	35.22	9	38.33
	9	Education, health, pharmaceutical	3	20.67	3	26.33
	10	Leisure and tourism, travel	6	37.83	6	42.67
RM	1	Manufacturing, automotive, dist/logistics	8	34.00	8	30.31
	2	Public utilities and public administration	12	28.96	12	32.50
	3	Construction, mining, petroleum, agricult.	7	27.71	7	29.64
	4	Telecommunications, media	8	43.06	8	42.63
	5	Finance, insurance, banking	6	35.33	6	32.33
	6	Consumer goods and retail	4	38.00	4	26.50
	7	Defence, aerospace	4	30.00	4	39.88
	8	Information Technology, software	9	31.78	9	32.78
	9	Education, health, pharmaceutical	3	46.00	3	41.83
	10	Leisure and tourism, travel	6	35.33	6	36.17
PE	1	Manufacturing, automotive, dist/logistics	8	26.00	8	26.75
	2	Public utilities and public administration	12	40.67	12	38.67
	3	Construction, mining, petroleum, agricult.	7	30.57	7	30.64
	4	Telecommunications, media	8	43.00	8	42.94
	5	Finance, insurance, banking	6	31.33	6	28.75
	6	Consumer goods and retail	4	26.00	4	18.88
	7	Defence, aerospace	4	34.00	4	39.00
	8	Information Technology, software	9	36.67	9	37.06
	9	Education, health, pharmaceutical	3	26.00	3	29.83
	10	Leisure and tourism, travel	6	31.33	6	35.83
	Total	for each process	67		67	

Table I.13 Comparison of capability levels of firms with private sector clients with firms without private sector clients
Mann-Whitney U tests

Process capability level	Public/private	N	Mean Rank	Sum of Ranks
For all processes	Total	22		
Requirements elicitation	Public 1	14	13.00	182.00
	Private 2	8	8.88	71.00
Software development	Public 1	14	13.25	185.50
	Private 2	8	8.44	67.50
Configuration management	Public 1	14	12.07	169.00
	Private 2	8	10.50	84.00
Quality assurance	Public 1	14	12.71	178.00
	Private 2	8	9.38	75.00
Problem resolution	Public 1	14	12.32	172.50
	Private 2	8	10.06	80.50
Project management	Public 1	14	12.82	179.50
	Private 2	8	9.19	73.50
Risk management	Public 1	14	13.21	185.00
	Private 2	8	8.50	68.00
Process establishment	Public 1	14	11.82	165.50
	Private 2	8	10.94	87.50

Table I.14 Comparison of ranks for attribute achievement public/private sector firms

Process attribute achievement	Public/private	N	Mean rank	Sum of ranks
For all processes	Total	22		
Requirements elicitation	Public 1	14	13.54	189.50
	Private 2	8	7.94	63.50
Software development	Public 1	14	12.00	168.00
	Private 2	8	10.63	85.00
Configuration management	Public 1	14	12.82	179.50
	Private 2	8	9.19	73.50
Quality assurance	Public 1	14	13.04	182.50
	Private 2	8	8.81	70.50
Problem resolution	Public 1	14	12.68	177.50
	Private 2	8	9.44	75.50
Project management	Public 1	14	12.32	172.50
	Private 2	8	10.06	80.50
Risk management	Public 1	14	13.75	192.50
	Private 2	8	7.56	60.50
Process establishment	Public 1	14	12.18	170.50
	Private 2	8	10.31	82.50

Table I.15 Comparison of ranks for capability levels: few or many target business sectors

Process capability level	Few/many sectors	N	Mean Rank	Sum of Ranks
For all processes	Total	22		
Requirements elicitation	Few 1	11	12.55	138.00
	Many 2	11	10.45	115.00
Software development	Few 1	11	12.14	133.50
	Many 2	11	10.86	119.50
Configuration management	Few 1	11	12.91	142.00
	Many 2	11	10.09	111.00
Quality assurance	Few 1	11	11.68	128.50
	Many 2	11	11.32	124.50
Problem resolution	Few 1	11	11.55	127.00
	Many 2	11	11.45	126.00
Project management	Few 1	11	11.36	125.00
	Many 2	11	11.64	128.00
Risk management	Few 1	11	11.55	127.00
	Many 2	11	11.45	126.00
Process establishment	Few 1	11	13.18	145.00
	Many 2	11	9.82	108.00

Few/many sectors is coded 1 for 1 or 2 sectors selected, 2 for more than 2 sectors

Table I.16 Comparison of ranks attribute achievement for few or many target business sectors

Process attribute achievement	Few/many	N	Mean Rank	Sum of Ranks
For all processes	Total	22		
Requirements elicitation	Few 1	11	11.77	129.50
	Many 2	11	11.23	123.50
Software development	Few 1	11	12.00	132.00
	Many 2	11	11.00	121.00
Configuration management	Few 1	11	12.82	141.00
	Many 2	11	10.18	112.00
Quality assurance	Few 1	11	11.86	130.50
	Many 2	11	11.14	122.50
Problem resolution	Few 1	11	12.59	138.50
	Many 2	11	10.41	114.50
Project management	Few 1	11	11.45	126.00
	Many 2	11	11.55	127.00
Risk management	Few 1	11	10.86	119.50
	Many 2	11	12.14	133.50
Process establishment	Few 1	11	11.95	131.50
	Many 2	11	11.05	121.50

Table I.17 Correlations importance of performance measures and capability levels and attribute achievement

Spearman rank correlation test results

Process		Importance of Measure					
		Budget	Schedule	Customer	Requirements	Productivity	Morale
Capability level- assessment							
RE	r_s	-.058	.110	-.141	.098	.052	.093
	p (1-tailed)	.399	.313	.266	.333	.410	.340
SD	r_s	-.100	.061	-.195	-.121	-.091	.211
	p (1-tailed)	.330	.394	.192	.296	.343	.173
CM	r_s	-.198	-.172	-.064	.134	-.123	-.088
	p (1-tailed)	.188	.222	.389	.275	.293	.348
QA	r_s	-.176	.112	-.274	-.102	-.019	.138
	p (1-tailed)	.216	.309	.108	.326	.467	.270
PR	r_s	-.245	-.102	-.282	.035	.059	.282
	p (1-tailed)	.136	.326	.102	.439	.397	.102
PM	r_s	.042	.182	-.140	-.097	.113	.315
	p (1-tailed)	.426	.208	.268	.334	.309	.077
RM	r_s	.452(*)	.001	-.233	.298	.001	-.056
	p (1-tailed)	.017	.498	.149	.089	.498	.403
PE	r_s	.183	.041	-.177	.145	-.072	.137
	p (1-tailed)	.207	.428	.216	.259	.375	.272
Attribute achievement at assessment							
RE	r_s	-.067	.109	-.218	.022	.098	.272
	p (1-tailed)	.383	.315	.165	.460	.331	.110
SD	r_s	-.069	.097	-.260	-.068	.016	.405(*)
	p (1-tailed)	.381	.333	.121	.382	.472	.031
CM	r_s	-.201	-.193	-.202	.015	-.107	-.064
	p (1-tailed)	.185	.194	.183	.474	.318	.388
QA	r_s	-.047	.109	-.417(*)	-.227	.128	-.007
	p (1-tailed)	.418	.315	.027	.155	.286	.487
PR	r_s	-.220	-.282	-.380(*)	.082	.004	.189
	p (1-tailed)	.163	.102	.041	.358	.492	.200
PM	r_s	.168	.225	-.210	-.082	.231	.312
	p (1-tailed)	.227	.157	.174	.358	.150	.079
RM	r_s	.316	-.075	-.251	.398(*)	.032	.122
	p (1-tailed)	.076	.370	.130	.033	.443	.294
PE	r_s	.107	-.132	-.172	.258	.005	.102
	p (1-tailed)	.318	.280	.222	.123	.492	.326

Note: 22 responses for each process for each perception

Table I.18 Process capability levels and attribute achievement at time of follow-up meeting

Firm	Process capability levels								Process attribute achievement							
Id#	RE	SD	CM	QA	PR	PM	RM	PE	RE	SD	CM	QA	PR	PM	RM	PE
1	2	1	1	0	1	0	1	0	7	4	4	2	3	3	6	1
2	1	1	0	0	1	1	1	0	6	7	1	1	3	4	3	
3	2	1	1	1	1	1	0	0	9	8	8	4	10	4	4	6
4	2	2	3	2	3	2	1	1	11	13	14	13	14	12	9	7
5	1	1	1	1	1	1	0	0	5	6	2	2	2	2	0	0
7	2	2	2	1	1	3	2	2	10	10	12	10	10	14	11	10
8	3	3	2	2	3	3	3	2	13	13	11	12	13	13	13	12
9	2	3	3	2	3	3	2	2	9	13	15	9	13	13	9	9
11	2	1	1	0	0	1	1	0	12	6	3	0	1	6	4	2
12	0	1	1	0	0	0	0	0	2	5	2	0	0	1	1	1
13	1	0	1	0	1	1	0	1	4	5	5	3	2	5	0	2
14	1	2	1	0	2	2	1	0	7	10	6	1	8	10	4	1
15	1	1	1	0	1	1	1	0	5	5	4	1	6	4	2	1
16	2	1	0	0	1	1	1	1	9	8	2	1	8	6	5	5
17	1	1	1	0	0	0	0	0	5	6	2	0	1	1	0	0
18	3	3	2	2	1	2	1	2	14	13	10	11	6	13	4	9
19	1	1	2	0	1	1	1	0	6	8	10	2	7	6	6	5
21	1	1	2	0	1	1	0	0	7	7	8	0	7	2	2	1
22	3	2	2	3	1	2	1	1	13	11	9	14	6	11	7	9
23	1	1	0	1	1	1	0	0	6	7	1	4	2	6	1	1
24	2	2	2	1	1	1	0	0	11	8	10	8	7	2	0	0
25	2	1	1	1	0	1	0	2	8	10	3	0	2	3	1	9

Table I.19 Correlations best practice survey adoption and process capability at assessment
Spearman's rho bivariate correlations

Process	r_s	p (1-tailed)	N
Requirements elicitation	.095	.364	16
Software development	-.052	.423	16
Configuration management	.073	.395	16
Quality assurance	.286	.141	16
Problem resolution	.050	.427	16
Project management	.107	.347	16

Table I.20 Software development process: mean adoption level from survey and process attribute achievement ratings

Firm #	Mean adoption level for BPS SD practices	Process attribute ratings				
		PA1.1	PA2.1	PA2.2	PA3.1	PA3.2
1	55.56	2	1	1	0	0
2	50.00	3	2	1	0	1
3	45.45	3	2	1	1	1
4	40.00	3	3	2	2	3
5	63.64	2	1	2	1	0
7	50.00	3	2	2	1	2
8	80.00	3	2	2	1	2
9	36.36	3	3	2	1	2
11	18.18	2	1	2	0	1
12		2	1	2	0	0
13	45.45	1	1	1	1	1
14	45.45	3	3	2	1	1
15	80.00	2	1	1	0	1
16	60.00	3	2	1	1	1
17		2	1	1	1	1
18	80.00	3	3	3	2	1
19		2	2	2	0	2
21	40.00	2	1	2	1	1
22		3	3	2	1	2
23		3	2	0	1	1
24	40.00	3	2	2	0	1
25		2	3	2	1	2

Table I.21 Software development process: correlations survey adoption with PIP attribute achievement
Spearman's rho bivariate correlations

Process attribute	r_s	p (1-tailed)	N
PA 1.1	.016	.477	16
PA 2.1	-.095	.363	16
PA 2.2	-.156	.282	16
PA 3.1	.083	.379	16
PA 3.2	-.253	.172	16

Table I.22 Configuration management process: mean adoption level from survey and process attribute achievement ratings

Firm #	Mean adoption level for CM practices (from survey)	Process attribute ratings				
		PA1.1	PA2.1	PA2.2	PA3.1	PA3.2
1	87.5	2.00	1.00	1.00	.00	.00
2	37.5	1.00	.00	.00	.00	.00
3	75.0	2.00	2.00	2.00	1.00	1.00
4	37.5	3.00	3.00	3.00	2.00	3.00
5	62.5	2.00	.00	.00	.00	.00
7	75.0	3.00	2.00	3.00	2.00	2.00
8	87.5	2.00	2.00	3.00	1.00	2.00
9	87.5	3.00	3.00	3.00	2.00	3.00
11	37.5	2.00	1.00	.00	.00	.00
12		2.00	.00	.00	.00	.00
13	87.5	2.00	1.00	.00	1.00	1.00
14	50.0	2.00	1.00	1.00	1.00	1.00
15	75.0	2.00	1.00	1.00	.00	.00
16	50.0	1.00	1.00	.00	.00	.00
17		2.00	.00	.00	.00	.00
18	100.0	2.00	2.00	1.00	1.00	2.00
19		3.00	2.00	2.00	1.00	2.00
21	12.5	3.00	1.00	.00	.00	1.00
22		3.00	2.00	2.00	1.00	1.00
23		1.00	.00	.00	.00	.00
24	37.5	3.00	2.00	2.00	1.00	2.00
25		2.00	.00	.00	1.00	.00

Table I.23 Configuration management process: correlations survey adoption with PIP attribute achievement

Spearman's rho bivariate correlations

Process attribute	r_s	p (1-tailed)	N
PA 1.1	-.130	.316	16
PA 2.1	.279	.147	16
PA 2.2	.324	.111	16
PA 3.1	.305	.125	16
PA 3.2	.206	.221	16

Table I.24 Project management process: mean adoption level from survey and process attribute achievement ratings

Firm #	Mean adoption level for BPS PM practices	Process attribute ratings				
		PA1.1	PA2.1	PA2.2	PA3.1	PA3.2
1	58.33	1	1	1	0	0
2	27.27	2	1	1	0	0
3	63.64	2	1	1	0	0
4	27.27	3	3	2	2	2
5	66.67	1	0	0	0	0
7	63.64	3	3	3	2	3
8	75.00	3	3	3	1	2
9	54.55	3	2	3	2	2
11	40.00	2	1	1	1	1
12	.	1	0	0	0	0
13	80.00	2	1	1	1	0
14	66.67	3	3	2	1	1
15	72.73	2	1	1	0	0
16	72.73	2	2	2	0	0
17	.	1	0	0	0	0
18	83.33	3	3	2	3	2
19	.	2	1	1	0	2
21	33.33	2	0	0	0	0
22	.	3	2	3	1	2
23	.	3	1	0	1	0
24	36.36	2	0	0	0	0
25	.	2	0	1	0	0

Table I.25 Project management process: correlations survey adoption with PIP attribute achievement

Spearman's rho bivariate correlations

Process attribute	r_s	p (1-tailed)	N
PA 1.1	.117	.333	16
PA 2.1	.315	.117	16
PA 2.2	.289	.139	16
PA 3.1	.188	.243	16
PA 3.2	.071	.398	16

Table I.26 Quality assurance process: mean adoption level from survey and process attribute achievement ratings

Firm #	Mean adoption level for BPS QA practices	Process attribute ratings				
		PA1.1	PA2.1	PA2.2	PA3.1	PA3.2
1	20.00	1.00	1.00	.00	.00	.00
2	.00	1.00	.00	.00	.00	.00
3	80.00	2.00	1.00	1.00	.00	.00
4	.00	3.00	3.00	2.00	2.00	3.00
5	.00	.00	.00	.00	.00	.00
7	25.00	2.00	2.00	2.00	2.00	2.00
8	25.00	2.00	3.00	3.00	1.00	2.00
9	25.00	1.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00
12	.	.00	.00	.00	.00	.00
13	25.00	1.00	.00	.00	1.00	1.00
14	.00	1.00	.00	.00	.00	.00
15	25.00	1.00	.00	.00	.00	.00
16	50.00	1.00	.00	.00	.00	.00
17	.	.00	.00	.00	.00	.00
18	100.00	3.00	2.00	2.00	2.00	2.00
19	.	1.00	1.00	.00	.00	.00
21	.00	.00	.00	.00	.00	.00
22	.	3.00	3.00	3.00	3.00	2.00
23	.	2.00	1.00	.00	1.00	.00
24	.00	3.00	2.00	1.00	1.00	1.00
25	.	.00	.00	.00	.00	.00

Table I.27 Quality assurance process: correlations survey adoption with PIP attribute achievement

Spearman's rho bivariate correlations

Process attribute	r_s	p (1-tailed)	N
PA 1.1	.372	.078	16
PA 2.1	.194	.236	16
PA 2.2	.306	.124	16
PA 3.1	.201	.228	16
PA 3.2	.169	.265	16

Appendix J. Quantitative and qualitative analysis supporting discussion

Table J.1 Survey discriminant analysis - case processing summary

Unweighted Cases		N	Percent
Valid		40	19.7
Excluded	Missing or out-of-range group codes	86	42.4
	At least one missing discriminating variable	33	16.3
	Both missing or out-of-range group codes and at least one missing discriminating variable	44	21.7
	Total	163	80.3
Total		203	100.0

Variables Failing Tolerance Test(a)			
Question	Within-groups variance	Tolerance	Minimum tolerance
Q4.2	.000	.000	.000

All variables passing the tolerance criteria are entered simultaneously.
a Minimum tolerance level is .001.

Note: values must be numeric, so responses were coded: 1=yes, 0=no, and null=missing values, all *not applicable* responses were coded as missing values.

Table J.2 Discriminant analysis summary of Yes responses and correlations for 20 highest and 20 lowest adopters.
Fishers exact test.

Question	Number of low adopters answered *yes*	Number of high adopters answered *yes*	χ^2	Exact *p*. (2-sided)	Corrected *p* value (2)
1.1	10	20	13.474	.000	.000
1.2	5	17	19.406	.000	.000
1.3	2	19	31.675	.000	.000
1.4	2	17	28.784	.000	.000
1.5	11	18	7.328	.020	.088(*)
1.6	5	15	12.629	.001	.044
2.2	1	19	42.153	.000	.000
2.4	8	16	11.536	.002	.088(*)
2.5a	8	19	19.078	.000	.000
2.5b	0	15	27.483	.000	.000
2.6a	1	18	41.614	.000	.000
2.6b	2	16	23.212	.000	.000
2.7	0	10	17.858	.000	.000
2.8	1	14	21.970	.000	.000
2.9	1	9	11.655	.001	.044
2.10	7	18	16.782	.000	.000
2.11	2	14	17.754	.000	.000
2.12	1	12	20.798	.000	.000
2.13	1	17	31.675	.000	.000
3.1	1	18	41.614	.000	.000
3.2	1	19	42.153	.000	.000

Question	Number of low adopters answered *yes*	Number of high adopters answered *yes*	χ^2	Exact *p*. (2-sided)	Corrected *p* value (2)
3.3	1	18	41.614	.000	.000
3.4	1	10	13.676	.000	.000
3.5	0	10	17.858	.000	.000
4.1	0	11	20.304	.000	.000
4.2	0	18	42.061	.000	.000
4.3	0	17	37.275	.000	.000
4.4	0	8	13.474	.000	.000
4.5	0	17	37.275	.000	.000
4.6	4	16	20.473	.000	.000
4.7	5	17	17.978	.000	.000
4.8	0	18	47.505	.000	.000
4.9	0	11	18.839	.000	.000
5.1	15	20	5.714(1)	.047	2.068(*)
5.2	7	16	8.286(1)	.010	.440(*)
5.3a	2	17	23.467	.000	.000
5.3b	0	10	24.631	.000	.000
5.4	4	18	24.698	.000	.000
5.5	0	13	21.109	.000	.000
5.6	3	20	29.565(1)	.000	.000
5.7	0	18	32.727(1)	.000	.000
5.8	0	20	40.000(1)	.000	.000
5.9	0	15	24.000(1)	.000	.000
5.10	0	8	13.474	.000	.000

Notes: all chi square values are for Fisher's exact test except for those denoted by (1) which are Pearson Chi Square. In most cases, the expected cell frequencies were less than five enabling the use of Fishers' exact test; in six cases, Pearson's chi-square value was reported.

(2) The p value is multiplied by 44 to account for inter-relatedness of questions (Bonferroni correction).

Table J.3 Comparison of means: non-COTS and COTS adoption by practice questions

Question	COTS	N	Mean Adoption	Std. Error	F	*p*
Q1.1	Non-COTS	114	.82	.036	1.226	.270
	COTS	87	.87	.036		
Q1.2	Non-COTS	86	.76	.047	.410	.523
	COTS	65	.80	.050		
Q1.3	Non-COTS	114	.48	.047	.667	.415
	COTS	85	.54	.054		
Q1.4	Non-COTS	99	.63	.049	.002	.967
	COTS	54	.63	.066		
Q1.5	Non-COTS	113	.77	.040	.215	.644
	COTS	84	.80	.044		
Q1.6	Non-COTS	104	.64	.047	1.412	.236
	COTS	67	.73	.055		
Q2.2	Non-COTS	112	.42	.047	.299	.585
	COTS	85	.46	.054		
Q2.4	Non-COTS	112	.72	.042	9.034	.003(**)
	COTS	85	.89	.034		
Q2.5A	Non-COTS	116	.78	.039	1.166	.282
	COTS	86	.84	.040		
Q2.5B	Non-COTS	84	.23	.046	.007	.934
	COTS	69	.23	.051		
Q2.6A	Non-COTS	115	.58	.046	2.236	.136
	COTS	83	.69	.051		
Q2.6B	Non-COTS	108	.60	.047	.119	.730
	COTS	83	.63	.053		
Q2.7	Non-COTS	113	.25	.041	.457	.500
	COTS	86	.29	.049		
Q2.8	Non-COTS	79	.32	.053	1.154	.285
	COTS	54	.41	.067		
Q2.9	Non-COTS	113	.09	.027	.852	.357
	COTS	85	.13	.037		
Q2.10	Non-COTS	116	.67	.044	12.516	.001(**)
	COTS	85	.88	.035		
Q2.11	Non-COTS	113	.55	.047	13.349	.000(***)
	COTS	86	.79	.044		
Q2.21	Non-COTS	114	.12	.031	6.208	.014(*)
	COTS	85	.26	.048		
Q2.13	Non-COTS	114	.54	.047	.030	.862
	COTS	84	.55	.055		
Q3.1	Non-COTS	115	.37	.045	9.109	.003(**)
	COTS	85	.58	.054		
Q3.2	Non-COTS	116	.52	.047	3.652	.057
	COTS	86	.65	.052		
Q3.3	Non-COTS	114	.54	.047	3.094	.080
	COTS	85	.66	.052		
Q3.4	Non-COTS	114	.14	.033	6.014	.015(*)
	COTS	86	.28	.049		
Q3.5	Non-COTS	114	.12	.031	9.115	.003(**)
	COTS	86	.29	.049		
Q4.1	Non-COTS	115	.11	.030	.102	.749

Question	COTS	N	Mean Adoption	Std. Error	F	*p*
	COTS	86	.13	.036		
Q4.2	Non-COTS	116	.41	.046	.660	.418
	COTS	86	.35	.052		
Q4.3	Non-COTS	116	.28	.042	2.960	.087
	COTS	85	.40	.053		
Q4.4	Non-COTS	115	.10	.029	.674	.413
	COTS	84	.14	.038		
Q4.5	Non-COTS	115	.30	.043	.800	.372
	COTS	85	.36	.053		
Q4.6	Non-COTS	115	.60	.046	.249	.619
	COTS	85	.56	.054		
Q4.7	Non-COTS	115	.40	.046	1.176	.280
	COTS	86	.48	.054		
Q4.8	Non-COTS	114	.39	.046	.201	.654
	COTS	82	.43	.055		
Q4.9	Non-COTS	66	.59	.061	.195	.660
	COTS	41	.63	.076		
Q5.1	Non-COTS	116	.84	.035	2.902	.090
	COTS	85	.92	.030		
Q5.2	Non-COTS	116	.51	.047	2.505	.115
	COTS	82	.62	.054		
Q5.3A	Non-COTS	115	.23	.040	.001	.971
	COTS	86	.23	.046		
Q5.3B	Non-COTS	24	.2917	.09478	.273	.604
	COTS	19	.3684	.11370		
Q5.4	Non-COTS	115	.65	.045	1.474	.226
	COTS	86	.73	.048		
Q5.5	Non-COTS	58	.53	.066	.210	.648
	COTS	36	.58	.083		
Q5.6	Non-COTS	116	.69	.043	4.217	.041(*)
	COTS	87	.82	.042		
Q5.7	Non-COTS	116	.34	.044	.127	.722
	COTS	86	.36	.052		
Q5.8	Non-COTS	116	.34	.044	1.881	.172
	COTS	84	.44	.054		
Q5.9	Non-COTS	115	.16	.034	5.616	.019(*)
	COTS	81	.30	.051		
Q5.10	Non-COTS	115	.16	.034	4.728	.031(*)
	COTS	85	.28	.049		
Note: * $p<.05$; ** $p<.01$; *** $p<.001$						

Table J.4 Analysis of Hofstede's scores by country and adoption of best practice

Hofstede scores (a)						Best Practice adoption (b)		
Country	Power distance	Individualism	Uncertainty avoidance	Masculinity	Long term orientation	Responses from	Number of responses	Average adoption
Australia	36	90	51	61	31	Overall Qld (c)	205	48%
Austria	11	55	70	79		Austria	16	53%
Belgium	65	75	94	54		Belgium	15	43%
Denmark	18	74	23	16		Denmark	17	55%
Finland	33	63	59	26		Finland	4	55%
France	68	71	86	43		France	18	65%
Germany FR	35	67	65	66	31	Germany	62	49%
Great Britain	35	89	35	66	25	United Kingdom	52	60%
Greece	60	35	112	57		Greece	18	57%
Ireland	28	70	35	68		Ireland	12	45%
Israel	13	54	81	47		Israel	11	46%
Italy	50	76	75	70		Italy	77	52%
Netherlands	38	80	53	14	44	Netherlands	30	49%
Norway	31	69	50	8		Norway	6	53%
Spain	57	51	86	42		Spain	34	44%
Sweden	31	71	29	5	33	Sweden	13	32%

Source: a. List of Hofstede scores for all countries: http://spectrum.troyst.edu/~vorism/hofstede.htm
b. Overall responses and average adoption level by country (source: ESI 1999); c. From this study

Table J.5 Correlations best practice adoption against Hofstede's scores

		Power distance	Individualism	Uncertainty avoidance	Masculinity
Adoption	Pearson Correlation	.172	-.001	.187	.211
	p (2-tailed)	.524	.997	.488	.433
	N	16	16	16	16

Long term orientation was not included scores for many of the countries were not available.

Table J.6 Comparison of best practice survey coverage to ISO/IEC 15504 processes

ISO/IEC 15504 Process group	ISO/IEC 15504 Base practices	Number of survey questions
Customer	CUS.1 Acquisition	2
	CUS.2 Supply	0
	CUS.3 Requirements elicitation	1
	CUS.4 Operation	0
Engineering	ENG.1 Development	9
	ENG.2 System and software maintenance	0
Support	SUP.1 Documentation	0
	SUP.2 Configuration management	8
	SUP.3 Quality assurance	5
	SUP.4 Verification	2
	SUP.5 Validation	0
	SUP.6 Joint review	0
	SUP.7 Audit	0
	SUP.8 Problem resolution	1
Management	MAN.1 Management	0
	MAN.2 Project management	12
	MAN.3 Quality management	1
	MAN.4 Risk management	0
Organisation	ORG.1 Organisational alignment	0
	ORG.2 Improvement	0
	ORG.3 Human resource management	1
	ORG.4 Infrastructure	1
	ORG.5 Measurement	0
	ORG.6 Reuse	0
TOTAL	24 Base Processes	43 questions

Note: Survey Q1.4 does not relate to any ISO/IEC 15504 process

Table J.7 Comparison of capability for small and large firms

Process	Size	N	Capability level		Attribute achievement	
			Mean Rank	Sum of Ranks	Mean Rank	Sum of Ranks
RE	1.00	19	11.00	209.00	10.89	207.00
	2.00	3	14.67	44.00	15.33	46.00
SD	1.00	19	10.95	208.00	10.95	208.00
	2.00	3	15.00	45.00	15.00	45.00
CM	1.00	19	11.71	222.50	11.45	217.50
	2.00	3	10.17	30.50	11.83	35.50
QA	1.00	19	10.42	198.00	10.32	196.00
	2.00	3	18.33	55.00	19.00	57.00
PR	1.00	19	11.34	215.50	11.37	216.00
	2.00	3	12.50	37.50	12.33	37.00
PM	1.00	19	10.84	206.00	10.82	205.50
	2.00	3	15.67	47.00	15.83	47.50
RM	1.00	19	11.00	209.00	10.82	205.50
	2.00	3	14.67	44.00	15.83	47.50
PE	1.00	19	11.00	209.00	10.71	203.50
	2.00	3	14.67	44.00	16.50	49.50
22 firms						

Note: Size=1 indicates <=50 staff FTE; size=2 indicates >50 staff FTE.

Table J.8 Qualitative analysis of factors relating to assessment

Factor/Issue	N	1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	18	19	21	22	23	24	25
Managing Director attended assessment	14	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	N	Y
Needed Tools for CM or to enhance /extend existing tools	7	Y	Y	Y		OK			Ok			Y	Y		Y	Y							
Need system/tool to record/track problems	8	Y			Y		Y	Y			Y				Y			Y				Y	
Testing needed to be formalized	10		Y					Y		Y	Y	Y			Y	Y		Y				Y	Y
Shortage of available staff	3			Y				Y				Y											
Rely on competent staff and informal standards (rather than documented processes)	13	Y	Y	Y	Y		Y		Y		Y	Y	Y			Y			Y		Y		Y
ISO9000 in progress (complete*)	5/4	Y	Y	Y			Y	*									Y		Y	*		Y	
Intranet development underway to enhance communication	5	Y			Y		Y												Y		Y		
Current situation OK, but need formalization as growth expected	8	Y	Y		Y	Y			Y				Y		Y		Y						
COTS developer	8	Y	Y	N	Y	Y	N		Y	N		Y	N	Y		Y							
None or insufficient measures related to problems (bugs)	8	Y	Y	Y		Ok	Y					Ok	Ok			Y	Y	Y		Y			
None or insufficient measures related to development effort	14	Y	Y	Y	Y	Y	Y		Y			Ok		Y	Ok	Y	Y	Y		Y		Y	Y
Factor/Issue		1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	18	19	21	22	23	24	25

Table J.9 Advice provided by assessors at assessment

Advice	Firms	N
Standards and Guidelines		
PMBOK	#4; #8; #9; #19; #21	5
SWEBOK	#9	1
ARM-95 (NASA) verification of requirements	#2; #4; #8	3
NASA audit guidebook	#1; #8; #19	3
NASA software quality model	#9	1
Mil-Std 498 risk severity and priority classifications IEEE standards (for software requirement spec standards)	#19; #25	2
ISO 15504 part 5 templates	#7; #19	2
IEEE 1058.1 project plan	#7; #19,	2
IEEE 1016 Recommended Practice for Software Design Descriptions	#1	1
ISO 9126 Software Product Quality Evaluation	#15	1
ISO/IEC 12207 life cycle model	#15; #19;	2
ISO9000	#1; #22, #24	3
Tools/software		
MS Outlook	#17; #24	2
Visual SourceSafe (CM management)	#1; #8; #9; #12; #19; #21; #24	7
MS Project	#1; #2; #7; #9; #16; #19; #21; #24	8
Test track / team track	#1; #9/#24	3
PASS-C code analyser	#1; #4	2
Evolutionary Rapid development model/; Evolutionary life cycle approach/'see SPC document'	#1/#2/#19	3
PR Tracker	#21	1
TRIM97 – risk management tool	#24	1
RCS source control tool; /RCS & SCCS	#16/#11; #22;	3
Bug Track from Seapine, PR Track and Visual Intercept;/ Bug Track	#19/#8	2
List of available tools for CM and change control: http://www.iac.honeywell.com/Pub/Tech/CM/CMTools.html	#11; #13	2
Techniques/approaches/methodologies		
Project breathalyser – URL?	#4; #8; #9	3
Earned value	#8; #15; #16; #21; #25	5
Balanced Score Card	#8	1
Personal Software Process PSP	#8	1
Incremental model development process	#15	1
Product Line Development approach http://Interactive.sei.cmu.edu/Features/Features.htm	#24	1
X-model for development;/ 'X-model superseded by Diamond model'	#9/#19	2
PSM Practical Software Measurement	#7; #8; #9	3
Principal Best Practices http://www.spmn/com/best_practices.html	#15	1
SEPO website for measurement plan example; /for process library	#8/#19	2
QA Partner	#15	1

Table J.10 Summary of themes from final reports

Factor/Issue	N	1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	18	19	21	22	23	24	25
Processes too new to be used yet	4		-	Y				Y							Y						Y	-	
Mentoring would have helped	3						Y	Y						Y									
Business problems got in the way:	7																						
Restructuring										Y													
Relocated						Y	Y																
Changed business focus		Y					Y																
Family illness					Y																		
Break in at premises									Y									Y					
Staff turnover problems	3	Y								Y						Y							
Y2K	3										Y	Y				Y							
GST	3										Y	Y				Y							
Improved testing	7			Y				Y				Y			Y	Y		Y					Y
RAPID valuable	9			Y					Y			Y	Y	Y	Y	Y	Y						Y
More measures	7					Y	Y					Y			Y	Y		Y	Y				
No action taken	1																			Y			
Difficult to implement SPI	1																				Y		

Table J.11 Extent of improvement, staff size and PIP program outcomes

Id#	Group	Staff	RE	SD	CM	QA	PR	PM	RM	PE	Outcome of PIP program
9	1	5.5	1↑	2↑	3	0↑	3	2↑	0↑	0↑	Improved 6 processes a total of 9 levels
8	1	55	2↑	2↑	1↑	1↑	1↑	2↑	3	1↑	Improved 7 processes a total of 8 levels
18	1	10.5	3	2↑	1↑	2	1	2	0↑	1↑	Improved 4 processes a total of 4 levels
5	1	6	1	1	1	0↑	1	0↑	0	0	Improved 2 processes a total of 2 levels
13	1	12.5	1	0	1	0	0↑	1	0	0↑	Improved 2 processes a total of 2 levels. GST and Y2K impact
21	1	15	1	1	1↑	0	1	1	0	0	Improved 1 process 1 level
23	2	60.5	1	1	0	1	1	1	0	0	Improved attribute. Inhibited by multiple sites
14	3	17.5	1	2	1	0	2	2	1	0	Improved QA, PE processes, and documentation
16	3	5.5	2	1	0	0	1	1	1	1	Increase in staff, # of projects.
7	4	6.5	2	2	2	1	1	3	2	2	Relocated. Improved CM
25	4	3.5	2	1	1	1	0	1	0	2	Some changes implemented
3	4	16	2	1	1	1	1	1	0	0	Adopted new methodology. Too new to assess
19	4	3.5	1	1	2	0	1	1	1	0	Disrupted by break-in at premises. Reduced operation.
1	4	8	2	1	1	0	1	0	1	0	Business focus change, sold product distribution rights
17	4	10	1	1	1	0	0	0	0	0	Lost key staff. GST big impact
4	5	2	2	2	3	2	3	2	1	1	Major non-business issue affected owner
22	5	65	3	2	2	3	1	2	1	1	1 day assessment too brief to be valuable
11	5	7	2	1	1	0	0	1	1	0	Management restructure. Changed business focus
15	5	7.5	1	1	1	0	1	1	1	0	Need mentoring, difficult to unfreeze current practices
12	5	6	0	1	1	0	0	0	0	0	Too busy due to Y2K and GST
24	6	17	2	2	2	1	1	1	0	0	SEA membership lapsed, no follow-up meeting held
2	6	4	1	1	0	0	1	1	1	0	Firm ceased to operate
Note: ↑ indicates the process capability improved											

Table J.12 Comparison of elapsed time (assessment to follow-up meeting) with type of reassessment

Reassessment Type	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
0 Informal	11	13.0909	2.11918	.63896	11.6672	14.5146	9.00	16.00
1 Formal	9	10.7778	2.10819	.70273	9.1573	12.3983	7.00	14.00
Total	20	12.0500	2.37254	.53052	10.9396	13.1604	7.00	16.00

Table J.13 ANOVA analysis: comparison of elapsed time against type of reassessment

	Sum of Squares	df	Mean Square	F	*p*
Between Groups	26.485	1	26.485	5.925	.026
Within Groups	80.465	18	4.470		
Total	106.950	19			

Table J.14 Correlations of capability level and attribute achievement at initial assessment with extent of improvement for each process

Spearman's rho	RE	SD	CM	QA	PR	PM	RM	PE
Capability Level								
r_s	.124	.750(**)	.164	-.101	-.502	.100	-.368	.204
p (1-tailed)	.376	.010	.337	.398	.084	.399	.165	.299
N	9	9	9	9	9	9	9	9
Attribute Achievement								
r_s	.435	.714(*)	.583(*)	-.183	-.104	-.044	-.081	.570
p (1-tailed)	.121	.015	.050	.319	.395	.456	.418	.054
N	9	9	9	9	9	9	9	9

* Correlation is significant at the 0.05 level (1-tailed).

** significant at .01

Table J.15 Number of firms with and without Managing Director for each outcome group

Outcome Group	Number of firms with Managing Director present	Number of firms without Managing Director present
1 Capability level	3	2
2 Attribute achievement	1	0
3 Processes improved	2	0
4 Limited improvement	4	2
5 No improvement	3	2
6 Withdrawn from PIP	1	1

Table J.16 List of assessments, assessors and outcome group

Firm #	Assessment date	Lead Assessor	Support Assessor	Follow-up date	Follow-up Assessor	Outcome group
1	Aug 1999	A1	A3	Nov 2000	A3	4
2	Aug 1999	A1	A2	Ceased operation	A5	6
3	Aug 1999	A3	A1	Dec 2000	A5	4
4	Aug 1999	A3	A2	Dec 2000	A3	5
5	Sep 1999	A1	A5	Apr 2000	A1	1
7	Sep 1999	A3	A9	Sep 2000	A3	4
8	Sep 1999	A3	A6	July 2000	A3	1
9	Sep 1999	A3	A7	July 2000	A3	1
11	Oct 1999	A1	A8	Nov 2000	A5	5
12	Oct 1999	A1	A9	Dec 2000	A5	5
13	Nov 1999	A1	A8	Oct 2000	A5	1
14	Sep 1999	A2	A6	Nov 2000	A5	3
15	Nov 1999	A6	A3	Dec 2000	A5	5
16	Nov 1999	A2	A5	Dec 2000	A5	3
17	Nov 1999	A1	A4	Aug 2000	A4	4
18	Oct 1999	A1	A4	July 2000	A4	1
19	Nov 1999	A3	A8	Oct 2000	A3	4
21	Nov 1999	A3	A5	Nov 2000	A3	1
22	Nov 1999	A1	A5	Dec 2000	A5	5
23	Dec 1999	A1	A2	Nov 2000	A1	2
24	Nov 1999	A6	A4	SEA membership lapsed		6
25	Nov 1999	A2	A8	Nov 2000	A5	4

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