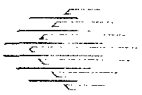

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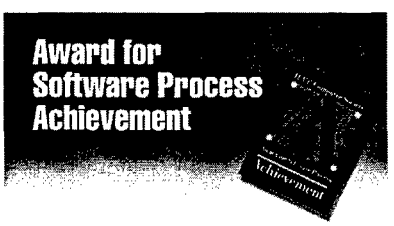
Software Engineering Institute

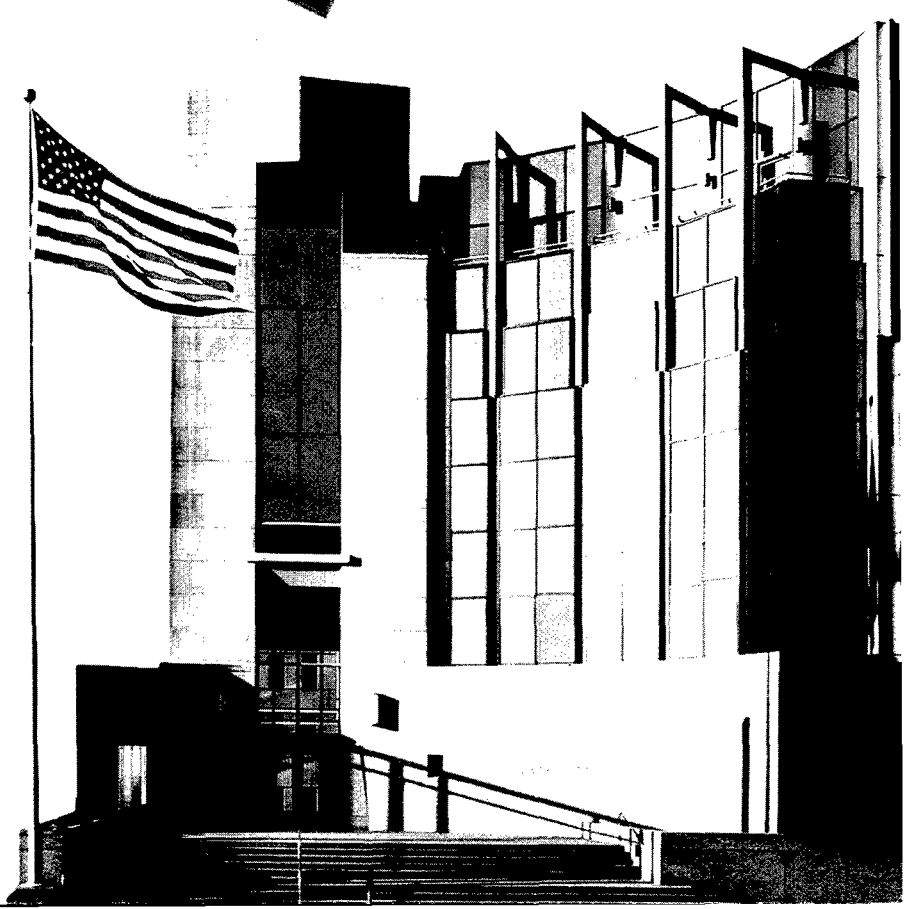
Software Process Improvement Journey: IBM Australia Application Management Services

Robyn Nichols
Colin Connaughton

March 2005

A Report from the Winner of the 2004 Software Process Achievement Award





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Carnegie Mellon
Software Engineering Institute
Pittsburgh, PA 15213-3890

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IBM Australia Application Management Services

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Foreword

Software Process Achievement (SPA) Awards are given to recognize outstanding achievements in improving an organization's ability to develop and maintain software-intensive systems. In addition to highlighting and rewarding excellence, the Award co-sponsors—the Institute of Electrical and Electronics Engineers (IEEE) Computer Society and the Software Engineering Institute (SEI)—intend to foster continuous advancement in the practice of both process improvement and software engineering through the dissemination of insights, experience, and proven practices throughout the relevant research and practitioner communities. In May 2004, the SPA Award Committee selected IBM Global Services Application Management Services (AMS) Australia for a 2004 SPA Award in recognition of rapid, continuous, improvement to their software capability in response to increasingly stringent marketplace demands.

With respect to the Award's criteria, the Committee's rationale for this decision was as follows:

Significant: The improvements must have a demonstrated impact on the organization's software capability.

Over the past eight years, AMS Australia has achieved high levels of software capability across a wide variety of software projects. Productivity, quality, and client satisfaction measures have significantly, and steadily, improved as a result of their well-planned and well-executed improvement program. Their improvements were guided by the Capability Maturity Model® for Software (SW-CMM®) framework [Paulk 93a, Paulk 93b]. In their most major projects, they were able to actually move directly from level 3 to level 5, an unusual and truly significant achievement. AMS Australia accomplished this improvement in the face of quite demanding year-to-year increases to the requirements for productivity and quality improvements levied by their clients.

Sustained: The improvements must have resulted in a broad, documented improvement program that will have a positive impact on the organization's future projects.

A particularly impressive part of AMS Australia's accomplishments is the degree to which they have established a strong commitment to continuous improvement at all levels of their organization. Top executives are fully committed to continued support for the improvement activities. And project personnel are universally and routinely informed of not only the importance of continuous software capability improvement but also effective

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practices to support and ensure continuous improvement. Operationally, AMS Australia has developed a wide variety of templates, examples, measurement data, training materials, and well-defined infrastructure technology. These process improvement assets not only "encode" their improvement program but are also readily available throughout the organization.

Measured: The improvements must be supported by data clearly demonstrating improved software capability to date as well as a plan to use data to guide future improvements.

Another particularly impressive part of AMS Australia's accomplishments is the extremely broad and well-defined set of metrics they have established to assess status and guide continuous improvement. The organization, unlike others that the Committee has reviewed, focused on measurement at the very beginning of their improvement activities. This, in fact, was the reason they were able to move directly from level 3 to level 5. Level 4 of the CMM counsels implementation of data collection and use of the data for statistical management control. AMS Australia had essentially implemented this improvement step at the very beginning of its improvement activities.

Impacting: The improvements must be shared throughout the organization, as well as with the community at large, to amplify their impact.

AMS Australia's initial improvement efforts focused on a large, major project that constituted almost all of their business. As their business has grown, new projects have been quickly "brought up to date" by using prior experiences to start them off at high levels of capability. Recently, AMS Australia has started to share their process improvement experiences and capability with other parts of IBM Global Services. That, along with this publication of their experiences and capability as a SPA awardee, will help other organizations in the community at large.

William E. Riddle,
Chairman, SPA Award Committee

Acknowledgments

This report recognizes the staff of AMS Australia and acknowledges their effort and commitment in making our vision for process improvement real. In particular the effort of those who led and motivated the organization in the improvement program made an essential contribution.

Thank you to those who have contributed material to this report, in particular Alan Norton, who was a key part of the AMS Australia process improvement program.

Abstract

IBM Global Services Application Management Services (AMS) Australia provides application development and support services, on an outsourcing basis, to a variety of clients. Typically, the organization delivers more than 3,000 work products in a year, with over 1,000 projects completed within overall schedule, budget, and productivity commitments. Client expectations of service standards increase year by year, requiring corresponding improvements in service delivery capability.

In July 1997, IBM Australia began providing application management services to a major client. Services were initially provided by over 2,500 staff members in 17 locations, servicing over 370 applications accessed by more than 55,000 users. Over the next six years, the service delivery teams were transformed into an organization whose practices have now been formally assessed at Capability Maturity Model® Integration (CMMI®) for Systems Engineering and Software Engineering, Version 1.1 (CMMI-SE/SW, V 1.1) maturity level 5.

Significant improvements to software practices led to improvements in cost, on-time delivery, on-budget delivery, and client satisfaction achievements. Over the same period, an application development productivity improvement of 76 percent delivered cost savings of A$412 million.

In May 2004, the Software Process Achievement Award Committee selected AMS Australia to receive a Software Process Achievement Award in recognition of those achievements. This report describes the history and experiences of the process improvement initiatives that transformed the AMS Australia organization.

1 Introduction

The benefit our organization has received by having a process improvement focus is unquestionable—in terms of productivity, quality, and customer satisfaction. Although the journey has been at times difficult, it has strengthened the team and instilled a sense of pride in performance. Our focus on process and quality is now institutionalized throughout the organization, providing a strong foundation for our further evolution. Our journey continues....

- David Norris, General Manager, AMS Australia

In July 1997, IBM Australia began providing application management services to a major client with 17 locations up to 1,500 kilometers apart and with over 370 applications being accessed by more than 55,000 users.

Originally, those services were delivered by over 2,500 staff members operating in disparate project groups and working in a Capability Maturity Model for Software (SW-CMM) level 1 environment. Over the next six years, this structure was transformed into IBM Global Services Applications Management Services (AMS) Australia, an organization whose work practices have now been formally assessed at Capability Maturity Model Integration (CMMI®) for Systems Engineering and Software Engineering, Version 1.1 (CMMI-SE/SW, V1.1) maturity level 5 [CMMI 02].

During that six-year period, the AMS Australia service delivery team's software practices underwent significant evolution, resulting in key improvements in

- cost reduction
- on-time delivery (98.5 percent of deliverables on time—an improvement of 9.6 percent)
- on-budget delivery (99.6 percent of projects on budget—an improvement of 41.3 percent)
- client satisfaction (currently 88.4 percent as reported in project completion surveys—an improvement of 33 percent in the last five years)
- problem resolution (The number of problems reported in production fell by 53 percent in the 1998-2002 period, and 98.4 percent are now closed within the client-specified time scale.)

Of particular note is a 76 percent application development productivity improvement, which has delivered cumulative cost savings of approximately A$412 million to the client over the

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past five years (compared with the price that would have been paid for the same portfolio of work by the client in the same period).

When compared to the estimated cost of process improvement initiatives, these savings represent a return on investment (ROI) approaching 10 times.

Today, AMS Australia is made up of approximately 2,000 information technology (IT) professionals located in seven capital and regional cities across multiple site locations in five Australian states, serving multiple clients.

During the course of a single year, AMS Australia typically delivers more than 3,000 work products (client deliverables), with over 1,000 projects being delivered to a standard that meets their overall schedule, budget, productivity, and quality commitments.

AMS Australia has numerous strategic goals, which include a focus on the continual improvement of the AMS Australia delivery capability to meet the demands of current clients and the marketplace. While a range of improvement initiatives in areas such as organizational structure, development methods, and tools have been undertaken, the primary improvement mechanism has been the establishment of standard development and management processes. These processes, which are documented in the AMS Australia Management System, describe the practices required of AMS Australia staff; a managed program of improvements to the processes is used to enhance the AMS Australia service delivery capability.

AMS Australia is a part of the IBM Global Services team in Australia and IBM Global Services worldwide team. The IBM Global Services AMS worldwide team consists of approximately 36,000 employees around the globe in 30 countries.

Many areas of IBM Global Services worldwide have individually been appraised against the SW-CMM, in addition to other models. IBM is committed to a continual program of improvement to ensure that all teams are enabled to deliver high-quality products and services. IBM is also committed to delivering a service of the highest possible quality to its clients, making sure their experience with IBM is superior in every way possible.

The journey of process improvement described in this report is for AMS Australia. That journey reflects the pervasive culture of IBM worldwide to deliver quality products and services to its clients.

2 The AMS Australia Process Improvement Journey

The AMS Australia process improvement journey has taken place over several years, covering multiple initiatives and the involvement of many people, each committed to the goal of establishing AMS Australia as a highly regarded and professional application management services delivery organization.

Even though that goal has been reached, AMS Australia recognizes that the journey is far from over. In fact, there is the realization that, by using its collective data and knowledge, AMS Australia can achieve even more to further expand and improve its capability, ultimately delivering greater value to its clients in an increasingly competitive and complex marketplace.

The timeline shown in Figure 1 and the following bullet points highlight major points in the AMS Australia process improvement journey.

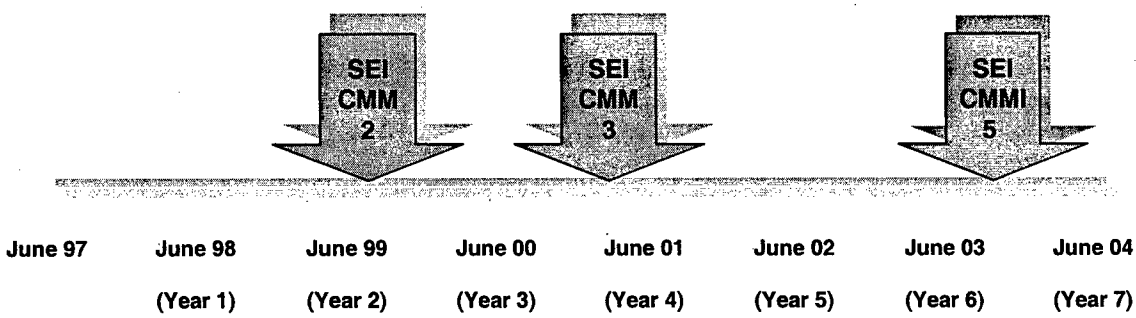

Figure 1: A Timeline of Major Points in the AMS Process Improvement Journey

- June 1997: AMS Australia commences its CMM journey.
- July 1999: AMS Australia achieves CMM maturity level 2 for outsourced commercial accounts.
- April 2001: AMS Australia is assessed at CMM maturity level 3.
- November 2003: AMS Australia becomes the first Australian organization to achieve CMMI-SE/SW maturity level 5.

According to the April 2003 Carnegie Mellon® Software Engineering Institute (SEI) Process Maturity Profile Worldwide, only five large (1,000+ employees) organizations have achieved CMM maturity level 5, with a median time of 91 months (approximately 7.5 years) to move from level 1 through to level 5. AMS Australia achieved this in 77 months—slightly less than 6.5 years.

2.1 The Early Process Improvement Steps

IBM Global Services is recognized globally as a leader and innovator in the area of IT outsourcing. High performance in service delivery is required by IBM clients, as specified in Service Level Agreements (SLAs) within many of the IT outsourcing contracts that preceded the AMS Australia process improvement program. Added to this is the fact that many contracts required AMS Australia to achieve certain levels of maturity against the SW-CMM.

Since AMS Australia is a commercial organization, one of its key business goals is to deliver value to clients through products and services, and its operational conduct reflects the reality of achieving this goal in a highly competitive market.

In the early years of IBM Global Services operation, a large IT outsourcing contract provided the starting point for the AMS Australia process improvement program. This account was successfully independently assessed at SW-CMM maturity level 3 in June 1997, and this provided the stage for further process improvement success across the whole of AMS Australia in the coming years. It was also this account that provided the base information for a number of the crucial processes and tools, such as the Project Management System, that are key to the AMS Australia organization today.

The following sections outline the key aspects of the overall AMS Australia process improvement program, following it through from SW-CMM maturity levels 2 and 3 to CMMI-SE/SW maturity level 5.

2.2 SW-CMM Maturity Level 2

The elements of the AMS Australia process improvement program described in this section also continued, with appropriate modifications based on previous learning, in the programs of work for SW-CMM maturity level 3 and CMMI-SE/SW maturity level 5.

For each of its process improvement programs, AMS Australia had the basic organizational structure shown in Figure 2.

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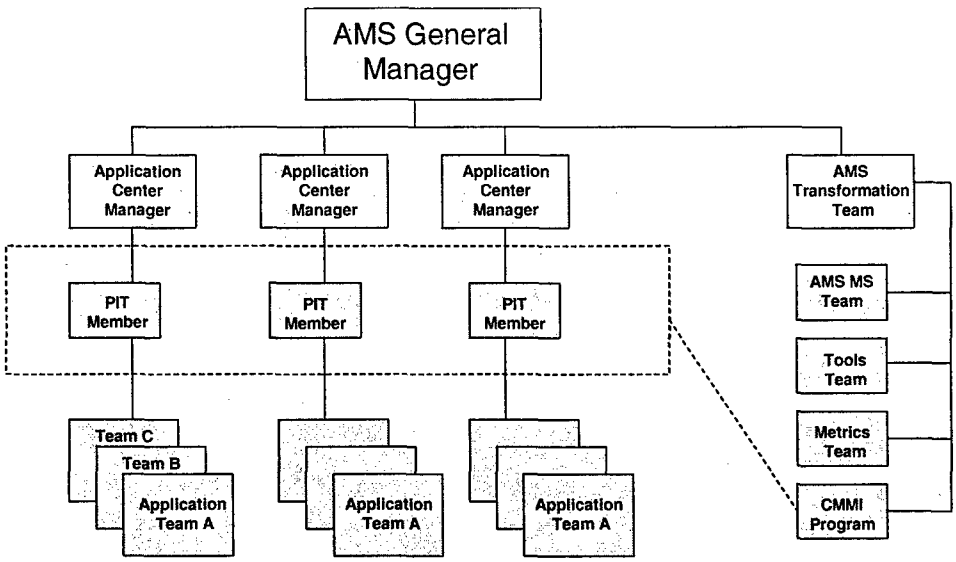

Figure 2: AMS Australia Basic Organizational Structure

In each instance, the process improvement program sponsor was the AMS General Manager. Reporting to the General Manager were the Application Center Managers and associated application teams as well as the AMS Transformation Team. The program manager for each CMM program was a part of the Transformation Team. The Process Improvement Team (PIT) members generally reported directly to the Application Center Managers and to the CMM Program Manager.

Further information on the AMS Australia organizational structure can be found in Section 5.2.3.

2.2.1 Approach to Gap Analysis and Planning

The initial approach to transforming AMS Australia used the Application Development Effectiveness (ADE) model in conjunction with the SW-CMM.

Essentially, the ADE model breaks the organization into key areas and gives a holistic view, as shown in Figure 3. These key areas are then assessed to help identify those areas of the organization that are strong and those that require improvement.

From there, an improvement plan can be developed to move the organization forward and achieve the desired levels of performance. These same ADE elements are also used in benchmarking work undertaken by IBM for its clients. Figure 4 shows the ADE approach to change.

After the initial gap analysis for AMS Australia was conducted using a combination of the ADE model and the SW-CMM, results were combined to produce an overall plan that would help the organization to address specific gaps in relation to the desired end state.

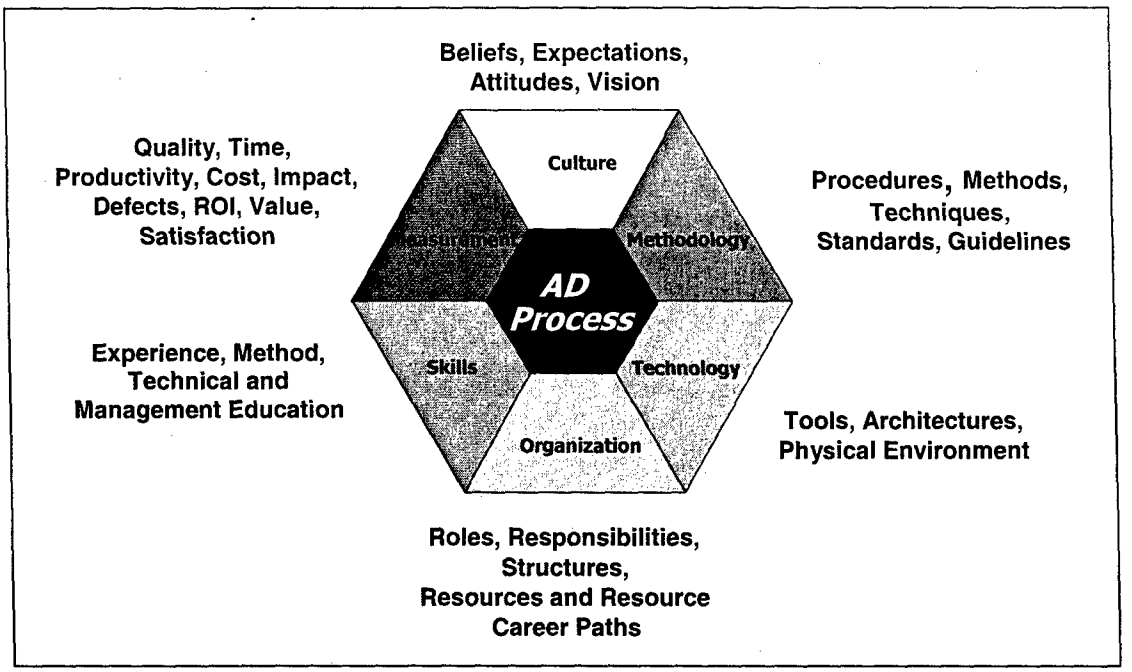

Figure 3: ADE Hexagon and Key Areas

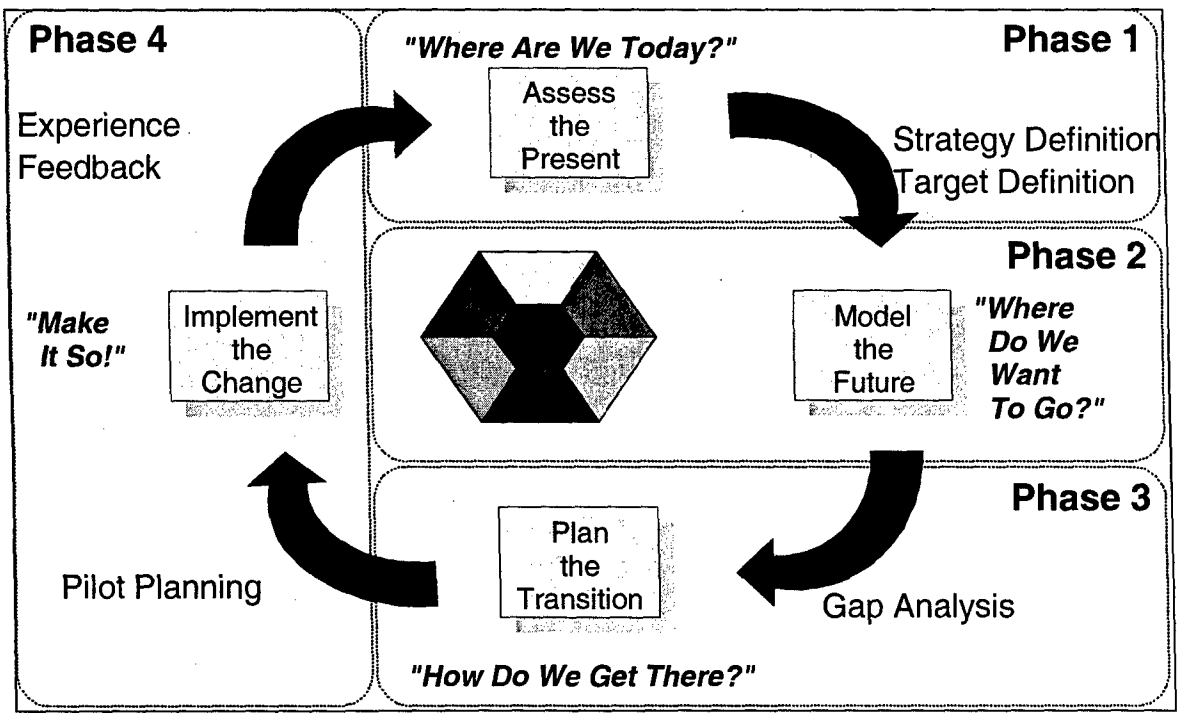

Figure 4: The ADE Approach to Change

2.2.2 The Initial Transformation Framework 1997-1999

For the SW-CMM maturity level 2 phase of the AMS Australia process improvement journey, the organization's key focus areas are shown below as bulleted points. These points represent the enablement of the successful transformation to SW-CMM maturity level 2 in July 1999.

These key focus areas were built on as AMS Australia progressed through to SW-CMM maturity level 3 and, subsequently, to maturity level 5. Without doubt, one of the most important aspects of the transformation was that it was thoroughly planned; performance and progress were strictly monitored against plans for each of the process improvement projects.

Planning and communication

- integrated process improvement plan
- road shows conducted by management and attended by all staff members
- calendars (addressing the areas of human resources, the project management office, application services and managed operations) for initiative rollout

Management framework

- Weekly project review meetings were established at all levels within AMS Australia, including reporting of quantitative measures (see Section 5.2.4).
- Senior management spent four to six hours per week on process improvement, ensuring a high focus and visible commitment.
- Monthly performance and contract review were established with detailed metrics.
- Metrics were linked to individual staff performance targets with incentives set for individual goals.

Process Improvement Team (PIT)

Resources were assigned to represent the Application Center Manager. These resources formed the PIT team and they

- assisted teams in planning, take-up,[1] and institutionalization
- undertook ongoing verification of practices
- ensured communication and feedback at the Application Center and group levels

Verification

- SW- CMM maturity level 2 assessment
- CMM readiness workshops

[1] The phrase "take up" means to start using (e.g., teams making a process improvement change will "take up" the change).

- interim profile tool for assessing individual practice areas
- independent audits to verify process adherence
- independent quality assurance reviews
- Project Quality Analyst role to sign off on process compliance and adherence
- monthly General Manager review of verification results

People/culture

- individual staff performance targets to ensure consistent focus
- staff reviews and roundtables, crossing organization levels
- IBM employee and manager training
- career management institutionalized through skills development planning
- management index established—employees provide the following confidential feedback about managers:
  - Does your immediate manager demonstrate effective leadership to achieve business goals?
  - Is there effective two-way communication between you and your manager?
  - How much trust and confidence do you have in your immediate manager?
  - How satisfied are you with the acknowledgment you receive when you do a good job?

2.3 SW-CMM Maturity Level 3

Immediately following the SW-CMM maturity level 2 assessment, AMS Australia began work on the creation of an integrated process improvement plan to achieve SW-CMM maturity level 3. The plan took into consideration the final findings from the SW-CMM maturity level 2 assessment, the business drivers, and the SW-CMM requirements.

The approach that we adopted to make changes to the processes and tools required for SW-CMM maturity level 3 was to define 22 sub-projects (initiatives) that would address all SW-CMM maturity level 3 requirements. To ensure that initiatives were undertaken and conducted in the best possible manner, each had an owner appointed to it, and its activities were overseen and monitored regularly by a program manager.

In addition, a number of the PIT members involved with helping AMS Australia achieve SW-CMM maturity level 2 were assigned roles in mentoring and verification activities. Other PIT members were temporarily absorbed into the maturity level 3 "build" team, working as initiative managers or as members of the various working parties. As initiatives reached completion, those personnel returned to their PIT duties, bringing the PIT back to full strength for implementation.

Broadly, all initiatives fell into one of four categories: methodology, tools, dependencies (relationships) with others, and ongoing skills development.

A national road show presented before *all* staff members provided an overview of the changes and their impact on application teams.

In light of the plan's timing, the Year 2000 (Y2K) issue was identified as the primary risk—a risk that was mitigated by employing a strategy of deferring adoption until January 2000. To avoid any possibility of lost time resulting from the strategy of deferment, each application team was required to prepare a "take-up" plan, which was reviewed and approved by the appropriate Application Center Manager.

Through the adoption of the overall mitigation strategy, AMS Australia was able to maintain an uninterrupted focus on process improvement, mitigate risks associated with Y2K, and remain on track to execute the process improvement plan for SW-CMM maturity level 3.

After the release of the AMS Management System Version 2, which included process assets to address the requirements for SW-CMM maturity level 3, project teams were given a six-month grace period, during which they were to ensure that their projects complied fully with the organizationally defined processes. Compliance to the organizational processes was then verified by an independent audit, and the results were reported to senior management and the sponsor. Non-compliance issues were resolved and tracked to closure.

During the CMM maturity level 2 initiative, the actual take-up progress, budget expenditure, and process verification were tracked on a weekly basis by the Application Center Manager and the AMS Australia General Manager.

2.3.1 The Transformation Framework for SW-CMM Maturity Level 3

For the SW-CMM maturity level 3 phase of the AMS Australia process improvement journey, the organization's key focus areas are shown below as bulleted points. These points represent the enablement of the successful transformation to SW-CMM maturity level 3 in April 2001.

System integration methodologies

- enhanced methodology incorporating complex systems life cycle
- rapid solutions development
- package integration
- custom application development
- application maintenance/enhancement

Consistent end-to-end tool suite

- controlled architecture for the standard development environment
- project management support
- financial management
- human resources (HR) management
- expense reimbursement
- time recording

Organization interlocks

- managed operations, through common procedures
- capacity, Service Level Agreement, recovery, performance
- documents of understanding (client, Project Management Office, Enterprise Services)
- project dependency agreements, interface dependency process

Skills development

- business strategy driven
- certification paths in the following areas:
  - project management
  - architecture
  - Microsoft
- training programs

2.4 CMMI-SE/SW Maturity Level 5

The decision to achieve higher SW-CMM maturity levels was made without the pressure of any contractual obligations being placed on AMS Australia by clients. Yet, the decision took into full account factors such as the pressures involved in achieving levels 2 and 3 and the state of the IT industry.

After achieving SW-CMM maturity level 3 in April 2001, AMS Australia required a period of consolidation. The large number of changes that had occurred over such a short period of time resulted in staff members being "saturated." At that time, absorbing the additional changes required for achievement of SW-CMM levels 4 and 5 would have proven difficult.

An added consideration was the IT industry's state as a result of the "tech stocks crash" of 2000. It was generally felt that personnel would benefit from—and appreciate—time taken to let the market achieve a level of stability.

During that period of consolidation, AMS Australia focused on strengthening the SW-CMM maturity level 3 practices, particularly in areas of weakness identified in the SW-CMM maturity level 3 assessment. These included the following:

- reuse of information between teams through sharing "lessons learned," templates, and examples of "best-of-breed" documents
- knowledge management—tapping into the IBM intellectual capital more effectively and, in turn, contributing to that repository
- streamlining management system processes by removing ambiguity and developing the concept of core management practices versus account-specific practices, enabling managers to tailor the processes more easily
- verifying processes and ensuring that teams followed the planned processes
- sharing knowledge with IBM AMS worldwide team personnel as they built the AMS Standard Delivery Framework for all IBM AMS areas
- analyzing and building a centralized metrics repository and reporting function to build on the already strong metrics program
- ensuring that new projects adopted the current standards and became familiar with these standards

After nine months of consolidation, the decision was made in March 2002 to move the organization to SW-CMM maturity level 5. It was also decided that the approach would be similar to that employed in achieving SW-CMM maturity level 3:

- Analyze gaps using the SW-CMM and results of the SW-CMM maturity level 3 assessment.
- Create plans to move forward and then gain approval and commitment.
- Execute the plans and track them through to completion.

In October 2002, the decision was made to move to the CMMI-SE/SW model. This decision is explained further in Section 4.1.2.

Again, as during the SW-CMM maturity level 3 program, key initiatives were identified with working groups and a leader was established for each. The key areas were metrics, quality, and process/technology improvement. Changes for SW-CMM and CMMI-SE/SW maturity level 5 were piloted prior to full take-up as appropriate.

The project teams and their line management were responsible for producing take-up plans based on the required changes and reporting on progress to the sponsor. A project manager was appointed for the CMMI-SE/SW maturity level 5 program from the process and tools support team. Other members of the AMS Transformation Team—such as members of the Process, Tools, and Metrics Groups—formed a virtual CMMI-SE/SW maturity level 5 project team. As part of the this team, the Transformation Team members were responsible for

- performing the work required to make the process asset and tools changes

- providing education and mentoring for the teams
- being a point of contact for feedback on key process and tool assets
- ensuring organizational readiness for the CMMI-SE/SW maturity level 5 appraisal by "health checking" the projects to help them close any final gaps before the appraisal
- developing the transformation framework for CMMI-SE/SW maturity level 5
- planning for and running the SEI Standard CMMI Assessment Method for Process Improvement (SCAMPI[SM]) process using an external lead appraiser

2.4.1 The Transformation Framework for CMMI-SE/SW Maturity Level 5

For the CMMI-SE/SW maturity level 5 phase of the AMS Australia process improvement journey, the organization's key focus areas are shown below as bulleted points. These points represent the enablement of the successful transformation to CMMI-SE/SW maturity level 5 in November 2003.

Planning and communication

- integrated process improvement plan
- kick-off meetings for all management levels
- regular updates to all employees in a monthly newsletter and at the quarterly update meetings (led by the AMS General Manager)
- request by the AMS General Manager for all employees to identify how they could assist with process improvement towards CMMI-SE/SW maturity level 5 in 2003 and to include such activities in their individual performance targets

Management framework

- continued weekly, quantitative project reviews at all levels within AMS Australia
- reviewed status at the monthly performance review (MPR) meetings with all Application Center Managers and senior AMS Australia management

Process Improvement Team (PIT)

The PIT was assigned resources to represent the Application Center Manager to

- assist teams in planning, take-up, and institutionalization
- ensure ongoing verification of practices
- ensure communication and feedback at the Application Center level

[SM] SCAMPI is a service mark of Carnegie Mellon University.

Verification

- CMMI-SE/SW appraisal, preceded by three "health checks" at approximately four-month intervals
- independent process adherence verification (PAV) reviews
- independent quality assurance reviews
- Project Quality Analyst (PQA) role to sign off on process compliance and adherence

People/culture

- focused less on cultural change activities at this level due to previous experience and level of existing understanding of process improvement/CMM
- asked individuals to agree on suitable performance measures with manager
- continued staff reviews and roundtables that crossed organization levels, but these did not necessarily focus solely on process improvement
- continued IBM employee and manager education for processes and tools, but less than in the previous SW-CMM level 2 and 3 programs
- continued Management Index questionnaires:
  - Does your immediate manager demonstrate effective leadership to achieve business goals?
  - Is there effective two-way communication between you and your manager?
  - How much trust and confidence do you have in your immediate manager?
  - How satisfied are you with the acknowledgment you receive when you do a good job?

3 The Benefits

Throughout the course of the AMS Australia process improvement journey, the organization has realized numerous benefits. Some of these were expected and, through metrics, quantifiable. Other benefits, while expected, were more qualitative in nature, yet they were every bit as important.

This section describes the benefits in terms of performance (covering both clients and the AMS Australia business) and people (covering the AMS Australia staff).

3.1 Performance

Substantial improvement has been achieved over the last six years in a number of the key metrics that impact clients. The most significant of these are

- productivity for both development and maintenance activities (76 percent improvement in development productivity and 65 percent reduction in maintenance cost achieved over the six-year period)
- on-time and on-budget delivery (Currently 98.5 percent of deliverables are on time and 99.6 percent of projects are on budget, improvements of 9.6 percent and 41.3 percent respectively over the six-year period.)
- client satisfaction (currently 88.4 percent reported in project completion surveys—an improvement of 33 percent in the last five years)
- problem resolution (The number of problems reported in production fell by 53 percent in the 1998-2002 period, and 98.4 percent are now closed within the client-specified time period.)

The benefits of this CMM program for clients have been significant over the five years since outsourcing its application development activities to IBM.

Those improvements have been achieved primarily through the implementation of SW-CMM maturity level 3-compliant processes. As shown in industry studies, most gains are seen in the moves to SW-CMM maturity levels 2 and 3 with smaller gains in areas such as on-time and on-budget delivery for CMMI-SE/SW maturity level 5.

Improvements today are now seen in areas such as phase containment of defects, finding defects earlier in the development life cycle, and categorizing the majority of projects at an "A" rating by the Quality Assurance Group. (See Section 6 for further information on metrics and defects.)

These improvement results are shown in Figures 5-10 in the following section.

3.1.1 Charting the Results of Process Improvement

The following charts have been included to show progress over time in the areas of

- on-time delivery (Figure 5)
- on-budget delivery (Figure 6)
- customer satisfaction (Figure 7)
- account productivity (function point/full-time equivalent [FP/FTE]) (Figure 8)
- problem resolution (production problems) (Figure 9)
- production problems (Figure 10)

These are just some of the quantifiable data available that demonstrate a clear return from the investment in process improvement. The business has been able to deliver real value to its clients in the midst of changing internal and external environments. These results have been feasible through the focus and stability gained in a properly implemented process improvement program with committed management and staff.

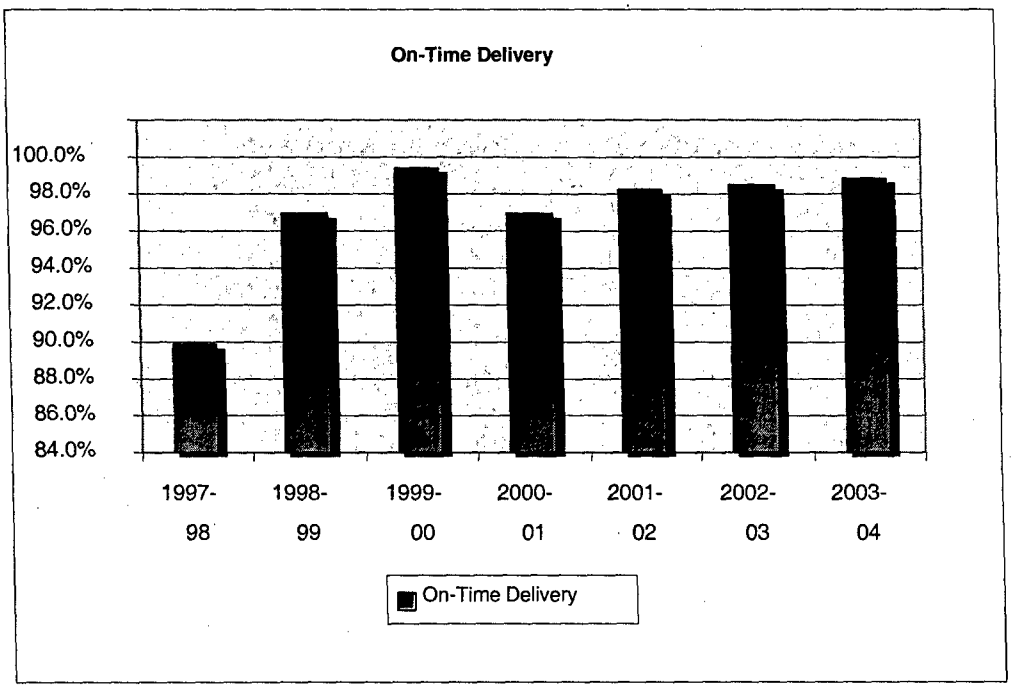

Figure 5: On-Time Delivery

9.6 percent improvement in on-time delivery

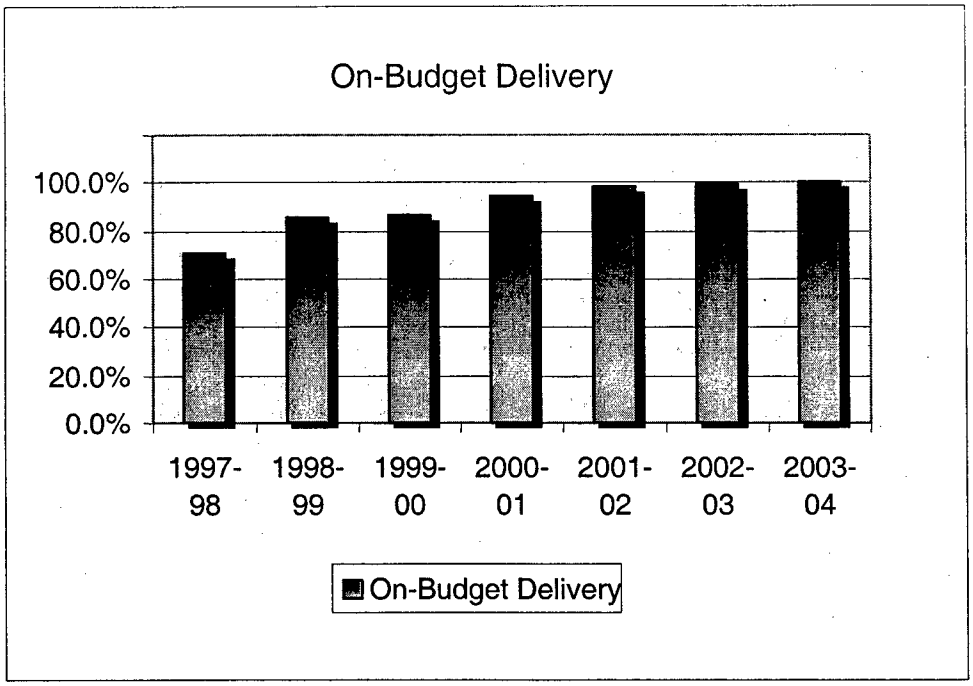

Figure 6: On-Budget Delivery

41.3 percent improvement in on-budget delivery

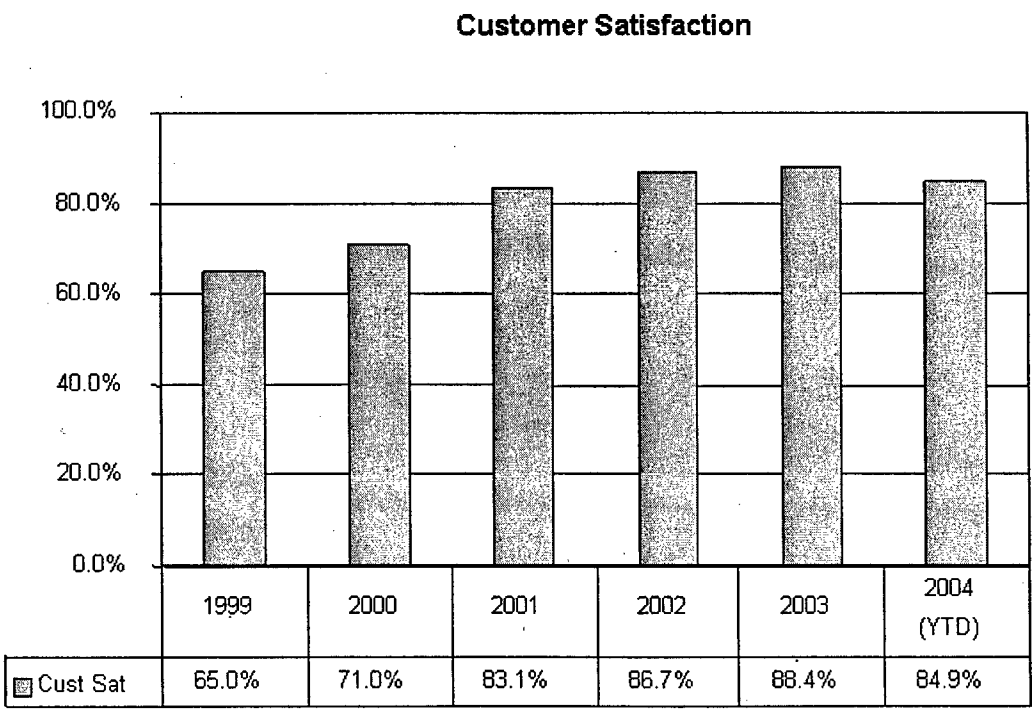

Figure 7: Customer Satisfaction

33 percent improvement in customer satisfaction

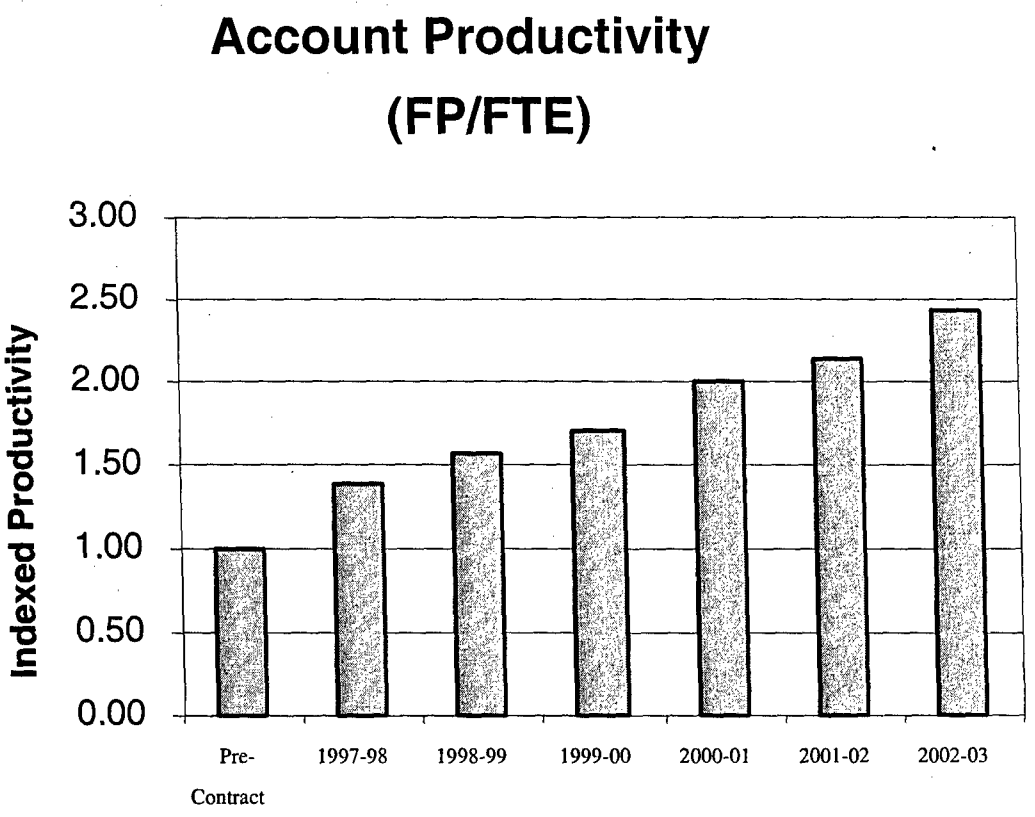

Figure 8: Account Productivity (FP/FTE)

145 percent improvement in productivity

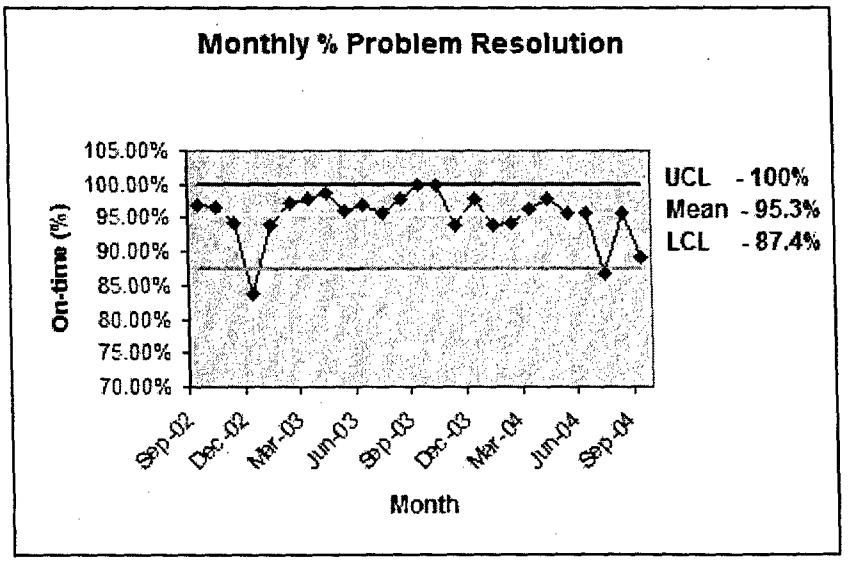

Figure 9: Monthly Problem Resolution

98.4 percent closed within customer-specified time frame

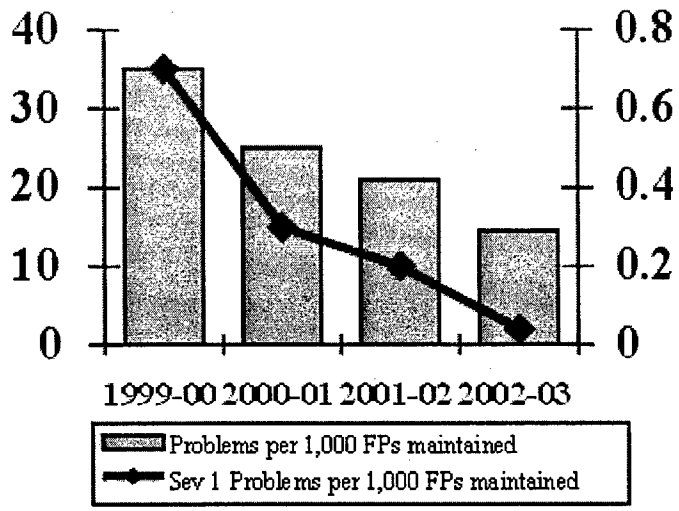

Figure 10: Problems per 1,000 FPs Maintained and Severity 1 Problems per 1,000 FPs Maintained

56 percent reduction in production problems and 94 percent reduction in Severity 1 problems

3.2 People

Working in a company that has chosen to undertake a program of process improvement has benefits for its employees. Much of what is mentioned in this section is qualitative in nature. There are a significant number of influences that can impact data, such as attrition rates, employee morale, and satisfaction. Given that it is difficult to attribute process improvement directly to metrics such as employee satisfaction scores, this section attempts to share some observations about the culture of the AMS Australia organization and the perceived benefits of CMM over this time.

3.2.1 Background

The culture of AMS Australia in the mid- to late-1990s strongly reflected the outsourcing contracts that had created the organization. For various reasons, many businesses made the choice to place part or even all of their IT development and maintenance with a vendor. In such contracts, the staff members of the company choosing to outsource its IT development and maintenance were usually offered the opportunity to join IBM. Many, but not all, took advantage of this offer.

The numbers of staff in such arrangements could range from small to very large. Therefore, AMS in Australia, and around the world, was made up of personnel from many different backgrounds and cultures, located at multiple sites, and used to various levels of process

definition and rigor. They operated at very varied levels of maturity even within the same client group with respect to the CMM. Often these new IBM employees were still at their old site with their previous colleagues, looking after exactly the same applications as they had always done.

It was in this culture that the program of process improvement against the CMM was started.

3.2.2 Client and Staff Satisfaction

While AMS Australia achieved SW-CMM maturity levels 2 and 3 and, subsequently, CMMI-SE/SW maturity level 5, there have also been significant improvements in the areas of client and employee satisfaction. Of particular note is the fact that these *quantified* improvements are, in part, related directly to the CMM maturity level achievements.

Client Satisfaction: In 2001, client satisfaction increased to an average of 83 percent from 65 percent in 1999 and 71 percent in 2001. This was followed by an increase to 87 percent in 2002. In addition to these increases, AMS Australia achieved 98 percent on-time and on-budget project delivery, driven through improved processes.

AMS Australia Attrition: Over the last few years, the AMS Australia attrition rate has been lower than the IT industry attrition rate. As of the third quarter of 2004, the AMS Australia attrition rate was approximately 30 percent lower than the industry average. This lower employee turnover is reflected in a reduced cost of sustaining its workforce and retaining core expertise.

3.2.3 Benefits for All Employees: Observations

The following observations have been made about the AMS Australia culture and the way in which its people work:

- New employees simply think this is "just the way we do things here." The discipline, the documentation, the visibility of the project progress, how issues are resolved, and how their ideas about what can be improved are all captured. Those who have worked in other organizations make the observation that it is much better than what they have worked with before.
- A project manager at the CMMI-SE/SW maturity level 5 appraisal made the comment that in his team the process of inducting a new staff member had gone from two months to a matter of days. This meant he had very little downtime with a new staff member and, as a result, could manage changes in workload very easily, which ensured client satisfaction.
- Management personnel remark on the ease with which they can see how projects are performing and concentrate their time where it is needed.

- Everyone speaks the same language. Managers and team members note the ease with which personnel can transfer from project to project and know exactly what documentation pertains to their role and where to find it.
- There is an atmosphere of "organization" and "control." The fire-fighting mode is gone.
- Employees and managers ask for and expect the level of discipline applied in AMS Australia projects. When a new account comes into the organization, they seek to make the changes necessary to bring it up to the standard with which they are used to working.
- Management personnel ask questions about the results they are seeing in the AMS Australia metrics. They compare results with each other and seek to find the best practices so they can be shared within the organization.
- Work is easier to do. There are many templates and examples to reuse. Time is saved by not creating work products from scratch each and every time.

We are one team.

4 Lessons and Observations

4.1 The Initial Drivers for Process Improvement

IBM has always maintained a strong focus on quality and continuous process improvement. As a whole, the IBM community seeks to apply these principles across its diverse operations, understanding that in doing so the organization can better serve its clients and build a strong and robust business.

Perhaps more than any other business process, application development occurs in an environment of endlessly shifting goal posts. This situation can be attributed primarily to the fact that application development takes time and, inevitably, the environment for which the application is being created changes and evolves throughout the application's development life cycle.

As a result, while hardware and networks have reached 99.9 percent reliability, it is application software that remains a key contributing factor to poor business performance.

The volatility that plagues application development causes more than 15 percent of IT implementations to fail and a further 51 percent of projects to be categorized as challenged, usually with cost and time overrun. In addition, only 52 percent of required features and functions make it to the released product.[2] The key issues responsible for these failures are *managerial* rather than technical in nature. These issues include

- unclear project requirements, in particular, relating to changes over the lifetime of the project
- poor communication between the developers and the client/business users, neither of whom may understand the implications of the changes being suggested
- unrealistic expectations that result in "shock" when the project exceeds budget and time

It was in this environment that IBM and its clients sought to bring about a dramatic improvement in application development practices.

[2] Standish Group International, Inc. *CHAOS Report*. http://www.standishgroup.com/press/article.php?id=2 (March 25, 2003).

4.1.1 Why CMM?

There are many process models, each of which is designed to be adapted to suit organizational business needs. Given their inherent adaptability, they must be evaluated carefully and intelligently to ensure that the progressive application of their principles actually meets business needs.

The decision by IBM worldwide to adopt the CMM model was reached primarily due to the model being an independent, industry-accepted benchmark for measuring software development and maintenance process maturity.

The CMM, above other models, provided a proven roadmap for process improvement, allowing AMS Australia to work in clear and logical steps toward each of its goals. This feature proved to be of great importance in helping AMS Australia to manage the organizational changes required as it adapted the model and implemented its principles.

Selection of the CMM was also part of AMS Australia's commitment to clients, with some client contracts stipulating that the organization be assessed against the SW-CMM and achieve maturity level 2 and 3 status. Within contracts there were also specific year-on-year delivery improvements to be achieved.

To a large extent, the initial drivers behind attainment of SW-CMM maturity levels 2 and 3 were contractually driven. For CMMI-SE/SW maturity level 5, though, the drivers were made without any contractual obligations and were primarily to

- continue the process improvement journey
- attain the highest level of maturity
- be a competitive force in the marketplace

Assessments confirmed compliance with the SW-CMM maturity level 2 standards after 21 months (July 1999) and SW-CMM maturity level 3 after a further 21 months (April 2001). The processes established were such that in March 2002, AMS Australia management chose next to target attainment of CMMI-SE/SW maturity level 5, planning to establish CMM level 4 and 5 practices by the end of 2003. In November 2003—19 months later—appraisal confirmed achievement of CMMI-SE/SW maturity level 5 standards.

4.1.1.1 ISO and CMM

Other models and standards such as International Standards Organization (ISO) and Six Sigma are also used within IBM, and in many cases they are used together successfully to achieve excellent results for the client and the IBM business. Within IBM Global Services Australia, ISO certifications have been maintained in several delivery centers since 1992 and were driven initially by the requirements of clients.

In evaluating models for continuous improvement, it was decided that AMS Australia would adopt the CMM methodology, which is entirely complementary with, and supports, the ISO

model. In 2004, AMS Australia elevated its ISO program to cover the entire business as part of the IBM certification.

4.1.2 SW-CMM to CMMI-SE/SW

When AMS Australia initially made the decision to be appraised against the SW-CMM for maturity level 5 in 2002, the CMMI-SE/SW model was very new. About six months into the maturity level 5 project, the CMMI-SE/SW model became more widely available and used, demanding that a firm decision be made.

Making changes to a project already underway always requires careful consideration, and this was certainly the case. In order to achieve a successful appraisal, a significant program of changes had already been put in place and was well underway.

In some respects, the cultural changes within the organization take the longest to effect. This then was a key consideration given that AMS Australia needed to inform its teams that there was a requirement for more changes and work than initially planned.

Coupled with time and budget considerations, the decision may have been easy from the point of view of those of AMS Australia who knew the model, but it was considerably more difficult for management. It was a case of, "Do you risk your whole program changing it part way though, or do you continue, lower the risk, and switch at a later stage?"

The approach to determine what was needed to effect the change was relatively simple:

- Analyze and understand the gaps.
- Estimate how closing the gaps would affect existing plans.
- Negotiate approval for the changes to plans.

In presenting the case for change to management, AMS Australia put forward the following findings:

- AMS Australia felt that the authors of the CMMI-SE/SW model had achieved what had been intended with the changes made for CMMI. The CMMI-SE/SW model was easier to use, the language and terminology were less open to misinterpretation, and the structure was simplified.
- The CMMI-SE/SW model was more strongly aligned to the business as a whole; thus, it could only be more effective as a tool for the continued business success of AMS Australia.
- The changes to the model were not so great as to cause significant change to the existing program. The risk of those changes could be managed with appropriate guidance from the lead appraiser, who was already familiar with the CMMI-SE/SW model.

- It was foreseen that in using the current SW-CMM, AMS would effectively be behind from the start; given that a number of other organizations were already looking at the CMMI-SE/SW model, it was considered important that AMS lead the way.
- Appraisal or assessment is a significant organizational investment. It was better to invest a little extra time and use the CMMI-SE/SW model than to use the SW-CMM and then repeat the process for CMMI-SE/SW appraisal.

The change from the SW-CMM to CMMI-SE/SW was made 8 months into what was initially a 16-month project. The project was extended by three months, and in November 2003, AMS was successfully appraised for CMMI-SE/SW maturity level 5.

4.2 Process Improvement as an Organizational Transformation Program

AMS Australia discovered early in its journey that a successful process improvement programs has the same key requirements for success that any project has. That is, it must have a committed sponsor; it must be planned, managed, and controlled; and each success and mistake provides a valuable learning experience.

In addition, when running a process improvement program, recognition needs to be given to the fact that process improvement deals directly with the transformation of an organization. Successful achievement of the final goal, whatever that may be, requires careful thought about how best to motivate and change individuals and ultimately the whole organization.

The following sections share some insights regarding some key aspects of running a process improvement program, which include

- organizational change management and how people handle change in the day-to-day environment
- sponsorship of the program and its importance for a successful outcome
- the impact of culture, particularly that of a large organization, on a process improvement program

4.2.1 Organizational Change Management

Process improvement involves changing the organization's basic culture. A program of change such as this will not succeed unless it is handled in a way that is sensitive to people and how *they* will respond to the changes it causes in the organization. In addition, organizational life, national crises, and global events do not stop for process improvement programs. Such programs are undertaken in the midst of everyday life, whatever that may bring.

4.2.1.1 People and Change

This report does not intend to repeat what can be found in any good reference dealing with change management. Rather, it details a number of key points based on the AMS Australia experiences.

A program that fails to be sensitive to the needs of people when they are asked to change the way in which they work is unlikely to be successful.

Apart from having a program sponsor (see Section 4.2.2), some of the key aspects of successful organizational change management are understanding what sort of culture is being dealt with, how the changes will be implemented, and how to have them accepted and institutionalized.

During the initial stages of the AMS Australia process improvement program, many staff members were quite wary of change. They were compelled to complete their project work while dealing with changes to the way in which they did this.

Today, process improvement and change are accepted parts of the organization's culture. However, resistance to change is also part of human nature. As maturity increased, it was found that resistance to change decreased; in addition, when changes were challenged, the points made were more focused and added greater value. People understood that their processes and tools would be better if they became actively involved in the changes.

Some key initiatives were undertaken each time changes were made, ensuring that those changes were accepted:

- Sell the change to those people who will be directly affected.

  It was most important that every time a change was introduced, people were "sold" on the change. The IBM culture is to question and challenge what is happening, ensuring that there is added value from making a change. Once people had been sold on the change and they saw the benefits, the change itself became easier.

  Selling meant communication, education, and hands-on help for the teams making the changes. It was never a case of management simply sending out an edict for change. Today, "selling changes" involves piloting as a key part of the strategy, along with education and hands-on help. By adopting this approach, AMS Australia found that quite often, the early adopters became effective advocates for the change.
- Involve the people affected by the change in defining the change and how it will be implemented, and then pilot the change to work out the "bugs."

  Involve key stakeholders from the project teams in the analysis of the change and the definition of the form it should take (e.g., procedural, tools, and education). A specialist group would guide various sub-groups to define the final changes. Key staff members from the AMS organization were involved by way of workshops, reviews, and piloting changes.

- As with any project, ensure that there is senior management support and a sponsor for all process improvement work. This will ensure that the changes are given the appropriate focus.

  The most well-thought-out program for change management can easily fail unless the sponsor and management team drive the changes and ensure that commitments are met and that action is taken if they are not.

4.2.1.2 The World Does Not Stop for Process Improvement

A process improvement program that is postponed until the "perfect moment" is one that is unlikely to start. Similarly, a delay in moving to a new phase of a process improvement program because of some "event" that will impact the program results in a program that is unlikely to finish.

Mid-way through the first AMS Australia program of work for the SW-CMM maturity level 3 assessment, the Y2K issue arose. In 1999, the world was involved in dealing with projects, each with the same immovable deadline—December 31, 1999. No one was inclined to accept the perceived delays brought about by making process changes. The processes weren't broken, so why fix them? The focus was on getting their projects completed and ensuring that computer systems around the world would make the transition to the next millennium.

In this real business situation, it was a case of *real* sponsorship, *real* plans, and *real* actions being vital in ensuring that commitments to change were met.

AMS Australia made it through to the year 2000; the world did *not* stop at the strike of midnight. The process improvement program for the SW-CMM maturity level 3 assessment accommodated the constraints imposed by Y2K, and it was on track to a successful outcome. In every program of work for the successive CMM appraisals, there have been similar business-critical situations, and each has been dealt with in the same manner as Y2K.

Following are some of the key elements for success of the AMS Australia journey in terms of organizational change management:

- Sponsorship of the process improvement program was in place and strong.
- The work effort was planned and managed as a project.
- Responsibilities for all involved were clearly defined and commitments were established.
- The work effort was tracked.
- Variations from the plan were investigated, followed up, and corrected.
- AMS Australia learned from its successes and mistakes and then applied that learning to the next project.

4.2.2 Sponsorship of Process Improvement Programs

One of the primary reasons for the sustained success of the process improvement program was the sponsor's absolute commitment to success. Given the dynamic nature of most organizations, people move and conditions change; for the AMS Australia process improvement program, this meant an occasional change in people filling the role of sponsor.

But at each phase of the program, there was a committed executive sponsor. The sponsor was also the AMS Australia General Manager, and there was absolute commitment to succeed. If such a program is not sponsored, it will not succeed!

4.2.2.1 What Is a Sponsor?

A sponsor is the person who sets the goal and provides overall leadership. More importantly, though, a *good* process improvement program sponsor will understand the following:

- Goals must be realistic.
- Change is continuous.
- How people react to change plays an important role in determining the success of a process improvement program.
- It is important to know when to "push" people, when to "pull," and how to balance the approaches.
- Leadership of people, process, and technology is necessary to facilitate this sort of change.
- Using the very best people is necessary for success.
- You must understand where you are before you can work out where you want to go and how to get there.
- Establishing and maintaining improvement is not free—it is an investment.
- A commitment to sponsor must be consistent, persistent, and highly visible to "the troops."
- Communication is a key.
- A good sponsor leads by example.

4.2.2.2 How Can a Sponsor Help a Process Improvement Program?

Process improvement programs necessitate broad-reaching organizational changes. They require moving people through changes to the way in which they think, work, and do business. It is the sponsor who provides vital leverage to achieve this change.

The sponsors were quite different in their approach to the program over the years. They were suited to the size, shape, goals, and culture of the organization at the time.

Sponsors for the SW-CMM maturity level 2 and 3 programs were very directive in nature. AMS Australia was then an organization with many staff members coming from newly acquired outsourcing organizations; this presented the need for firm management to ensure that things were done as, and when, expected.

As AMS Australia moved to the higher levels of maturity, sponsors for the CMMI-SE/SW maturity level 5 program expected a more participative approach from staff and teams. The organization already "spoke the same language" when managing projects, and although there was no room for failing to meet commitments, there was more leeway given for project managers to develop individual plans for the changes required for CMMI-SE/SW maturity levels 4 and 5.

In all programs, a key to success was planning, tracking, and managing the work effort. The sponsor played a key role in the success of the program, ensuring that commitments were met by checking the progress of teams regularly and ensuring that escalated issues were resolved in a timely manner.

There were also strong messages from staff that sponsors needed to be very visible in their support of the program—and they were! Even though sponsor visibility remained high and communication occurred through many avenues, the message still remained that there could have been more visibility.

Do *not* underestimate the influence of a sponsor on a process improvement program's outcome.

4.2.2.3 Funding for Process Improvement

Finally, one of the questions that arises regularly is, "How can process improvement be funded?" There is no single right answer to this question. It depends on the business and many other factors.

However, the following points are highly relevant and are listed to prompt thinking about funding in cases where a program of process improvement is being considered:

- Process improvement is an investment and must be funded. How this is done depends on the business.
- Treat the process improvement program as a project and hold the organization accountable for what is spent and done.
- Keep records. Eventually someone will want to know the ROI.
- Think creatively. Often, process improvement efforts seem to exist on little or no budget allowance. Plan ahead and make management aware of any need for funding so it can be built into the organizational plans, just as with any other work.
- The organization will get better at implementing change as the maturity level increases, thus the cost of deployment will be less and the ROI greater.

- Maintenance of process assets and continuous optimization is also an investment that must be funded on an ongoing basis.

4.2.3 Culture of the Large Organization and Process Improvement

The large organization presents its own unique challenges when working with process improvement. Size, physical locations, history, culture, attitudes and beliefs, senior management styles, and current work all form the environment in which the process improvement program must be implemented.

4.2.3.1 The IBM Business Culture

The IBM business culture has always been one that places meeting the needs of clients first. From the top down, quality is a priority for all transactions, whether they are for hardware, software, or services.

Quality is understood and practiced by all staff members, with all individuals having quality-related goals in their personal performance targets for the year. They are encouraged to provide feedback that will improve the way in which business is done and to participate in the process improvement initiatives that result from that feedback.

Process improvement cannot be achieved in isolation from the culture of the organization or the country. The culture must be understood and used for the benefit of the process improvement program. Change could be slowed if the culture is not well understood.

4.2.3.2 The AMS Australia Culture

At the start of this journey in 1997, a unique culture at AMS Australia was formed from a mix of personnel from relatively new IT outsourcing accounts, along with existing IBM employees.

In addition, the "Aussie" culture of challenging and questioning changes to ensure they added value and needing to have "buy-in" at all levels had to be taken into account. The challenge was to provide an environment for change that would ensure that the best aspects of what IBM had to offer were integrated with the best of what personnel from the newly outsourced organizations brought to the equation. This integration was achieved by developing a new, common set of processes and methods for this group that aligned with IBM worldwide requirements for project management and quality; it was the organization's staff members who played a part in the development of the processes, along with their adoption and improvement.

A number of reusable artifacts were produced as a result of the process improvement work in AMS Australia, the most significant of which is the AMS Management System—a Web-based intranet tool available to all staff members (see Section 5.1.1). This set of policies, pro-

cedures, standards, templates, and guidelines addresses all areas of system development practice required in AMS Australia engagements. As such, it incorporates the experiences gained and lessons learned throughout many years of service delivery performance, and it provides a vehicle to capture continuing experience and process improvement. It has been a key to the cultural change in the organization both in AMS Australia and in the IBM worldwide AMS team.

Today, the culture of the organization reflects the integrated approach taken at the beginning. Use of the processes created is just "the way we do things around here," and staff members within AMS Australia recognize that the organization has come a long way. Staff members on new accounts implement the disciplines and processes, which they now readily accept as being standard operational practice. They are open to change and look for opportunities to make suggestions for changes. They are not afraid to put new changes to the test and push back when things could be made even better.

4.2.4 Piloting

AMS Australia has always used change management principles when rolling out changes to the organization's tools, methods, and processes. Doing this ensures that a new tool, process, or method is tested with early adopters before it is broadly introduced across the organization.

However, formal piloting was not used within AMS Australia until the CMMI-SE/SW maturity level 5 program. In fact, a great deal was learned about making successful organizational changes through the SW-CMM maturity level 2 and 3 programs.

In looking to move to the higher levels of the CMMI-SE/SW model, piloting stood out as a key area for enabling AMS Australia to achieve greater success with its CMMI-SE/SW maturity level 5 change program. Piloting also played an important role in continuous improvement success. The CMMI-SE/SW maturity level 5 program changes were conducted using a planned piloting method, which was refined during this time.

Piloting has provided the right information to the appropriate groups, enabling informed decisions on changes in the organization. This information has been an important factor in helping AMS Australia direct resources (personnel, financial, and others) where they will provide the most benefit in terms of business goals.

4.2.4.1 About Piloting

When major changes (and other smaller changes that are critical, such as process changes) are required within the organization, the assigned pilot program manager develops a pilot management plan, defining

- why the pilot is needed
- what the solution will look like

- how the solution will be used
- success and evaluation criteria

The pilot manager must also ensure that the pilot is performed in a relevant target environment and that it involves personnel from a variety of areas, ideally *not* part of the group that developed the technology or process improvement.

The process of conducting a pilot is the same as with any other project: it has requirements, a plan, a test schedule, expected quality levels, and so forth.

It is essential that a change's qualitative measures be included (for example, user perceptions of the change as to whether it will make it easier to use/learn a process or tool). *Quantitative* measures are also expected from a pilot, and these are linked with current process capability baselines as applicable. Examples of quantitative measurements are

- measurable improvement in productivity
- measurable increase in the speed of the technology or development process
- measurable reduction in technology or process cost

4.2.4.2 Evaluation of Pilots

Evaluation criteria are the key elements used to determine the success of the pilot. When planning pilots, it is critical to define criteria for evaluating the pilot results (i.e., results that prove the expected benefits can be achieved and that test any assumptions that have been made).

Evaluation criteria include

- organizational objectives
- business objectives
- processes
- technology
- usability

It is also important that evaluation criteria be ranked and rated by their importance in the overall solution so that informed decisions can be made about the results of the pilot.

AMS Australia developed a Pilot Evaluation Report, which is used to consolidate and summarize the results of the pilot into a readily understandable format. This report is used by management in making decisions based on the pilot's results.

5 Organizational Assets and Supporting Infrastructure

5.1 Processes, Methods, and Tools

The AMS Australia team created many reusable assets, which included processes, methods, and tools, as part of the process improvement efforts. Also available to use as part of the AMS Australia Process Library and tool set were assets from IBM worldwide. Probably the most important asset created as part of the process improvement work is the AMS Management System, which is explained in Section 5.1.1.

As part of the IBM worldwide team, AMS Australia has been able to share and receive a great deal of knowledge. Sharing and reuse are key to the way in which IBM operates and strives to have the very best practices in place for use across the business.

5.1.1 The AMS Management System

The AMS Management System was developed as part of the initial transformation work within AMS Australia for SW-CMM maturity level 2. It is a Web-based intranet tool, which is an integrated repository of process assets (policies, procedures, guidelines, forms, and templates) that provides the organization with the tools and guidance to perform its project management functions. It brings together

- IBM worldwide policies, processes, and methods, such as
  - IBM Global Services Method, which provides technical methods (engagement models and work product descriptions) for performing software engineering and other IT services (See Section 5.1.2)
  - Client Relationship Management (CRM) processes—specifically, Solution Design and Solution Delivery
  - Worldwide Project Management Method (WWPMM), which defines IBM's common project management method for IBM projects worldwide
- local information, such as
  - organization-level policy and procedure
  - project and program management policy and procedure
  - account-specific policy and procedure
  - account-specific program management practices

The AMS Management System currently supports all levels of the SW-CMM and CMMI-SE/SW.

The AMS Management System was adopted by IBM Global Services AMS worldwide as the standard for its application service delivery engagements and is part of the AMS Standard Delivery Framework.

5.1.1.1 Building the AMS Management System

Work on developing the AMS Management System commenced simultaneously with that of the process improvement activities. It was seen as a logical extension of an existing IBM methodology for project management, which included life cycles, project management processes, and templates.

The AMS Australia culture, as noted earlier, consisted of projects from many client accounts with varied practices. It was quickly recognized that all projects required a standard framework in order to improve the delivery to clients and to run the business effectively.

Although projects can work quite well with different processes for SW-CMM maturity level 2 and still deliver the necessary information to allow organizational reporting, SW-CMM maturity level 3 requires that all projects work from an organizational standard and tailor the standard for individual project needs. Rather than wait until SW-CMM maturity level 3, AMS Australia started the AMS Management System.

At SW-CMM maturity level 2, the AMS Management System was developed, containing an exhaustive amount of information. It was enormous and contained everything that was deemed as being even possibly useful. Upon reflection, this meant that it quite likely contained *too much* information.

By the time SW-CMM maturity level 3 projects commenced, team members could not imagine what they would do without the AMS Management System. It had been refined through consistent use and a SW-CMM maturity level 2 assessment, becoming a key part of the organization. Its use was truly institutionalized.

Once AMS Australia had achieved SW-CMM maturity level 3, the organization found that it could begin to trim the AMS Management System to eliminate "noise" and ensure that further additions or changes were more streamlined and simple. By the time AMS Australia was ready to make the changes for CMMI-SE/SW maturity level 5, the AMS Management System was a well-used and firmly institutionalized tool that had become part of the IBM AMS team's worldwide Standard Delivery Framework.

In its findings, the CMMI-SE/SW maturity level 5 appraisal team recognized the importance of the AMS Management System in the organization, stating the following:

"The AMS Management System is viewed as a major strength of the organization. Among other advantages, it

- provides a standard way of doing business
- facilitates staff movement across organizational and geographical boundaries
- increases the efficiency and effectiveness of the organization
- incorporates continuing process improvement"

The AMS Management System is a key part of the organization. The following points share some lessons learned about building it:

- A project management system is vital for a successful business and is a system that requires a deal of effort to build.
- There is the possibility that far too much information will initially be incorporated. With maturity, though, ways to streamline it, yet still achieve the same end goals, will be recognized. This is a natural maturity progression.
- As IBM services many clients and they all have individual contract requirements, one of the key approaches used by AMS Australia was to keep the basic project management aspects as core information in the AMS Management System and to append client-specific items as needed. In this way, teams could identify core requirements, such as project planning, quality management, risk management, and so forth. They could then service a particular client's needs by linking to appropriate sites or additional information without a cluttered management system.

5.1.1.2 What Is in the AMS Management System?

The components of the Management System are

- policies and procedures
- guidelines for further optional information on particular subjects
- forms and templates for various work products that are the verifiable outcomes of management system procedure
- definitions (including roles, responsibilities, and delegations)
- training materials

The most significant components of the Management System are the AMS Australia policies and procedures. Policy defines what is expected of staff, and the procedures describe how the policy is to be implemented.

In Figure 11, the AMS conceptual procedure map shows how the procedures relate to one another and combine to form a comprehensive Management System, while Figure 12 provides a list of the Management System's available procedures.

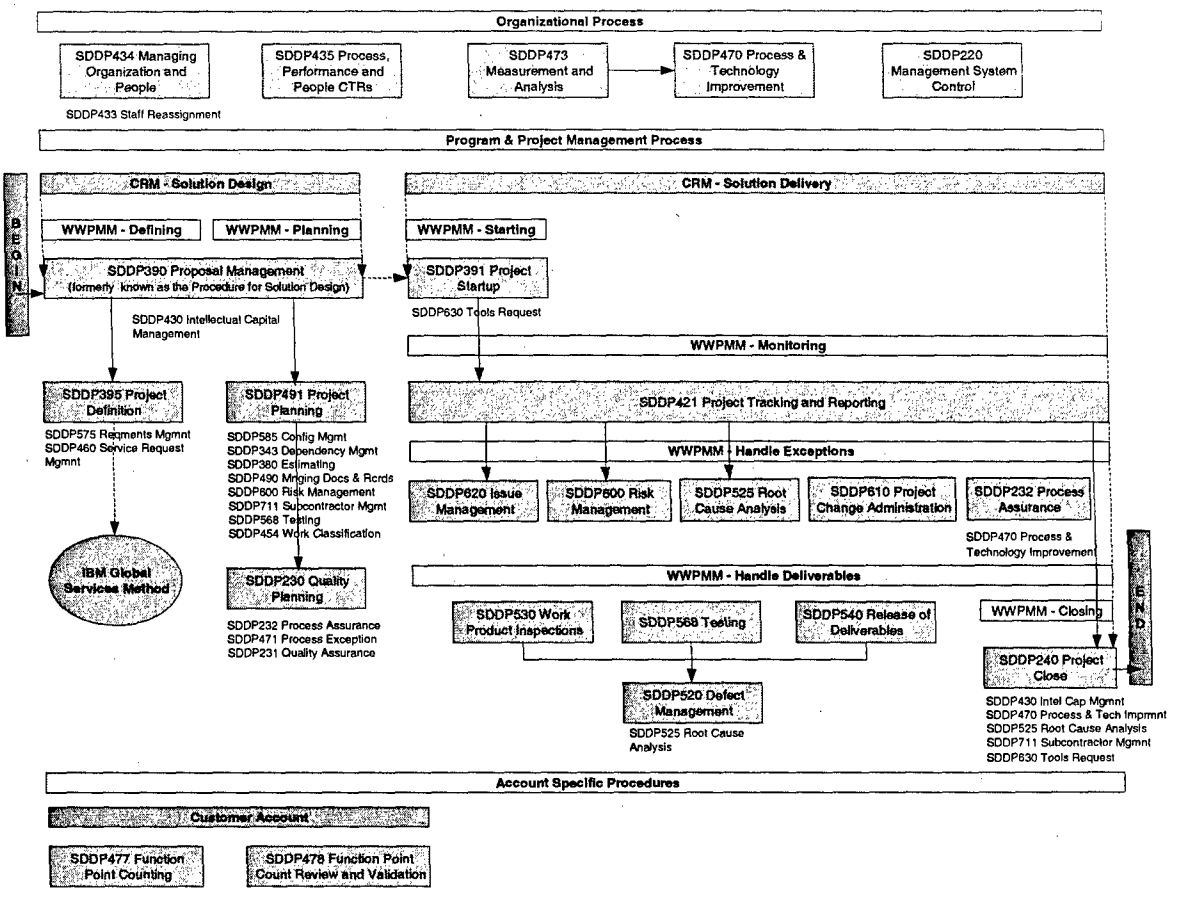

Figure 11: The AMS Management System Conceptual Procedure Map

SDDP585: Configuration Management SDDP520: Defect Management SDDP343: Dependency Management SDDP380: Estimating SDDP477: Function Point Counting SDDP478: Function Point Count Review and Validation SDDP430: Intellectual Capital Management SDDP620: Issue Management SDDP220: Management System Control SDDP490: Managing Documents and Records SDDP434: Managing Organization and People SDDP473: Measurement and Analysis SDDP470: Process and Technology Improvement SDDP232: Process Assurance SDDP471: Process Exception SDDP435: Process, Performance and People Critical Thread Reviews (CTRs) SDDP610: Project Change Administration SDDP240: Project Close	SDDP395: Project Definition SDDP491: Project Planning SDDP391: Project Startup SDDP421: Project Tracking and Reporting SDDP390: Proposal Management SDDP231: Quality Assurance SDDP230: Quality Planning SDDP540: Release of Deliverables from Solution Delivery SDDP575: Requirements Management SDDP600: Risk Management SDDP525: Root Cause Analysis SDDP460: Service Request Management SDDP433: Staff Reassignment SDDP711: Subcontractor Management SDDP568: Testing SDDP630: Tools Requests SDDP454: Work Classification SDDP530: Work Product Inspections

Figure 12: AMS Management System Procedure List

5.1.2 IBM Global Services Method

The IBM Global Services Method (The Method) is part of the Process Asset Library used by AMS Australia. The techniques it contains are used within projects to select the appropriate project life cycle as well as the technical and project management work products that will be produced. It is a ready source of work product templates along with guidance on how work products are carried out.

The Method provides a single method that enables the use of a "common language" among all practitioners delivering business solutions. It is a fundamental component for accelerating the IBM Global Services' shift to asset-based services, providing a mechanism for practitioners to reuse knowledge and assets using a consistent, integrated approach.

Contained within The Method is IBM's software life-cycle methodology, a multiphase methodology for managing solution architecture, design, build, and integration. This methodology integrates the combined knowledge and experiences of IBM professionals. It is a balanced, iterative approach with overlap between phases to provide the flexibility to respond to changing business conditions and scenarios. Each phase builds upon those that precede it and further refines the design and release strategy before development begins.

The Method consists of work/product-based software development and maintenance models that assist project teams in expertly planning and executing software development and maintenance projects. The individual models cover a wide variety of work types, including complex systems life-cycle management, rapid solutions development, custom development, package selection and implementation, maintenance, minor enhancements, and major enhancements. These models provide a collective sum of approaches that are necessary to complete service delivery.

Tools provided to use with The Method can generate the project work breakdown structure (WBS) based on the selected life cycle and work products. Projects can then modify and use this WBS for scheduling.

5.1.3 Tools and Technology

The IBM vision for project management tools is "a single comprehensive, scaleable, and supported tool set that enables and assists project teams across all IBM operating units and geographies."

AMS Australia works under that same principle, along with a policy for the use of tools that states, "Any software tools used will be selected from the list of approved tools."

In AMS Australia, there is

- a preferred tool set for existing applications

- a preferred system development life cycle (SDLC) tool set for new applications from IBM Rational Software
- a set of business processes for tool selection, acquisition, and management

It was apparent from the initial stages of the AMS Australia process improvement journey that having a common set of tools for the organization was important. Establishing this common set of tools was one of the key initiatives started during SW-CMM maturity level 2 and completed for maturity level 3.

Common tools have many benefits, and the key ones that have been seen relate to the organization's ability to provide proper support and education for the tools in use. An additional benefit is that team members are able to move easily between teams, knowing they will most likely be familiar with nearly all the tools (and methods and processes) that their new team uses.

Today, the AMS Australia tools team links with IBM worldwide and externally in the industry to ensure that AMS Australia has the best available tool set for project teams to execute their work. The team is actively involved in any proposed tools changes within the organization and participates with the IBM worldwide AMS group, sharing knowledge and learning from other areas. When new tools are planned, pilots are conducted and the results are used to make decisions about what benefits will be gained from using a new tool.

5.1.4 Rational Tools

AMS Australia began using the Rational tools after a search on the open market for a tool set that could be used to assist in achieving an increase in productivity. The Rational tool set is used within AMS Australia as part of the organization's standard tool set, with particular focus on the RequisitePro, ClearCase, and ClearQuest tools.

A key tool in terms of the AMS Australia CMMI-SE/SW maturity level 5 program was Rational ClearQuest, which is used for defect management. A front end to ClearQuest was developed to facilitate the capture of data relating to defects found during development (particularly, the results of the work-product inspection process). The additional capabilities were implemented in a Microsoft Excel tool (the Project Metrics Workbook) that extracts defect data from Rational ClearQuest and provides statistical process control reports for project teams.

The data reported via the Excel tool is used to establish process capability baselines for the work-product inspection sub-process. These baselines are maintained at the organization level and for specific groups of applications supported by individual project teams. The baselines are used to manage process performance and to identify opportunities for process improvement at the project and organization levels.

The overall defect data collected is used to monitor the stability and effectiveness of defect-removal activities across the organization. It is also used to drive a predictive model for the

expected number of defects, which is used for project planning and performance management.

5.1.5 Knowledge Management

Knowledge Management (KM) in AMS Australia is "a disciplined, systematic approach to leveraging people's expertise and information to improve organizational efficiency, responsiveness, competency, and innovation."

KM is simply about getting the right knowledge, to the right person, at the right time, in the right context.

IBM Global Services' goal is to provide the client with the best service possible. In an effort to attain this goal, the IBM Global Services KM Program provides for a system of policies, processes, people, values, and technology that enables IBM practitioners to identify, store, and reuse assets and knowledge for use in the client's environment.

IBM Global Services offers added value to the IBM client relationship in two areas:

- access to subject matter experts (SMEs) through global communities called Knowledge Networks and through local Communities of Practice (CoP) in Australia/New Zealand
- access to assets, which are referred to as intellectual capital (IC) and are produced by practitioners in the Knowledge Networks

IBM's IC comes in many different forms and, when integrated into projects, improves the quality of the deliverable while reducing the project's delivery time and risk factors. Assets may be used "as is" or customized to address project-specific requirements. Assets may also be very detailed, such as technical/white papers, architectures, and code components. They may also be more general, such as process descriptions or methodology overview materials. To facilitate reuse, IBM's IC is organized and stored within a repository available to all IBM Global Services employees.

For AMS Australia, examples of documentation, lessons learned, and helpful hints are placed in the Knowledge Café. This is an IBM Lotus Notes-based repository, which is accessible to AMS Australia staff, helping facilitate the reuse of IC.

If the asset has application potential beyond AMS Australia, a recommendation is made that it be deposited in Intellectual Capital Management (ICM) Asset Web or Knowledge View.

In addition to the formal repositories, the AMS Management System should be viewed as the best example of IC in terms of submission and reuse within the organization.

Figure 13 shows the relationship between the KM tools in AMS Australia.

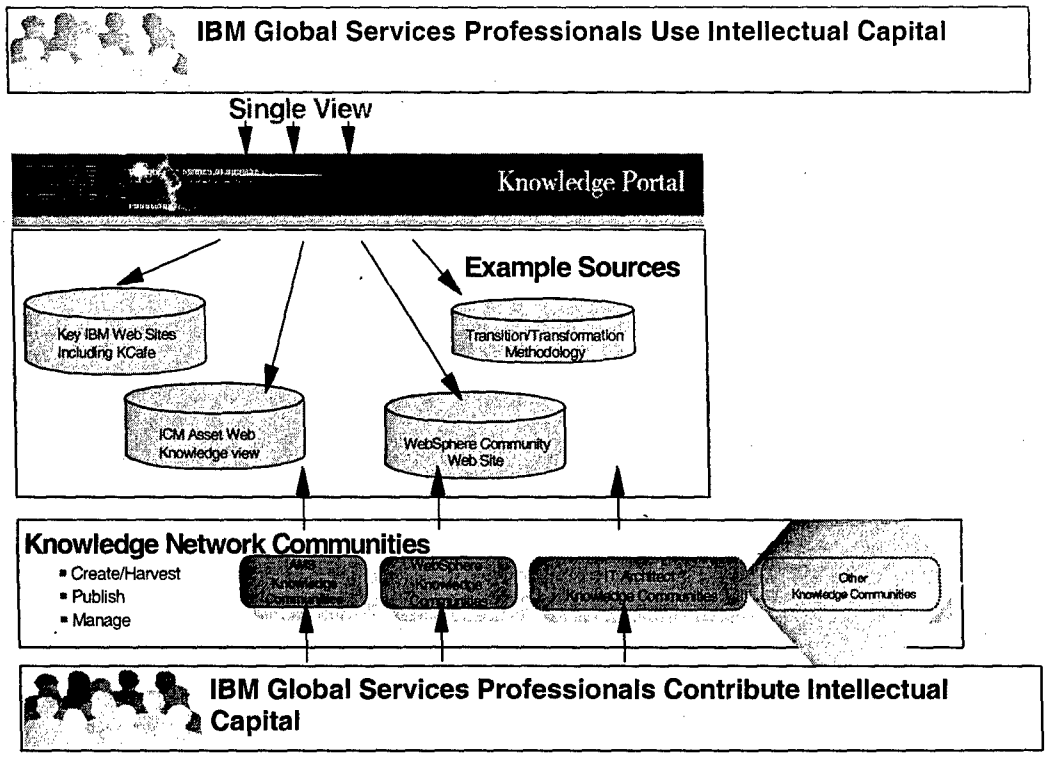

Figure 13: Knowledge Management Tools

5.2 Organization and People

5.2.1 People CMM® in IBM

The People CMM® [Curtis 95] provides IBM in Australia/New Zealand with a stable framework for managing and measuring change, transformation, and growth of its people capability. Its principles have been used in conjunction with the overall CMM program in the IBM Global Services Australia organization, and their use is one of the means by which success in this area can be measured.

The program of cultural change undertaken by IBM Global Services Australia was called the PACE program and is tightly linked with the IBM worldwide "Our Values at Work" program. Through this program, all employees have the opportunity to shape the company through initiatives such as World Jam where ideas, comments, and feedback can be collected and used to build IBM into the company that all employees believe it can be.

5.2.1.1 The PACE Program

The following values are part of the PACE program and have evolved over time. IBM has always had a strong culture, with people, clients, and a quest for excellence at its heart. In the

research and development of a more contemporary set of values and behaviors, AMS Australia found that people, clients, and excellence in everything are as appropriate now as they have ever been.

However, the addition of teaming was made, as teaming needs to be a way of life for all IBM employees and is key to the organization's ongoing success.

P People are our strength

A Achieving greater success through teaming

C Customers are our driving force

E Excellence in everything we do

5.2.1.2 People CMM Background for AMS Australia

The first People CMM (P-CMM) assessment in IBM worldwide was conducted in the first quarter of 2000 by Application Development and Maintenance (now AMS), IBM Australia account. The assessment was conducted to establish an initial baseline to support AMS Australia's account process and people goals and to understand opportunities for using the P-CMM in the wider organization.

Using the P-CMM, eight areas of people-management processes and practices were selected for initial focus and improvement. These areas were aimed at

- going back to the basics of people management
- actively leading and managing people and people-management practices
- building culture and teaming capability

The eight key areas, called key process areas (KPAs), were

- training
- communication
- compensation
- performance management
- work environment
- staffing
- participatory culture
- team building

The areas addressed some of the key issues faced by AMS Australia, such as

- integrating new staff quickly into the IBM culture
- harnessing IBM's people and process assets

- institutionalizing processes
- managing people
- using a one-team approach, common goals, and support across the organization
- improving employee morale and retention

5.2.2 Managing and Training People

IBM's success, just as with any company, depends on how well all employees achieve individual goals and contribute to the company's strategic objectives. IBM has a set of processes, tools, and methods dedicated to the management and training of its personnel.

Programs ranging from personal goal setting for contribution to the business (under the Personal Business Commitments [PBC] program) to the Individual Development Plan (IDP) and the professional development program for skills development set the stage for the business to succeed.

5.2.2.1 Skills Development

Skills development and training of staff is taken seriously within IBM, and the education and training programs in place are a significant strength. Career paths exist in management, architecture, technical competencies, sales, and other streams. These are complemented by many forms of training, such as formal courses, e-learning online, mentoring, and on-the-job training.

Skills development is planned for, supporting the organization's strategic business plans and ensuring that employees are trained for their roles. One of the key tools supporting skills development is the professional development (PD) tool.

The PD tool forms a repository for each individual's skills, skill level, and areas of competency. Skills are related to job roles. This repository is one of the means by which AMS Australia can ensure that it has the correct skills available at the right time and in the right location to meet the client's needs.

At the management level, the effectiveness of training is a key success factor.

Effectiveness is measured through its effect on a number of key AMS Australia business metrics:

- utilization
- on-time delivery
- on-budget delivery
- client satisfaction

Without processes and tools in place, it would be very difficult to manage such a large and diverse workforce effectively. These processes and tools have been refined and improved by using both the CMMI-SE/SW model and the P-CMM.

5.2.3 Organizational Structure

AMS Australia is a large organization. Clearly, structure is important in any organization, and the roles and responsibilities of the teams within the structure play an important part in successful delivery of products and services to the client. The following descriptions are intended to serve as an insight into the general structure of the AMS Australia organization. This information will help with understanding some of the approaches taken for process improvement.

This section does not cover the human resources and other common business functions such as finance. These functions broadly sit across the AMS Australia team and are aligned with the IBM Australia and worldwide team's requirements.

5.2.3.1 Application Centers and Project Teams

The AMS Australia organization is structured around Application Centers, with each having an Application Center Manager. Within these centers, application teams operate and undertake multiple projects in the course of a year.

Usually, applications have a release-based approach to development work for the client, with frequency and content of releases being determined with the client for each project undertaken. Project teams also undertake maintenance work on those same applications.

Each application team is assigned a manager who is accountable for the work on that application. In some instances, where the application is large and the individual projects undertaken are significant, a separate project manager is assigned in addition to the application manager.

Projects are structured in the usual way, with analysts, development staff, testers, and so forth. In addition, applications and projects will also have access to a Project Quality Analyst (PQA), who is responsible for checking that the planned processes have been followed in the project.

Resources that make up the team may be located in different regional, capital city, and geographic locations.

5.2.3.2 Support of the Application Centers

Support of the Application Centers includes, but is not limited to, the following groups:

IBM Quality Assurance Group: This group is responsible for ensuring that the quality of projects within IBM is maintained. This involves evaluating the proposal and overall project performance on a regular basis and implementing actions to ensure that

- the proposal or project meets the client and IBM objectives
- the proposal or project goals are achieved
- procedures are followed

See Section 5.2.7 for further information on quality assurance within AMS Australia.

AMS Transformation Team: This group is responsible for the organization's processes, tools, methods, metrics, skills, and culture programs. The team supports the Application Centers in the following areas:

- development and maintenance of the organizational processes as contained within the Management System (see Section 5.1.1)
- tools licensing, ensuring the use of a common tool set within AMS Australia, evaluating new tools, and interacting and linkage with the IBM worldwide community for new ideas
- assisting the delivery areas to ensure that accounts are integrated successfully into the AMS Australia environment. This covers deployment and institutionalization of processes, methods, and tools.
- ongoing collection and collation of measurement data and production of the metrics reports used to run the business. A specialist group is also responsible for evaluation of the metrics and production of the process capability baselines for the organization. (See Section 6 for more information on metrics.)
- linking the entire AMS Australia team to the IBM worldwide practices for skills management. Team members also ensure that staff can be used effectively in the business and have the right skill mix to service clients' current and future needs.

5.2.4 Organizational Meetings—P3

As a part of the organization's process improvement, the need for a well-defined and structured set of meetings was identified. The Process, People, and Performance—Critical Thread Reviews meetings (known as P3 meetings) were developed.

This meeting hierarchy covers the activities at all levels of management from project team to General Manager, allowing insight into key elements required to run a successful business (see Figure 14).

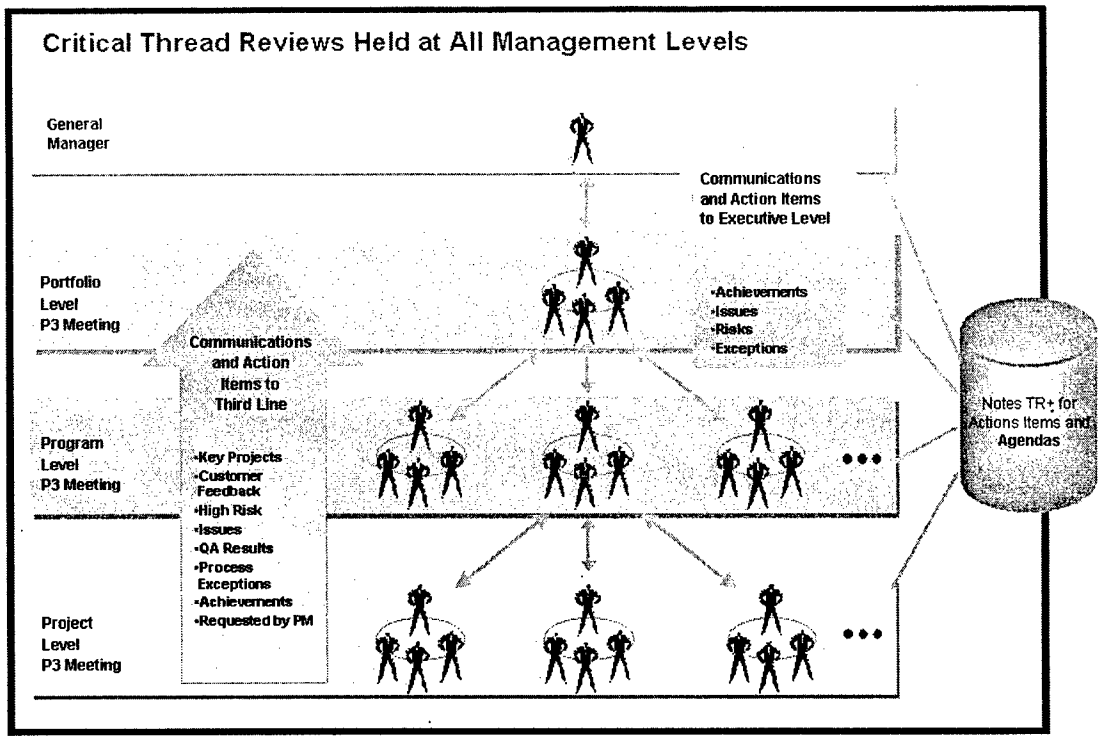

Figure 14: Process, People, and Performance Meetings (P3)—Critical Thread Reviews (CTRs)

The P3 meeting structure

- allows rapid implementation of core metrics and roll out of new metrics as accounts mature
- is tightly linked to the governance model
- encourages the use of a fact-based approach to managing (which is essential in cross-vendor delivery initiatives)
- provides consistency throughout all delivery initiatives, enabling quick problem identification and leveraging best practices
- is supported by a low-cost infrastructure to capture and roll up metrics
- provides a clear escalation path for issues

The meeting structures cover factors such as, but not limited to, the following:

- processes, including
  - processes used
  - metrics
  - improvements
  - quality assurance issues
  - process verification

- performance, including
  - on-time/budget deliveries
  - metrics
  - logs of risk issues, actions, and dependencies
  - maintenance activities
- people, including
  - skills development
  - leave
  - individual performance targets
  - skills development plans
  - attrition
  - skills blend
  - succession plans

5.2.5 Process Improvement Team

To make changes within an organization, communication is essential. Getting the message across and having it understood and implemented can often prove to be quite difficult. Usually, Process Improvement Teams (PITs), or those personnel who must develop and implement organizational processes and tools, do not possess an endless supply of resources to get the job done, even though they are sponsored and funded. The business, after all, must continue to operate successfully even if it is in the middle of a process improvement program.

The PIT model is one that worked successfully within AMS Australia. It was implemented differently for SW-CMM levels 2 and 3 and CMMI-SE/SW levels 4 and 5, but in essence the idea was to have a group of people in the business (in the project areas) separate to the usual core team that develops and maintains the organization's processes and tools.

Those people were dedicated to ensuring that plans for process improvement were created and that actions were carried out successfully. They were the link between the AMS Transformation Team (those creating the project management system and procedures, those in the tools support groups, or those running the CMM program) and the project teams on the "shop floor."

The PITs were essential. Without them, the job of transforming the organization would have been far more difficult. Below are some lessons learned about the use of PITs.

5.2.5.1 Lessons Learned

Think carefully about who manages the PIT: Management by the business buys ownership of the role and results. But it can also mean that staff members may be consumed by other work as well as their process improvement role(s).

Management by the core PIT means that the role is controlled, managed, and dedicated to the job at hand. However, the business areas may feel a lack of ownership if they don't own the PIT role. It also requires more effort to make things happen, as the work required for process improvement has to be inserted into the business at each step.

Don't try to give the PIT members too many roles: The PIT members are very closely involved with the projects in implementation of the process changes, new tools, and much more. Within AMS Australia, they were also targeted for Software Engineering Process Group (SEPG) membership and a host of other jobs in the organization's early process improvement efforts. They need to focus on the role of helping teams implement process improvement, as this can become lost among all the "urgent work."

Members of the PITs are excellent sources of information, and AMS Australia found they served best in focus groups helping the teams implement and institutionalize. They were invaluable in assisting in communication and solving specific problems as projects for the SEPG.

Choose the PIT members wisely: the best people in the organization are needed for process improvement work.

5.2.6 The Software Engineering Process Group

The SEPG is an essential part of the organization, and its function is necessary to run the business. Its role is to identify and develop proposals for process improvement initiatives and to carry out the work programs to implement these improvements. To do this, the SEPG must coordinate with management, service delivery, and subject matter experts, drawing together the organization to implement these improvements.

The SEPG at AMS Australia has taken several forms as the organization has learned about better structuring such a group to participate effectively in and with the business. Today the SEPG is a virtual team made up of members from the AMS Transformation Team, the Application Center Managers, and the AMS General Manager. This group provides oversight of process improvement initiatives in AMS Australia. Figure 15 shows the structure of the SEPG.

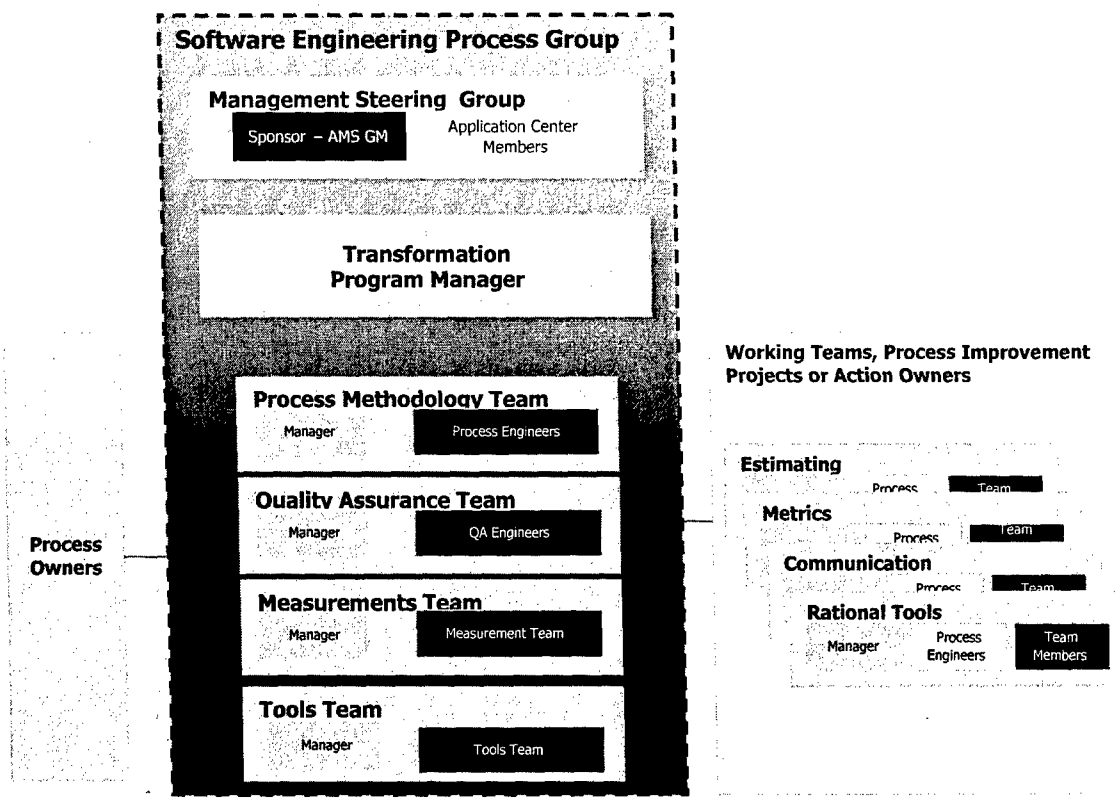

Figure 15: SEPG Structure

Below are some of the lessons learned from implementing such a group and making it work.

5.2.6.1 Lessons Learned

Choose the members of the SEPG with care. It is important to consider the following:

- Members must be competent in representing their area and its ideas.
- A group that is too large will have difficulty reaching consensus.
- Members must have the authority to make decisions on behalf of the group they represent. Otherwise nothing will happen, or the chain of events to gain approval will be unbearably long.

Ensure that the SEPG includes project representation. An SEPG that is made up of people from a "central quality group" suffers from the "ivory tower" syndrome. Project teams are not likely to agree with, or be quick to implement, what a group perceived to be isolated from reality decides to do.

Define the role of the SEPG clearly. It cannot and should not do everything related to process improvement. There are other teams for those jobs. The AMS Australia SEPG makes decisions about process improvements that have been identified and qualified. It approves process improvement work or, if necessary, refers it to the Change Control Board (senior executive team that has the authority to provide funding) for approval. It also tracks progress

of process improvement initiatives at a high level and enables successful completion of this work. It does not meet to solve the problems of the organization. Solution work is usually done in a separate forum, as is the work to implement solutions.

5.2.7 Process and Product Quality in IBM

IBM addresses overall quality through a combination of practices.

The CMMI-SE/SW model uses the practices in the process and product quality assurance process area to ensure that planned processes are implemented. The practices in the verification process area ensure that the specified requirements are satisfied. As stated in the model, "These two process areas may on occasion address the same work product but from different perspectives."

Simply speaking, work product inspections and testing allow AMS Australia to check that what is being done satisfies the specified requirements. In terms of ensuring that planned processes are implemented, a combination of IBM worldwide quality assurance activities and internal process assurance activities are used. In this way, IBM can ensure that the business undertaken will be successful and provide clients with the level of quality both they and IBM expect.

5.2.7.1 Key Aspects of Quality Management

Software quality assurance can be defined as the set of systematic activities providing evidence of the ability of the software process to produce a software product that is fit for use. Figure 16 depicts how software quality assurance is viewed within AMS Australia. These three areas and their associated activities provide the complete picture of quality for product and process.

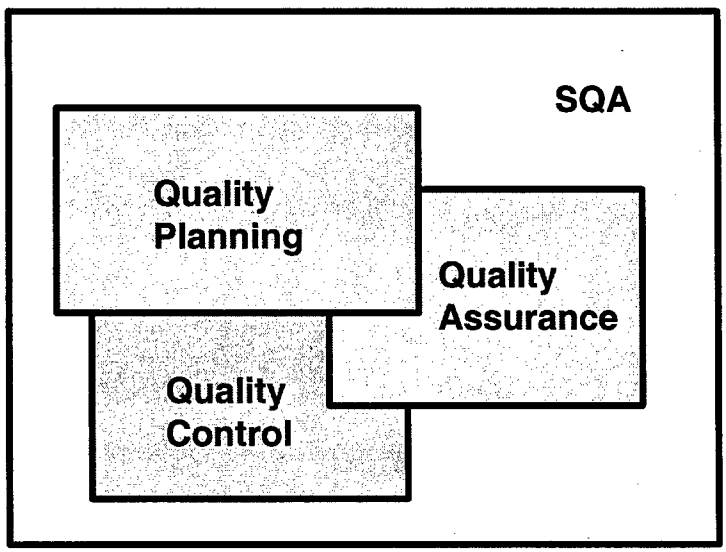

Figure 16: The Three Major Quality Management Processes

Quality management involves planning, performing, and managing software quality assurance (SQA) activities in order to

- achieve specific quality goals
- provide management with appropriate visibility into the processes being used by software project teams and the products being built
- identify opportunities for improvement
- develop a quantitative understanding of the quality of projects' software products

Key characteristics of each of the three major quality management processes—quality planning, quality assurance, and quality control—are outlined below.

Quality planning: This involves identifying the quality standards that apply to a proposal or project and documenting them through the quality plans. It occurs at the commencement of the proposal or project, and it defines the quality-related activities to be carried out or conformed to during the execution of the proposal or project.

Quality assurance: Quality assurance involves evaluation of the proposal and overall project performance on a regular basis, and implementing actions to ensure that

- the proposal or project meets client and IBM objectives
- proposal or project goals are achieved
- procedures are followed

In addition, quality assurance

- is carried out through interaction between the Quality Assurance Group and the proposal or project team (usually only the project manager and a quality assurer who is independent of the proposal or project team)
- is essentially external to the day-to-day activities of the project environment
- relates primarily to the proposal to be presented to the client and to the project planning and processes (Quality assurance pertains to the process for producing work products and deliverables, delivering the products and deliverables profitably and with high customer satisfaction, and identifying risk.)
- ensures that what is delivered is provided on time, is within budget, and meets the client's requirements
- ensures that risk is managed

Quality control: Quality control involves monitoring particular work products and deliverables in order to determine compliance to relevant standards or acceptance criteria. It also confirms that the overall solution and major deliverables (in contrast to the individual work products and deliverables, which undergo peer reviews and testing)

- have been developed and verified in accordance with the project's solution engineering plan and test plans
- meet the client's requirements
- are ready to be delivered to the client

In addition, quality control

- is carried out with the help of project SMEs and independent SMEs for the review of the overall solution or major deliverables
- should be performed with some independence from the management responsibility for project delivery. However, in practice, many of the quality control activities are performed within the project environment, relying heavily on project-specific inspections, reviews, tests, and records
- relates primarily to the project work products and deliverables produced by the project effort
- includes assessment and confirmation of compliance to business processes

5.2.7.2 Implementing Quality Control—Process Assurance

For AMS Australia, probably the most complex element to implement over the process improvement journey was quality control, particularly process assurance.

Process assurance ensures that projects follow their planned processes. The difficulty comes in ensuring that this is done in a balanced way, achieving the desired results without overburdening the projects. The final outcome is to ensure that projects *do* follow the appropriate processes and that information is collected to enable improvement of those processes. This is done in the following ways:

- verification of processes' completion: This takes place during the life of the project—usually at the end of major phases, such as design—and at the end of a project. It ensures that, as the project progresses, it is doing so according to the planned processes.
- process adherence verification: This ensures that a project, or small projects grouped under a single manager, follows the planned processes. This check is done either
  - at the end of a project (This depends on size, criticality, etc.)
  - at the end of a phase (Again, this is dependent on size, criticality, etc.)
  - periodically on groups of smaller projects under the same manager
  - periodically on larger applications that are in enhancement and maintenance mode

In addition, predefined criteria are used by the IBM Quality Assurance Group to select projects for quality review. These reviews include assessment of the project's stated processes.

Process assurance is conducted independently of the line management by a Project Quality Analyst (PQA). This is done for the application, a group of applications, or project(s). Results are used to evaluate project, application, and organizational compliance to processes. They

are also used to determine candidate areas for process improvement if, for example, some processes are consistently granted an approved exception from use.

The PQA role requires a great deal of knowledge about how projects should operate and, as such, should be filled by staff members who are suitably experienced. Within AMS Australia, proper use of this role has been yet one more learning experience.

5.2.7.3 Tools for Process Adherence Verification

During the earlier stages of our improvement initiatives, a manual method of evaluating compliance against organizational processes was used. It was a simple Microsoft Word-based tool used by the PQA.

As AMS Australia moved higher up the CMM maturity rating scale and toward CMMI-SE/SW, it became increasingly evident that a manual tool for this activity would be ineffective. A means of capturing the data and making use of the results at an organization level was needed.

A Microsoft Excel tool has since been developed and, for projects, this captures the essence of the CMMI-SE/SW model through the use of about 100 questions. As shown in Figure 17, the tool gives ratings against the AMS Australia organizational process set and the CMMI-SE/SW model, with questions mapped to the model's process areas down to the level of specific practices. This tool has allowed the organization to roll up organizational results, identify areas for improvement, and track process compliance.

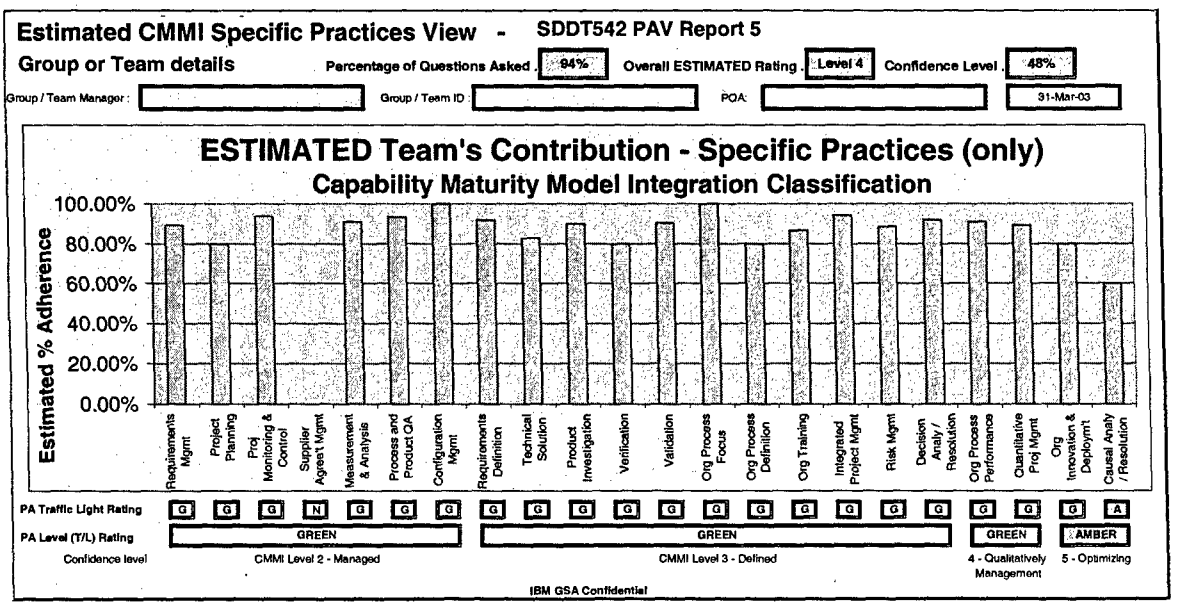

Figure 17: Process Adherence Verification—CMMI View

5.2.8 Involvement of Practitioners in Process Development

All AMS Australia staff members are expected and encouraged to participate actively in process improvement, with online feedback through the AMS Management System being the primary means of participation. Staff members may also raise opportunities for improvement (OFIs) through their Process CTR meetings, which may then be fed to the SEPG. All OFIs are logged on the AMS Management System and tracked through to closure.

There are awards given for active assistance in identification of OFIs, and even reuse of work products through the IBM Intellectual Capital Management process.

The online feedback page is used to submit OFIs in

- software development processes
- methods
- tools
- metrics
- quality
- organization
- other areas

Information collected from within the submission allows categorization of the OFI, allowing it to be directed to the appropriate process owner for investigation. A view of the OFI log can be formulated to show, for example, the most common categories of OFIs as well as other useful information.

Submissions must contain

- description of the feedback
- benefits of implementing the feedback (OFI)
- impact of not implementing the feedback (OFI)

Once submitted, an OFI is assigned a unique number and a system-generated message advises that the submission has been received. Submitters may view their OFI and its progress online via a link from the feedback page.

Figure 18 shows how opportunities for improvement are managed within AMS Australia.

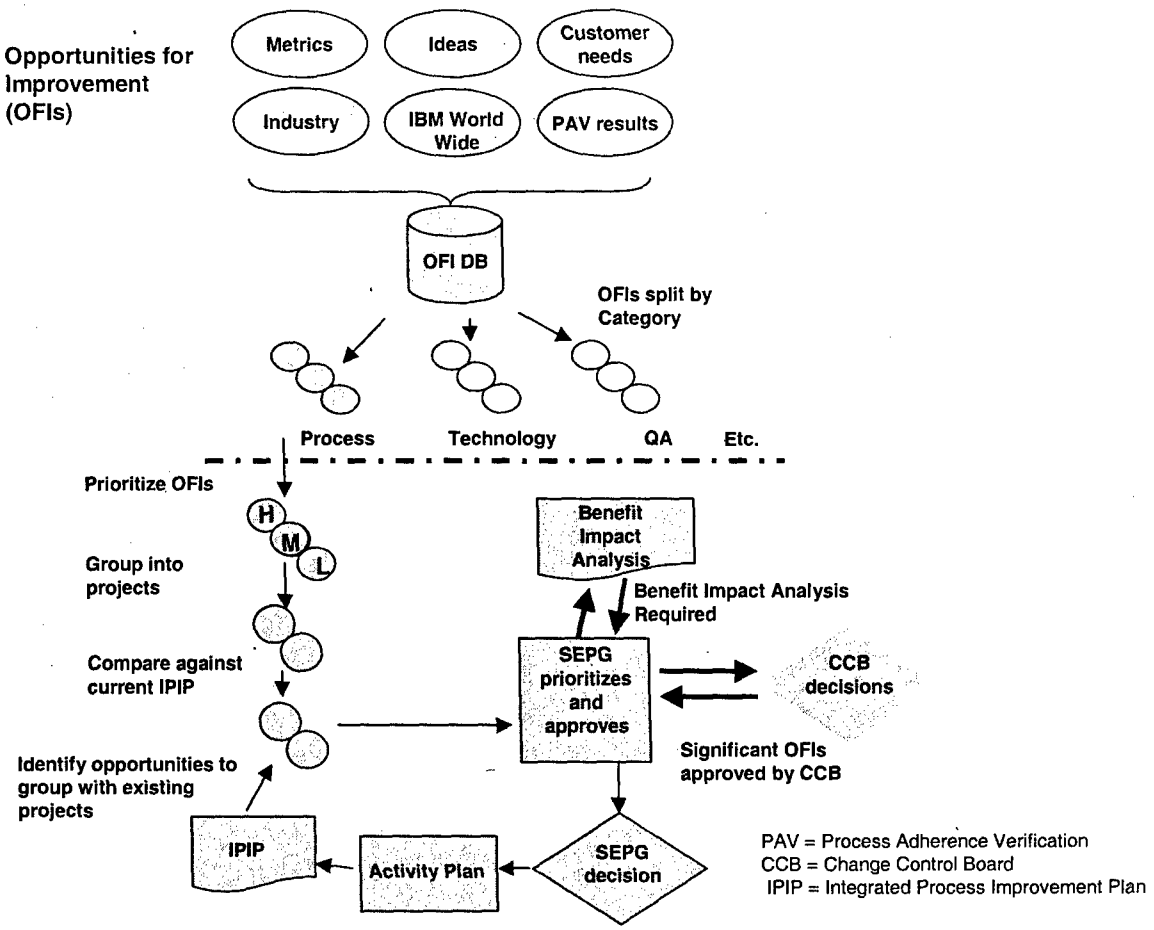

Figure 18: OFI Action Process

6 Measurement and Metrics

Within IBM, there is a well-established requirement that measurements will be used to run the business. This culture is reinforced by the need to deliver services that meet quantitative contractual goals and client expectations. Aligning measurements to client and business goals and needs is common practice. If it is important to the business, it is measured and the measurements are used by management on a daily basis.

In Australia, AMS grew from outsourced client organizations, which typically performed little formal measurement beyond schedule and budget for individual projects. However, measurement and reporting of performance under Service Level Agreements is an expected part of service delivery contracts, so measurement practices in the outsourced accounts matured rapidly.

Initially, measurement and reporting functions concentrated on specific requirements of client accounts (e.g., Service Level Agreements) and operational management (e.g., on-time and on-budget project performance). Over time, this has matured into a broader view of performance achievements and improvement opportunities for the AMS Australia line of business.

Because of this strong background of measurement, IBM has been able to bring together a metrics program that adds significant value to the client and IBM business. From the early years, measurement activities have grown to the point that more than 3,000 operational level reports are published each month, covering

- quality assurance (QA) activities
- process improvement activities
- status of work in progress
- defect data
- contractual metrics (service levels, etc.)
- hours worked
- staff utilization and leave
- skills development and education

In addition, a monthly reporting cycle for the AMS Australia line of business includes performance measures at the Application Center and line of business level, covering

- client satisfaction
- staff utilization

- recovery position
- cost per function point
- fixed price maintenance
- QA issues
- timesheets on time
- projects on time/budget
- business controls
- staff attrition
- individual development plans in place
- average staff skill levels
- succession plans

Subsequently, AMS Australia has moved to a further level of maturity in measurement of process performance. A program of statistical process control and the use of predictive models for key measurements now form part of project and organization level management.

The following sections outline current operation of the AMS Australia metrics program.

6.1 Selection of Key Metrics for the Organization

The key metrics for AMS Australia are chosen to reflect and support the organization's business goals. These are derived both from client requirements and from consideration of the performance required of the AMS Australia service delivery organization. Figure 19 shows the relationship that is developed between the business goals, metrics, and delivery processes.

Because they are linked to business goals, the measures are subject to ongoing review and change. Shifts in market conditions, service offerings, and business goals dictate that new measures be established, while process and performance improvement leads to evolution or retirement of established metrics.

However, the varying scope and maturity of client organizations outsourced (and thus added to the AMS Australia service delivery organization) determine what level and type of data are immediately available. At the same time, growth and maturity of the AMS Australia business operations identify more specific measures to address key performance concerns.

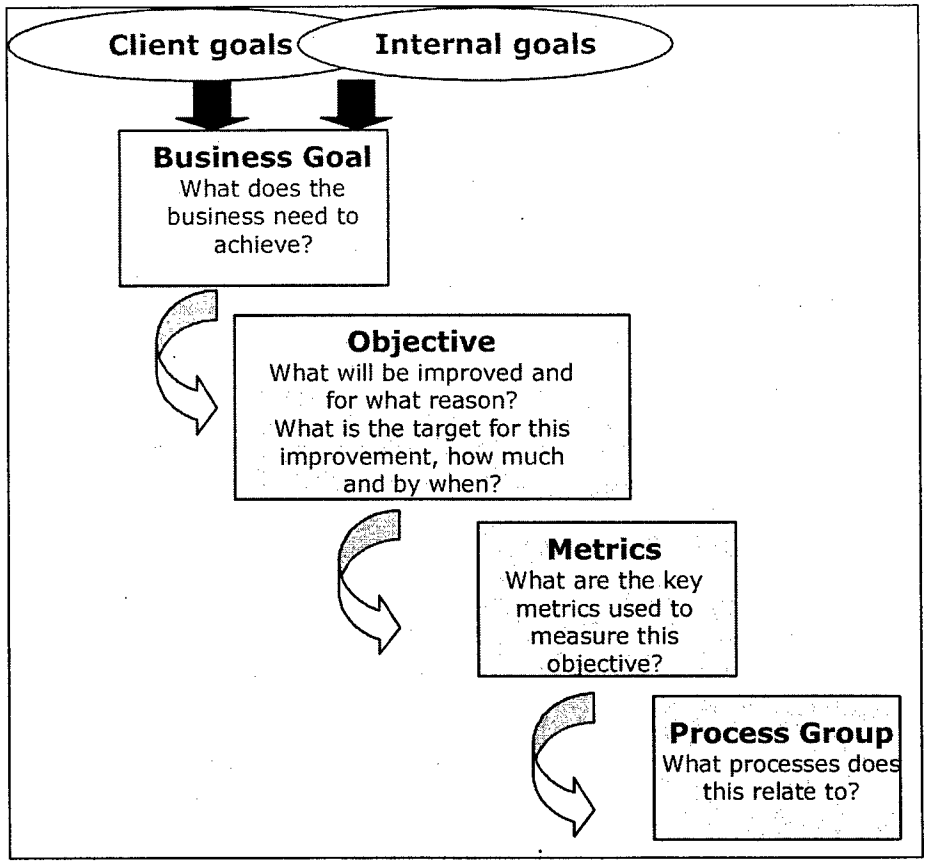

Figure 19: Identification of Key Metrics

To maintain a relevant set of measurements and reports, key metrics are regularly reviewed and revised. For the AMS Australia line of business, measurement and reporting are developed to support the annual business goals and senior management objectives as part of start-of-year goal setting by senior management. Adjustments may also be made throughout the year, as required by changing circumstances.

The key metrics selected are described in the AMS Measurements Strategy. This document details the linkage between the business goals and metrics selected to support their management. It links the business terminology with a description of what is to be measured and its related process. This linkage allows the organization to ensure that delivery performance is quantified against client and business requirements. Figure 20 shows a typical entry from the key metrics table.

Business Goal	Objective	Metrics	Process Group
The AMS delivery capability matches market demand	Improve delivery processes to reduce the level of defects entering production. Target 10% reduction of production problems by end of year.	Inspection Coverage (inspection hours / 1,000 build hours) during the code phase Inspection Defect Density (defects found / 1,000 build hours) during the code phase Inspection Effectiveness (defects found / 100 inspection hours) during the code phase	Work Product Inspection

Figure 20: Key Metrics Table Entry

Activities necessary to implement data collection, analysis, and reporting for the key metrics are described in the AMS Organizational Quality Management Plan (QMP). Both organizational and project-level activities are addressed by the requirements of this document. AMS Management System procedures ensure that the appropriate quality management goals, measurement, and reporting are inherited from the organizational QMP by each project.

6.2 Managing the Projects Using Metrics

Projects inherit the standard set of project quality and performance objectives set by the organization to reflect business goals, and add to these only if dictated by specific client requirements.

Baselines and control limits for measures under statistical process control are maintained by the AMS Transformation Measurements Group as a service to projects. Targets and control limits for processes under statistical control are established from either organization- or project- (application) specific baselines as appropriate. Project teams are responsible for managing to the control limits, identifying and investigating significant instances in the control charts, and taking action where assignable causes are identified.

The project data collection and reporting tools are shown in Figure 21. Organization functions undertake productivity tracking and the activities required to produce the various metrics reports and maintain the work request database (known as the Work Order Register), the AMS Datamart database, and the statistical process control baselines.

Individual project teams are responsible for quantitative management of development defects using the ClearQuest, Project Metrics Workbook, and application control limit tools; they are also responsible for collecting and reporting productivity and project delivery data via the Work Order Register database.

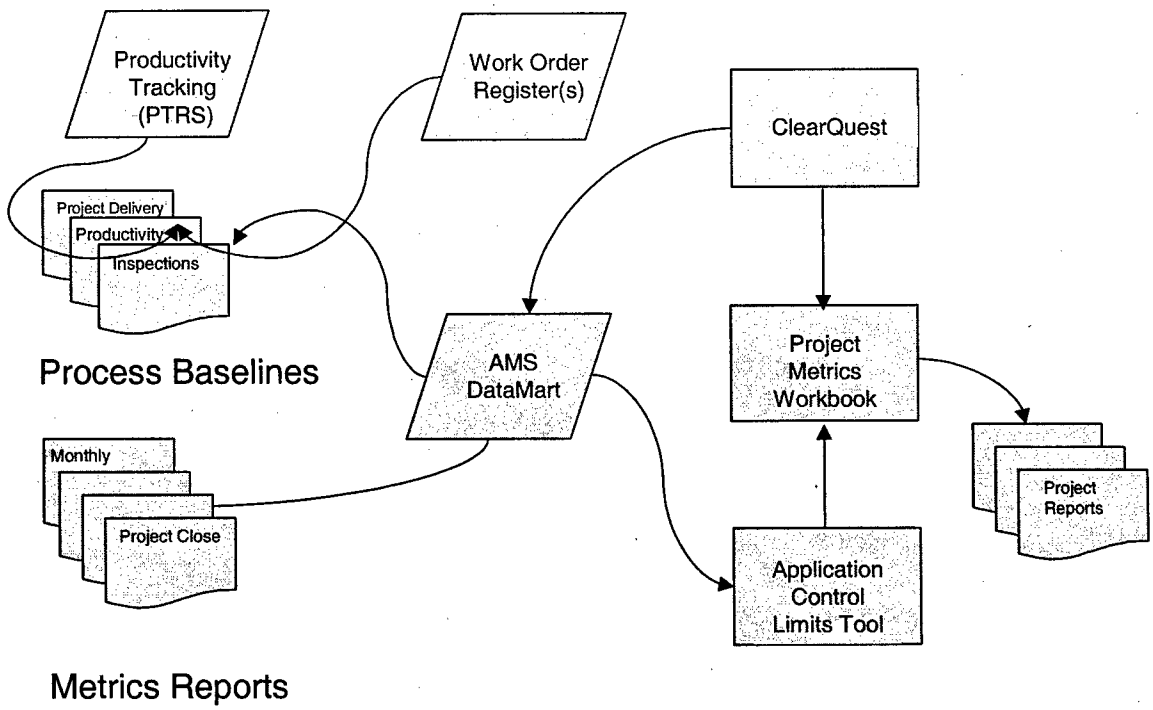

Figure 21: Measurement Collection and Reporting Tools

Projects manage against quality and performance objectives on a weekly basis (including Earned Value, schedule, budget, work product inspection, and defect data). Performance is monitored throughout the project using statistical process control charts for key measures. Performance against objectives is also verified at phase or project end, and causes of performance variations are analyzed.

Corrective action or process improvement actions are undertaken by the project as appropriate. Opportunities for improvement may also be escalated to the AMS Transformation Measurement Group for analysis or action at the organization level.

6.3 Statistical Process Control Approach

Where there is business benefit, performance measurements of selected processes have been placed under statistical control with

- work product inspection sub-process
- service delivery productivity processes
- project delivery (on-time, on-budget, estimation) processes

The processes subject to statistical process control vary from time to time according to business and performance goals and concerns. Factors influencing the choice of processes include

- the work product inspection sub-process
  - supports a key AMS Australia delivery objective (product quality)
  - leads to reduced defects (and thus reduced cost and rework effort)
  - is a self-contained, clearly defined process (process stability is expected)
  - is repeatedly executed during each project phase (acceptable quantity of measurement data)
  - has automated data capture in place (part of existing defect management process)
- the service delivery productivity processes
  - directly support AMS Australia delivery objectives (client satisfaction)
  - use data already collected and reported (ease of implementation)
  - are supported by an automated tool set (ease of implementation)
  - are already integrated into project reporting and review processes (relevant to management practices)

The AMS Transformation Measurement Group maintains process capability baselines for the selected measurements at the organization level and for project- or application-related subgroups as required. The Measurement Group reviews new performance data, provides regular recommendations for capability baseline updates, and reviews performance at the organization level to identify common trends and OFIs. An example control chart from the project delivery (on-time) baseline is shown in Figure 22.

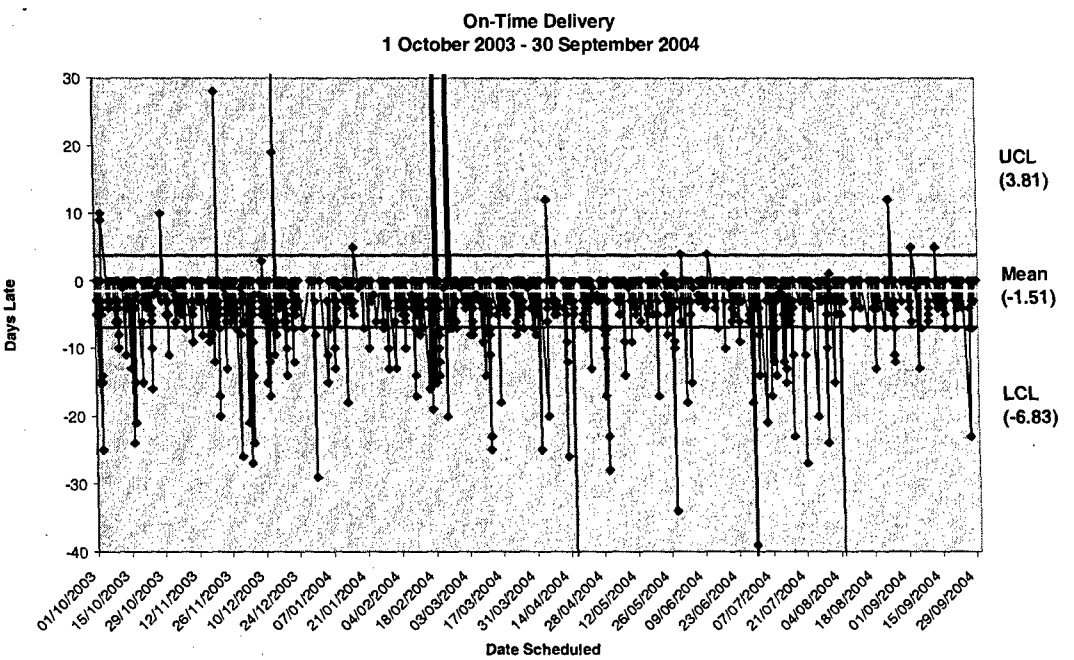

Figure 22: Control Chart for Project Delivery (On-Time)

Data from all projects is collected and stored in the AMS metrics databases, from where it is extracted, "scrubbed," and analyzed as required to establish or update process capability baselines. Baseline updates take place regularly (typically every six months) or as required when significant changes in process performance are identified. Baseline data and statistical analysis reports are presented to management with recommendations for action.

Baselines (data and reports) are available on the AMS Measurements Reporting (intranet) site for use as required. Work product inspections and defect baseline data (control charts and limits) are also presented via Project Metrics WorkBook (PMWB) reports.

Control chart models are selected individually for each measurement, depending on the characteristics of the underlying process and the available data. Current measures are analyzed using individual and moving range models, but the application of rational sub-grouping is being investigated to recognize time-based (weekly, monthly, annually) and attribute-based (platform, language, Application Center) characteristics.

Modeling approaches are also evolved in light of project experience. For example, control charts are now produced for work product inspection measures for groups of application programs, rather than pooling data at the organization level. Doing this yields more specific control limits and more clearly presents performance trends.

Historically, process performance targets were applied to measurement now under statistical process control. These targets were based on industry averages, historical performance, or business goals. Control limits calculated from current and historical process performance data now supplement or replace these targets.

Service delivery project teams manage their performance using these control charts and limits. Data is collected from projects as it becomes available, and it is reviewed either weekly or at phase or project end points as appropriate for the measure. Where actual performance is outside the control limits, or control chart features suggest possible assignable causes, the project undertakes causal analysis and corrective action.

6.4 Measurement and Reporting Infrastructure

Collection, analysis, and reporting of data are performed by project teams and (above the project level) the AMS Transformation Measurements Group. Where possible, measurement collection is supported by the following tools:

- ClearQuest (defect management)
- Project Metrics Workbook (work product inspection metrics)
- Work Order Register (project status and attributes)
- Earned Value (EV) tool (project status)

Copies of data and reports are kept in Project Control Books, AMS Measurements Datamart databases, working directories for the AMS Australia management monthly performance review, and on the AMS Measurements Reports (intranet) site, with access controls as appropriate.

Reporting is largely automated, either as tools output (ClearQuest and EV) or as weekly and monthly reports available on the AMS Measurements Reports (intranet) site and the AMS Knowledge Café. The tools and databases used to implement reporting are shown in Figure 23.

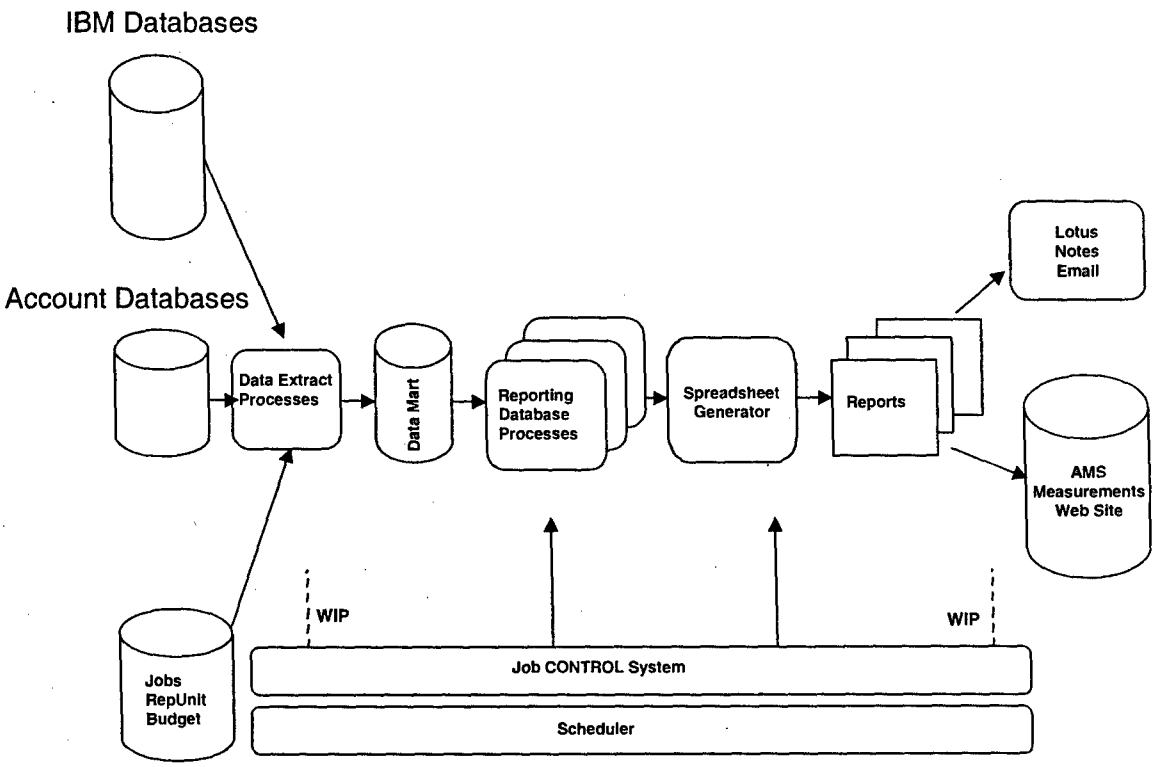

Figure 23: Measurement and Reporting Infrastructure

More than 3,000 operation-level reports are published each month, addressing specific areas aligned to project reviews. These reports cover

- QA activities
- process improvement activities
- status of work in progress (WIP)
- defect data
- contractual metrics (service levels, etc.)
- hours worked

- staff utilization and leave
- skills development and education

The majority of reports are made available through the AMS Measurements Report site (shown in Figure 24), which is a Web site maintained on IBM's worldwide intranet that is accessible to project and management staff in Australian and overseas locations. A simple "filing cabinet" site organization provides access to current reports (typically in Microsoft Word or Excel format).

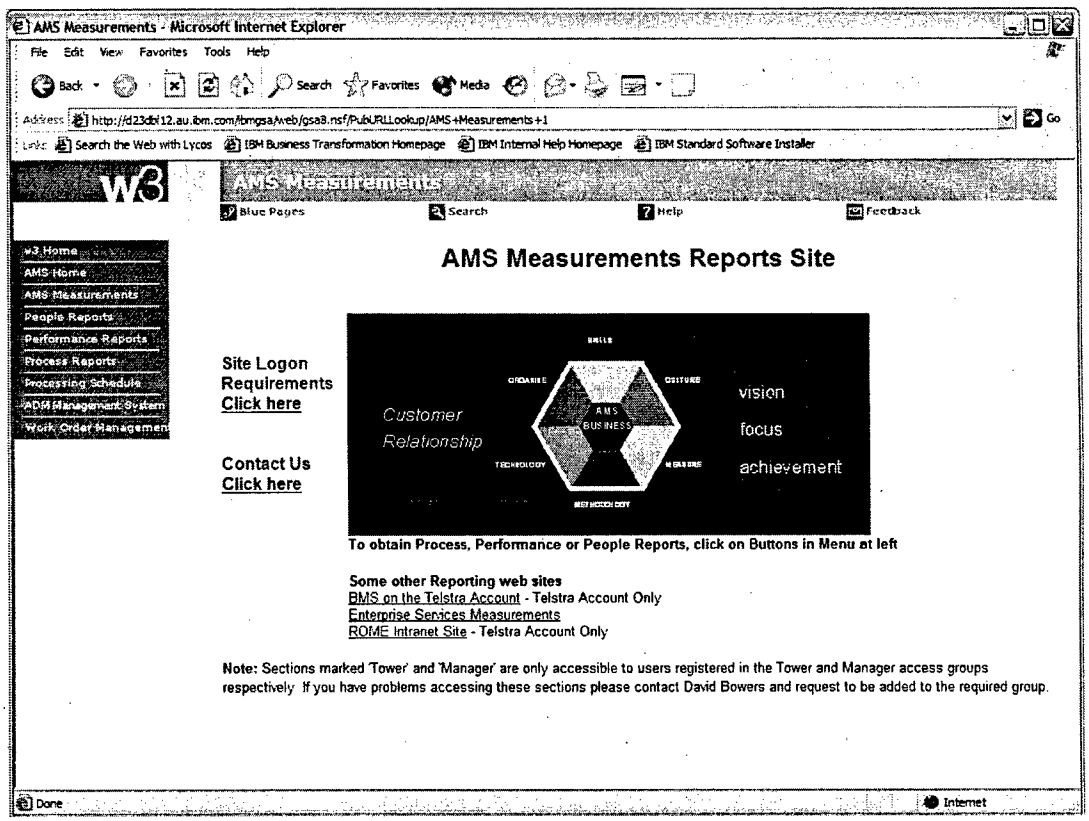

Figure 24: AMS Measurements Web Site

6.5 Performance Models

The process performance data gathered has enabled the construction of predictive models in the areas of productivity and defect management.

The productivity prediction model (Forecaster) uses historical productivity data for individual application groups in the portfolio to predict likely productivity in the forthcoming productivity measurement period. Expert judgment from development staff, taking account of factors affecting productivity, is used to modify the historical prediction. This information is com-

bined with forecasts of the budgeted effort for development and enhancement activities for each application group.

The result is a forecast of total effort and productivity for activities in the portfolio. As the measurement period progresses, actual values of effort and productivity are substituted for the forecast values, resulting in a more accurate prediction of overall performance against business and client commitments. The model also allows departures from the original forecast and developing performance trends to be identified in time to take corrective actions.

The defect prediction model supports phase-by-phase prediction and tracking of the number of defects likely to be encountered during development. Supported by tools and analysis guidelines, this information assists project managers in accurately planning projects and in assessing project progress against expected results at interim points (phase ends).

Organizational (or application-/project-specific) historical data is used to predict defect levels for projects during their planning and early execution phases. The model uses simple averages of defects found per phase, normalized to phase effort. The data required is drawn from statistical process control measurements for the work product inspection process.

In addition, the numbers of defects injected or detected in each phase are managed at the level of Application Centers (individual locations with up to several hundred staff members). For each development life-cycle phase, both the number of defects encountered in each phase and the percentages of total defects are monitored for trends and recent changes. An example of monthly reporting for an Application Center is shown in Figure 25.

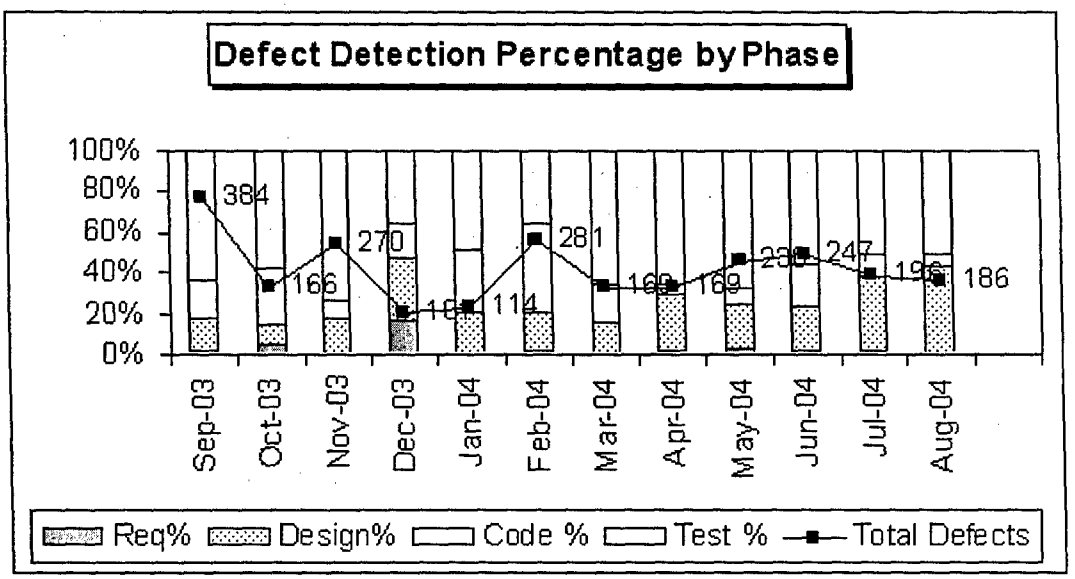

Figure 25: Application Delivery Center Reporting

The number of defects encountered and their profile across life-cycle phases are also reported at the AMS Australia line of business level. Management's focus is on the early detection of

defects as well as consistent absolute levels. Reporting of these measures is included in the monthly performance review reports, examples of which are shown in Figures 26 and 27.

August 2004	Phase Detected								
Phase Injected	Concept	Req'mts	Design	Code	Testing	Impl'n	Total	Phase Injected Ratio	AMS Average
Concept	31	4	32	22	4		93	1%	2%
Requirements		565	50	62	135	2	814	11%	13%
Design			829	158	288	7	1,282	17%	19%
Code				964	2,396	116	3,476	47%	44%
Testing					1,542	21	1,563	21%	18%
Implementation						144	144	2%	2%
Total	31	569	911	1,206	4,365	290	7,372	100%	100%
Phase Detected Ratio	0%	8%	12%	16%	59%	4%	100%		
AMS Average	2%	10%	14%	21%	50%	3%	100%		

Figure 26: Defect Rate Matrix Report

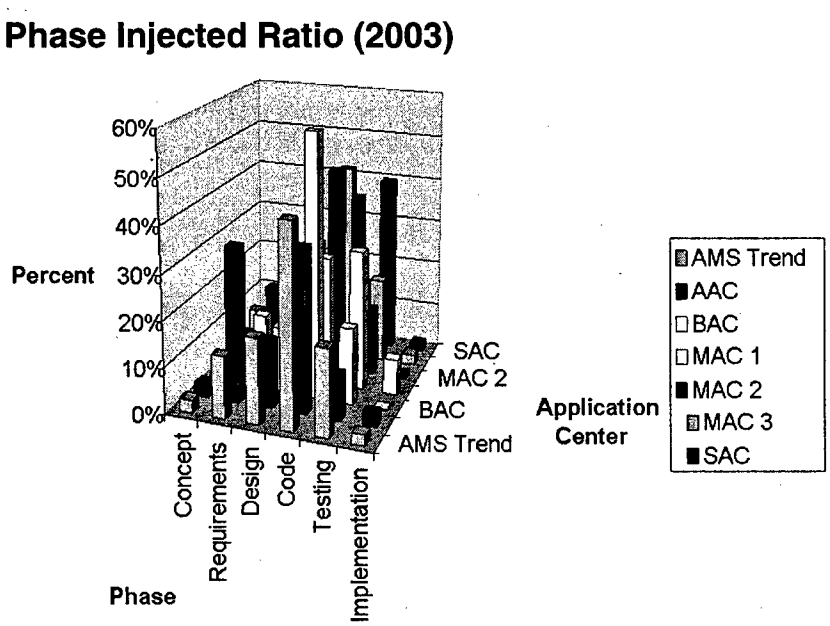

Figure 27: Comparison of Phase-Injected Ratios

6.6 Using Metrics to Improve the Future

Inevitably, the AMS Australia metrics experience has identified areas where further benefits may be gained; as with all process improvement, it is a continuing journey.

The initial measurements program addressed the application development and enhancement activities that represent the majority of AMS Australia service delivery activities. However, significant work that follows different development life cycles is undertaken. Most notably, these include application maintenance and support (problem correction and small enhancements), complex multi-system enhancement programs, and multi-supplier/multi-site work programs. The business goals and risks for these life cycles are significantly different, and work continues to establish measurement sets to address their specific requirements.

At the same time, AMS Australia continues to develop its skills in the area of statistical analysis. The initial application of control chart techniques encountered some difficulty with non-symmetrical measurement distributions, and the organization is now evaluating alternative approaches with assistance from research staff at National Information Communications and Technology Australia (NICTA).

The baseline data that AMS Australia now has available also allows specific analytical studies to be undertaken, with a current focus on quantifying productivity and quality drivers in the organization's environments. In related activities, AMS Australia is working to extend its predictive models for productivity and quality attributes of its services and products.

Sharing measurement experience has also become a significant activity. AMS Australia now provides consulting and support to other IBM sites worldwide as they undertake process improvement activities. Worldwide initiatives within IBM to maintain measurement and management tools and guidelines similarly make use of AMS Australia's experience. As process measurement and management capabilities improve, AMS Australia fully expects to contribute further to the broader activities of IBM.

7 AMS Australia Today and Tomorrow

The business environment today holds many challenges for all companies. It is a global environment that is demanding and never "switched off." Among other things, all companies want to

- be more responsive to changing market conditions, including opportunities, customers, and competitive actions
- enhance the experience their customers have while doing business with them
- improve the overall relationship, leading to greater loyalty and increased future revenue

The key enablers for achieving these goals are software applications. Unpredictability in the delivery of software development projects is no longer acceptable. A company needs to be able to respond to changes quickly, and this requires ever-decreasing project life cycles—which can only result from ever-increasing productivity requirements.

Software engineering practices provide the vehicle to achieve the level of performance that today's business climate demands. As we move to a collaborative working environment across multiple worksites, mobile employees, and global operations, the rigor that software engineering disciplines bring becomes an imperative, rather than an optional extra.

AMS Australia has made the demanding journey to CMMI-SE/SW maturity level 5 and in using this framework has achieved high levels of predictability and improvements in productivity. But the journey must continue, and it is through an ongoing focus on software engineering that we will strive to turn the "art" of software development into an engineering science and, in so doing, support the increasing demands of our clients.

Appendix Acronyms

ADE	Application Development Effectiveness
AMS	Applications Management Services
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
CoP	Communities of Practice
CTR	Critical Thread Review
EV	Earned Value
FP	function point
FTE	full time equivalent
IC	intellectual capital
ICM	intellectual capital management
IDP	Individual Development Plan
IPIP	Integrated Process Improvement Program
ISO	International Standards Organization
KM	Knowledge Management
P3	People, Process, and Performance
MAPM	measurement and performance management
MPR	monthly performance review
NICTA	National Information Communications and Technology Australia
OFI	opportunity for improvement
PAV	process adherence verification
PBC	personal business commitment
PD	professional development

PIT	Process Improvement Team
PMWB	Project Metrics WorkBook
PQA	Project Quality Analyst
QA	quality assurance
QMP	Quality Management Plan
ROI	return on investment
RUP	Rational Unified Process
SDF	Standard Delivery Framework
SDLC	system development life cycle
SEI	Software Engineering Institute
SEPG	Software Engineering Process Group
SLA	Service Level Agreement
SME	subject matter expert
SQA	software quality assurance
WBS	work breakdown structure
WPD	work product description
Y2K	Year 2000

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13. ABSTRACT (MAXIMUM 200 WORDS)

IBM Global Services Application Management Services (AMS) Australia provides application development and support services, on an outsourcing basis, to a variety of clients. Typically, the organization delivers more than 3,000 work products in a year, with over 1,000 projects completed within overall schedule, budget, and productivity commitments. Client expectations of service standards increase year by year, requiring corresponding improvements in service delivery capability.

In July 1997, IBM Australia began providing application management services to a major client. Services were initially provided by over 2,500 staff members in 17 locations, servicing over 370 applications accessed by more than 55,000 users. Over the next six years, the service delivery teams were transformed into an organization whose practices have now been formally assessed at Capability Maturity Model® Integration (CMMI®) for Systems Engineering and Software Engineering, Version 1.1 (CMMI-SE/SW, V 1.1) maturity level 5.

Significant improvements to software practices led to improvements in cost, on-time delivery, on-budget delivery, and client satisfaction achievements. Over the same period, an application development productivity improvement of 76 percent delivered cost savings of A$412 million.

In May 2004, the Software Process Achievement Award Committee selected AMS Australia to receive a Software Process Achievement Award in recognition of those achievements. This report describes the history and experiences of the process improvement initiatives that transformed the AMS Australia organization.

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