



Software quality assurance in Australia

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ABSTRACT

This paper will trace the history of the software quality assurance (SQA) movement in Australia from its inception in the early Eighties. In particular, the development of Australian standard AS3563 *Software Quality Management System* and the implementation of 'quality' purchasing policies by several State Governments and the Federal Government will be covered. AS3563 will then be described. Finally, the results of a recent management survey in Sydney will be presented to show that software quality standards and policies can raise awareness but do not ensure successful implementation of software quality programmes. The paper concludes that senior management commitment to SQA is the key to successfully implementing software quality programmes.

INTRODUCTION

Quality is a major issue for government and industry in Australia and around the world. Quality assurance techniques are widely accepted as a method of producing quality goods and services. Traditionally, quality assurance techniques have been based in manufacturing environments, but there is increasing acceptance of similar principles in service industries, in general, and the computer software industry, in particular.

The Australian software industry has been actively addressing the issue of quality in the development of computer software since the early Eighties. This is evidenced by the

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strength of an SQA special interest group throughout Australia and the publication of the first quality standard that specifically addresses the development of computer software. These efforts are being reinforced by the Commonwealth and State Governments through the adoption of purchasing policies that insist on suppliers implementing quality assurance programmes. The first part of this paper will trace significant aspects of this history.

The practical application of traditional quality assurance techniques to the development of software has been something of a problem. AS3563 *Software Quality Management System* is a world leader in overcoming this difficulty. It establishes the key elements required to implement and operate an effective quality management system in the development of computer software. The second part of this paper will describe this standard.

Finally, a recent management survey of fifty leading information technology companies in Sydney indicates that, while the development of software quality standards and policies can raise awareness, they do not in themselves ensure successful implementation of software quality programmes. The final part of this paper will present the results of this survey.

HISTORY OF SQA IN AUSTRALIA

Software Quality Association

The Software Quality Association started as a small group in Sydney in 1984, where the initial impetus came from Toni Gous, then with the Reserve Bank of Australia, and Jeff Bergman, of Bergman Voysey and Associates. By 1988, this group had expanded to include chapters in five mainland states and the Australian Capital Territory (ACT). In 1989, as a result of the recommendations in the report of the Committee of Review of Standards, Accreditation and Quality Control and Assurance [1] (known as the Foley Report) and a plea from then Federal Technology Minister John Button for rationalisation of professional industry groups, Toni Gous sought affiliation for the group within a larger professional body. The Software Quality Association is now a national organisation, affiliated within the Australian Computer Society (ACS), with branches in six states and over 200 financial members, both corporate and individual,

Australia-wide. The present national chairman is Terry Woodings, of University of Western Australia.

The Software Quality Association regularly responds to government information technology initiatives, particularly those through the Department of Employment, Education and Training (DEET) and the Department of Industry, Technology and Commerce (DITAC). Two 1991/92 projects have been the development of a national SQA curriculum and the drafting of government policies in response to a national IT strategy. The Association is also well represented on national standards committees and, in the person of John Phippen, has contributed the chairman of both the QR/3 and IT15 committees. In summary, the Software Quality Association is an active professional organisation which enables information systems professionals to meet and discuss software quality issues and topics.

Quality Standards

In 1978, the Standards Association of Australia published the first public domain quality standard, AS1821/2/3 *Suppliers Quality System*. Until the publication of this landmark standard, quality standards had been largely published in the military domain. AS1821/2/3 was revised in 1985, when, despite this revision, certain limitations were recognised. As a result three quality review committees were formed : QR/1 Quality Systems for the Project and Construction Industry, QR/2 Quality Systems for the Service Industry, and QR/3 Software Quality Assurance.

QR/3 first met in March 1986 and by September 1987 had produced a draft standard for comment (issued as DR87176). This was eventually released as AS3563 *Software Quality Management System* in August 1988. This first version closely followed AS1821/2/3; unfortunately, also in 1987, Standards Association of Australia had decided to adopt the International Standards Organisation's ISO9000 series (published in Australia as AS3900-04), which superseded AS1821/2/3. QR/3 commenced the task of bringing AS3563 in line with the AS3900 series. In parallel with this activity, QR/3 also began development of an implementation guide to support AS3563. The implementation guide was circulated as a draft for comment in October 1989 (issued as DR89185:R).

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These revisions were finally published in November 1991 as AS3563 *Software Quality Management System*, AS3563.1 *Requirements* and AS3563.2 *Implementation Guide*. Since publication, this standard has received wide acceptance by industry, academe and government in Australia. Working Group 8 of Sub-Committee 7 of the First Joint Technical Committee of the International Standards Organisation and the International Electrotechnical Commission is now considering AS3563 as an international standard; the next meeting will be held 26-30th October 1992 in Toulouse, France.

Government Purchasing Policy

One of the major recommendations of the Foley Report [1] is that the Commonwealth and State Governments of Australia should modify their purchasing procedures to require conformance to nationally recognised quality standards and that government purchasing offices should adopt a uniform policy of using and applying such standards. The Commonwealth and State Governments have responded positively to this recommendation as they recognise that government can provide an incentive to suppliers to adopt world-recognised quality practices and so boost the competitiveness of Australian industry. As Nick Bolkus, Commonwealth Minister for Administrative Services, writes [2, p v]:

"A quality system helps guarantee that every part of a business performs at maximum efficiency, which overall means that the organisation becomes more productive, more profitable and more competitive. In this way, the use of quality assurance requirements in government purchasing will help local companies replace imports and export their goods and services to other countries"

The Queensland State Government was the first to implement such a policy, from 1st July 1990. The South Australian (1st January 1991) and the West Australian (1st August 1991) Governments followed. However, the most significant announcement was in May 1992 [2], when the Commonwealth Government indicated its intention to adopt a quality assurance policy in the procurement of manufactured goods from 1st July

1993 and for the provision of services from 1st January 1994. The governments of the two most prominent states, New South Wales and Victoria, are yet to announce their intentions, although the adoption of similar policies is widely expected.

Generally, these policies apply to the purchasing of goods and services by all departments and agencies of the respective governments. The suppliers of selected goods and services must demonstrate that they meet the quality assurance requirements of the relevant policy. The Commonwealth policy defines six categories of quality assurance [2], which are summarised in Table 1. All except the sixth and lowest category refer to the AS3900 series standards; the first and highest category specifically refers to AS3563 for "the development and supply of computer software" [2, p 13].

AS3563 SOFTWARE QUALITY MANAGEMENT SYSTEM

AS3563 Software Quality Management System establishes the key elements required to implement and operate an effective quality management system in the development of computer software. It can be applied either to in-house development for the purpose of providing a control system within an organisation or as a contractual requirement for external procurement.

AS3563 defines the essential features of a quality management system, but does not attempt to prescribe how such a system shall be implemented. Developers should establish procedures appropriate to their own scale, methodologies and organisation in order to achieve the requirements of this standard. In this way, AS3563 can be adopted to support various and different software development life cycles, by large or small development groups. The non-prescriptive nature of AS3563 is best illustrated by an example [3, p 8]:

"4.21 CONTROL OF DEVELOPMENT ENVIRONMENT. The developer shall adopt or develop and maintain, procedures for the control of the software development environment. These procedures shall include methods for -

Category 1-3

Certification of conformance to a standard in the AS3900 series will apply when specified performance is critical and the consequences of non-compliance or failure are high. Other Government objectives may also require certification or registration.

Category 1 : during several stages which may include design, development, production, installation and servicing

Category 2 : during production and installation only.

Category 3 : during final inspection and test only.

Category 4

Production certification may be more appropriate than certification of process through the AS3900 series or as a useful addition to the AS3900 series. For example, product certification is important in the manufacture of electrical goods and where health and safety regulations apply.

Category 5

Registration or certification of conformance to a standard may be regarded as desirable but not absolute and its usefulness should be weighed against the buyer's knowledge of the market's ability to meet such a requirement.

The use of Category 5 is expected to be phased out as quality systems become more widely implemented in the supplier base.

Category 6

Routine or off-the-shelf purchases of low value products with low cost of non-compliance or failure may be obtained, at the buyer's discretion, from suppliers who do not have a registered quality system.

Table 1 : Categories of Quality Assurance
(Commonwealth Government of Australia)

- (a) secure maintenance of libraries containing software under configuration control and the implementation of all changes;
- (b) provision of authorized back-ups;
- (c) proper identification, storage and handling of software media; and
- (d) control of software support tools, techniques, and methodologies used. The extent and depth of testing for support software shall be defined".

In this section, AS3563 describes **what** must be done to control the software development environment but not **how** it must be done. Developers must themselves determine appropriate procedures for their own particular organisation. This is the style of approach adopted throughout AS3563.

The scope and coverage of AS3563 is demonstrated by the Clauses of Part 1 shown in Table 2. The 'essential features' described by this standard range from specific quality issues through the software development process to general management responsibilities. Specific quality issues covered include the quality system itself, quality documentation control and quality records, quality reviews and audits, and statistical techniques. The development process covered includes the development environment (the life cycle), system documentation, configuration management, inspection and test, and system maintenance. There are also clauses that cover non-general requirements such as contract control, purchasing, customer-supplied information and materials, and the handling and storage of software products. The general management responsibilities covered include roles within the organisation, training of personnel, control of non-conforming products and corrective action. Remember, in each clause, AS3563 describes **what** must be done but not **how** it must be done. Developers must themselves determine appropriate procedures for their own particular organisation.

AS3563 is primarily used in two ways. Firstly, by a quality assurance manager to review the software development activities of an organisation when a software quality management programme is first being implemented. Secondly, by external or

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internal auditors in reviewing the effectiveness of an established software quality management programme. In both cases, the clauses of AS3563 drive the review of current practices and procedures of organisation, in general, and the information systems department, in particular. Do appropriate practices and procedures exist? If not, they must be established. Do existing practices and procedures enable the organisation to easily and adequately meet the requirements of AS3563? If not, they must be improved. As a result of such a review, 'quality' practices and procedures become the normal way in which the organisation goes about its software development : the setting of standards and measurement of performance; the continuous improvement of processes; and a holistic approach to people involvement and development.

MANAGEMENT SURVEY

A 1991 pilot survey undertaken by the New South Wales (NSW) Department of State Development for the NSW Information Industry Advisory Council (IIAC) suggested that management skills could be a key factor in the competitiveness of the IT industry in NSW. Consequently, the IIAC initiated a more complete survey to investigate the demand for professional, postgraduate education courses suitable for the needs of the IT industry. This survey was conducted in January/February 1992 by the University of Technology, Sydney (UTS) with funding provided by the NSW National Industry Extension Service (NIES). The results have been published in two reports [4, 5].

The methodology for the survey, developed by UTS in consultation with the IIAC, was face-to-face interviews with the Chief Executive Officers (CEOs) of a representative sample of 'IT organisations'. IT organisations were classified either as being IT companies in their own right or as being IT departments of non-IT (user) companies. Fifty companies were contacted initially and forty-one companies were finally interviewed, a response rate of just over 80%. A profile of the respondent sample is shown in Table 3 (all percentages are of the whole sample). While many organisations are active to some degree in hardware, software and services, across the whole sample, just over 75% can be categorised as being in the software and/or services business. The IT departments tended to be large, with an average annual budget

1. SCOPE AND FIELD OF APPLICATION
 - 1.1 Scope
 - 1.2 Application
2. REFERENCED DOCUMENTS
3. DEFINITIONS
 - 3.1 Baseline
 - 3.2 Development
 - 3.3 Software product requirements document
 - 3.4 Test specification
4. QUALITY SYSTEMS REQUIREMENTS
 - 4.1 Management responsibility
 - 4.2 Quality system
 - 4.3 Contract review, planning and requirements control
 - 4.4 Design, programming and user documentation control
 - 4.5 Quality system document control
 - 4.6 Purchasing
 - 4.7 Customer-supplied information and material
 - 4.8 Configuration management (including product identification and traceability)
 - 4.9 Process control
 - 4.10 Inspection and testing
 - 4.11 Inspection, measuring and test equipment
 - 4.12 Inspection and test status
 - 4.13 Control of non-conforming product
 - 4.14 Corrective action
 - 4.15 Handling, storage, packaging and delivery
 - 4.16 Quality records
 - 4.17 Internal quality audits
 - 4.18 Training
 - 4.19 Software maintenance
 - 4.20 Statistical techniques
 - 4.21 Control of development environment

Table 2 : Clauses of AS3563.1
(Standards Association of Australia)



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of A\$59 million, ranging from A\$10 million to A\$150 million, and an average of 630 employees, ranging from 90 to 3100. The IT companies have an average turn-over of A\$175 million, ranging from A\$6.5 million to A\$1.9 billion, and an average of 560 employees, ranging from 10 to 3000.

IT Departments	13	32%
Public Sector	6	15%
Private Sector	7	17%
IT Companies	28	68%
Hardware	10	24%
Software	12	29%
Services	6	15%

Table 3 : Profile of Respondents

The survey explored fundamental issues of competitiveness, areas of perceived management skill shortage and the nature of demand for postgraduate courses tailored for the IT industry. The respondents attitude to 'quality' is of interest in the context of this paper. Over 68% of the respondents rated 'quality management' as either 'very important' or 'important' as a challenge to their survival and competitiveness over the next five years (raw data for the top five 'challenges to competitiveness' are shown in Table 4). The significance of this issue was reinforced when respondents ranked quality management third in absolute order (three first and four second rankings). The survey shows that senior IT management is aware of the importance of a software quality programme.

Whilst 88% of respondents claim to have used quality management, at least 30% felt that they had an extremely critical skill shortage in this area (raw data for the top five 'skill shortages' are shown in Table 5, where 'E' indicates an 'extremely critical' shortage and 'S' indicates a 'significant'

	IT Dept. (13)		IT Comp. (28)		Total (41)	
	VI	I	VI	I	VI	I
Marketing : business development	4	4	19	3	23	7
Quality management	9	2	14	4	23	6
Marketing: sales	4	2	17	3	21	5
Developing and managing alliances	2	3	17	6	19	9
Strategic planning	6	3	13	6	19	9

Table 4 : Challenges to Competitiveness

shortage) and 62% indicated an interest in external quality management training programmes. The survey indicates that, although quality management techniques are being used by a majority of the respondents, CEOs are far from satisfied with the performance and results of their software quality programmes. More significantly, respondents views on the overall quality of the local IT industry were sought. 72% of respondents indicated that they are supplied on a regular basis by Australian IT companies. When these respondents were asked to rate the quality of their supplier companies, 33% rated suppliers as 'good', 38% as 'satisfactory' and 29% as 'poor'. Again, the survey indicates that an overall improvement in the quality of software products is yet to be realised despite the reported high level of use of quality management techniques.



	IT Dept. (13)		IT Comp. (28)		Total (41)	
	E	S	E	S	E	S
Quality management	7	-	6	6	13	6
Project management	4	3	8	3	12	6
Developing and managing alliances	1	-	11	3	12	3
Strategic planning	1	5	9	5	10	10
Marketing : business development	1	1	9	5	10	6

Table 5 : Management Skill Shortages

In summary, the survey shows that there is a high level of awareness of the importance of quality to the IT industry, but also that there is a real sense of dissatisfaction with the performance and results of software quality management programmes to date. The aim of the survey was to identify the need for professional, postgraduate management education courses for the IT industry, not to investigate the effectiveness of software quality management programmes. By identifying perceived management skill shortages, the survey has highlighted concerns about the implementation of SQA programmes; these concerns need to be the focus of further research, directed specifically at software quality management.

CONCLUSION

Australia possesses a prominent SQA community. There exists an active, professional special interest group operating at a national level; government is taking a proactive role in promoting the implementation of quality standards in Australian industry; and AS3563 is a world leader in software quality standards. All these activities have had the desired effect of raising awareness of quality issues in the Australian IT industry. However, this awareness has not yet been translated into the successful implementation of SQA programmes; there are strong indications that the quality of software produced in Australia is still not at an acceptable level and that CEOs have concerns about their organisation's software quality management. Joseph Juran wrote that 'It is important that top management be quality-minded. In the absence of sincere manifestation of interest at the top, little will happen below' [6, p 54]. Although written in 1945, this is still true today! Australia's top IT managers appear have the necessary awareness but do they have the will and commitment to implement the necessary changes? The next two or three years will answer this question.

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