# Benchmarking Civil Maintenance Performance and Practices In The Urban Water Industry: Key Perspectives and Emerging Challenges

*Paul Harris, Managing Director – Asia Pacific, UMS Group Australia*
*Tony Saker, Director of Consulting, UMS Group Australia*
*Don Vincent, Asset Management Service Line Leader, GHD Australia*

**Introduction**

In early 2005, 17 WSAA Members from Australia and New Zealand plus two water utilities from the USA and Canada embarked on a comprehensive process benchmarking study of Civil Maintenance activities. This study was designed to measure the efficiency (cost) and effectiveness (service level) of each company in the group within each activity. These analyses were fully normalized to produce meaningful and robust performance comparisons and to allow identification of best performers within each activity. Detailed interviews at each of these companies then identified the best practices currently in place across the group. Table 1 shows the benchmark peer group.

| ***Australia*** | | |
|---|---|---|
| **Queensland** | **Victoria** | **New South Wales / Australian Capital Territory** |
| Brisbane Water<br>Gold Coast Water<br>Ipswich Water<br>Logan Water<br>Maroochy Water | Barwon Water<br>Central Highlands Water<br>City West Water<br>South East Water<br>Yarra Valley Water | ActewAGL<br>Gosford City Council<br>Hunter Water<br>Sydney Water |
| ***International*** | | |
| **New Zealand** | **United States** | **Canada** |
| Metrowater (Auckland) | Seattle Public Utilities | City of Hamilton |

**Table 1: Benchmark Peer Group**

The benchmarked activities were classified into Reactive, Preventative and Renewal (Capital) Maintenance and included activities covering the range of water and wastewater assets and operations. Table 2 shows the 15 civil maintenance activities benchmarked.

| **Reactive** | **Preventative** | **Renewal/Capital** |
|---|---|---|
| Repair of Burst Water Main<br>Repair of Leaking Water Main<br>Repair of Hydrants<br><br>Repair of Stop Taps<br>Repair of Water Service Pipes<br>Clearing Blockages in Sewer Mains (No Dig Out Required)<br>Clearing Blockages in Sewer Branches (No Dig Out Required)<br>Sewer Repairs Requiring Dig Out | Water Main Cleaning<br>Sewer Main Cleaning<br>Wet Well Cleaning | Water Main Renewal<br>Water Service Renewal<br>Raising/Lowering Maintenance Holes<br>Sewer Relining |

**Table 2: Civil Maintenance Activities Benchmarked**

Results of the study identified utilities that are leading and lagging in each performance area and highlighted the key drivers of such performance. Peer group members were pleased at the rigor of the analytic insights and perspectives produced and reported immediate benefits from identification of specific gaps and opportunities to improve their performance. Interestingly, the water industry as a whole has been presented with important evidence of the leading practices with greatest potential for industry improvement. As with many successful studies, the lessons learned here have revealed in turn key challenges to be addressed in the next round of Civil Maintenance benchmarking, expected to be

undertaken by the group in two to three years, once each company has had the chance to use these results to drive further performance improvement.

**Project Details and Deliverables**

UMS with its alliance partner GHD, was selected from a WSAA tender process to carry out the engagement, with oversight of the project conducted by a WSAA Steering Group comprising five member companies including Barwon Water, Hunter Water, South East Water, Sydney Water, and Water Corporation of Western Australia. (UMS has delivered three other large scale benchmarking projects for WSAA over the past several years, including the group's initial benchmarking project undertaken in 2000).

An important element of project delivery is that WSAA allow all program participants to use their benchmarked performance results in public or to share them with their respective economic regulators. All data and performance output information was therefore blind coded on an activity by activity basis to ensure that no utility was able to identify the specific performance of individual industry peers. Examples of this output are shown in Figs. 1 and 4 later in this paper.

Key project deliverables included Individual Utility Data Validation Reports and Teleconferences, On Site Interviews (conducted over one to two days), an Industry Report, Individual Utility Reports and Teleconferences including customized Improvement Roadmaps. The Industry Report covered program approach and methodology, key industry themes and leading practices, and overall industry performance results. The Individual Utility Reports were focused on specific utility performance results by benchmarked activity, practice observations and areas of improvement. Improvement Roadmaps were used to communicate individual improvement initiatives and contained recommended improvement actions, implementation complexity issues, key success factors, the time frame for implementation and potential cost savings.

The program culminated in a Best Practice Workshop that was conducted over two full days and provided opportunities for best performing peers in each activity to present their leading practices and technologies in civil maintenance. The Best Practice Workshop also provided opportunities for all program participants to network directly with local industry peers and global water industry thought leaders.

**Comparison of 2000 and 2005 Civil Maintenance Benchmarking Programs**

A number of program enhancements and improvements to measures were made in 2005 compared to the 2000 study, making detailed trending comparisons difficult. However, from a qualitative perspective, the industry has identified and made fundamental changes in a number of key strategic and operational areas relating to Civil Maintenance since 2000. These include:

*Improved Regulatory Responsiveness:* Regulatory requirements are increasing, particularly for meeting environmental and service level standards. For utilities operating under licenses, the requirements and accountabilities are becoming more stringent and are driving increasing costs of compliance.

*Asset Management:* The industry has improved their approach to asset management. Many utilities are now organized around the separation of asset decision making and service delivery activities and responsibilities.

*Systems:* In 2000, the application of comprehensive and integrated asset management and field based systems was very much in its infancy. The industry now recognizes the efficiency advantages of automated and integrated systems and is actively allocating funds to this area.

*Performance Management:* In 2005, many utilities better understand the drivers of their service level and cost performance, particularly those operating under increased economic and environmental regulation.

*Data Management:* While significant improvements have been made in the capture of cost and service level data in the last five years, the industry still struggles with identifying critical data requirements and conducting detailed data analysis. Some in the industry have recognized the importance of the collection, storage and retrieval of good asset condition data, and the use of this data in investment decision tools, but this remains an area of limited focus.

*Optimizing the Reactive and Proactive Maintenance Mix*: In 2000, we made the observation that in some areas too much preventative maintenance was being conducted. In 2005, reductions in water main cleaning as a result of water saving measures under drought conditions, budget constraints and an inability

for the industry to justify such programs, has reduced the level of preventative maintenance. Many utilities across the industry do not have an assessment framework to quantify the benefits of preventative maintenance in terms of cost savings, service level impacts, or reduction of risk in the business. These utilities agree that an improved understanding of the reactive versus proactive mix is important and requires development.

*Contract and Resource Strategy:* The industry has moved to better optimizing the mix between internal and external labor, and adopting high degrees of crew specialization in order to support this strategy. In 2005, many utilities are adopting elements of alliances and partnering in order to achieve cost and service level targets, and in general are adopting new ways of working with the marketplace.

*Staffing:* Aging workforce, staff recruitment and retention are emerging as major issues, which were not identified in 2000. There is a pressing need for the industry to give higher levels of attention to strategies for dealing with their aging workforce, and attracting and retaining high calibre personnel. Developing effective knowledge management systems is also seen as important in addressing these staffing issues.

*Crew Sizing:* Many within the industry have moved towards single person crews on reactive tasks such as hydrant repair, stop tap repair & replacement, and repair of water services. There are, however, still some utilities with relatively large crews that are incurring high costs.

*Overtime:* In 2000, overtime was identified as a problem area. In 2005, this problem still exists in some parts of the industry. Several utilities have adopted innovative strategies, including annualized salary arrangements and contractor schedules of rates for out-of-hours work in order to minimize these costs.

**Industry Performance: Cost and Service Level Analysis**

Analysis of cost and service level performance highlighted key differences in the industry. A major characteristic relates to the degree of corporatization and/or the degree of economic and environmental regulation utilities may be subject to. In general, non-capital city and economic regulated companies tend to be relatively low cost but with mixed service levels. Council-owned (small municipal) utilities tended to be moderate service level but at higher cost. Fig. 1 shows the overall performance and the spread of cost and service level performance across the benchmark peer group.

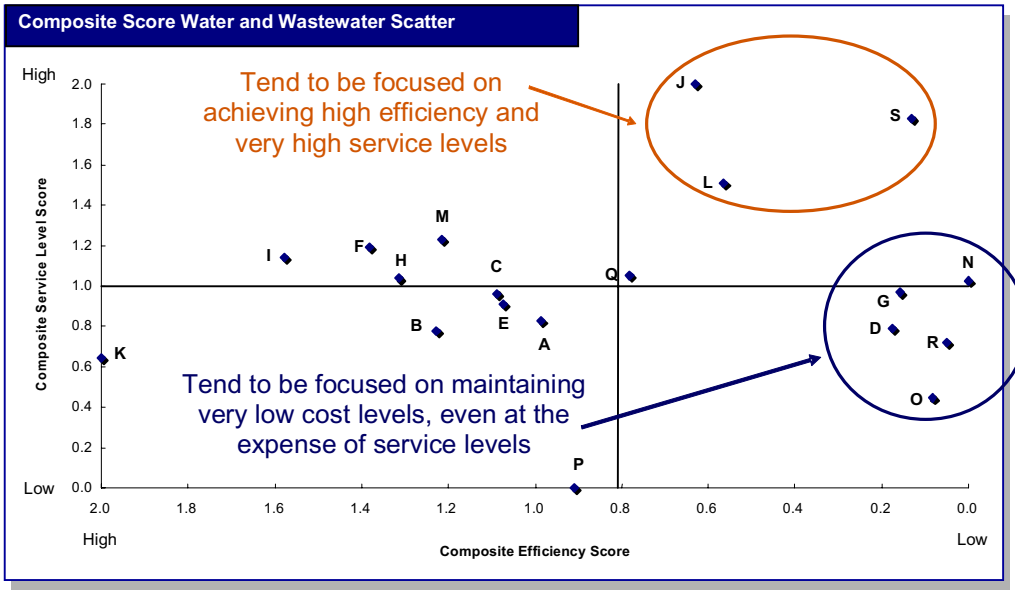



**Fig. 1: Overall Cost and Service Level Performance**

In terms of quantifying cost saving opportunities, two reference utilities were identified. Utility Q and N in Fig.1 representing respectively the highest cost ("prospective") performer (Q) and the lowest cost ("stretch") performer (N) in the best practice (low cost, high service level) quadrant. Even for Utility N, which can be classed as the "lowest of the low cost utilities," a significant number of strategic challenges still emerge in maintaining that status and staying ahead.

Fig 2 summarizes the significant opportunities that may be on offer for the industry, particularly in the Renewals domain. A prospective to stretch cost savings range of $50M to more than $100M across all of the benchmarked activities has been identified.

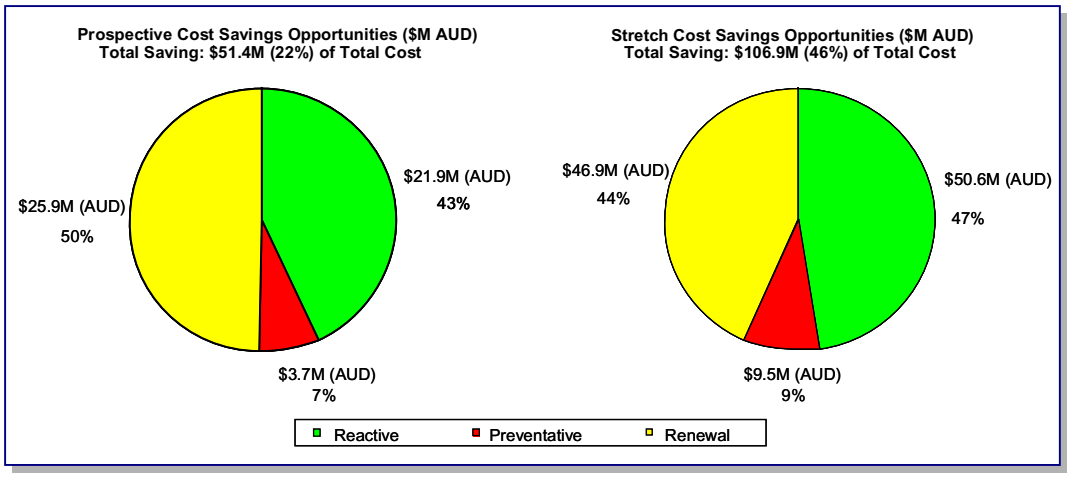



**Fig. 2: Potential Savings Range: Prospective to Stretch Target Levels**

Fig.3 breaks down the identified savings opportunities into their constituent benchmarked activities. The high spend areas of Repair of Burst Water Mains, Repair of Water Services, Water Main Renewal and Sewer Relining are the primary sources of high saving opportunities.

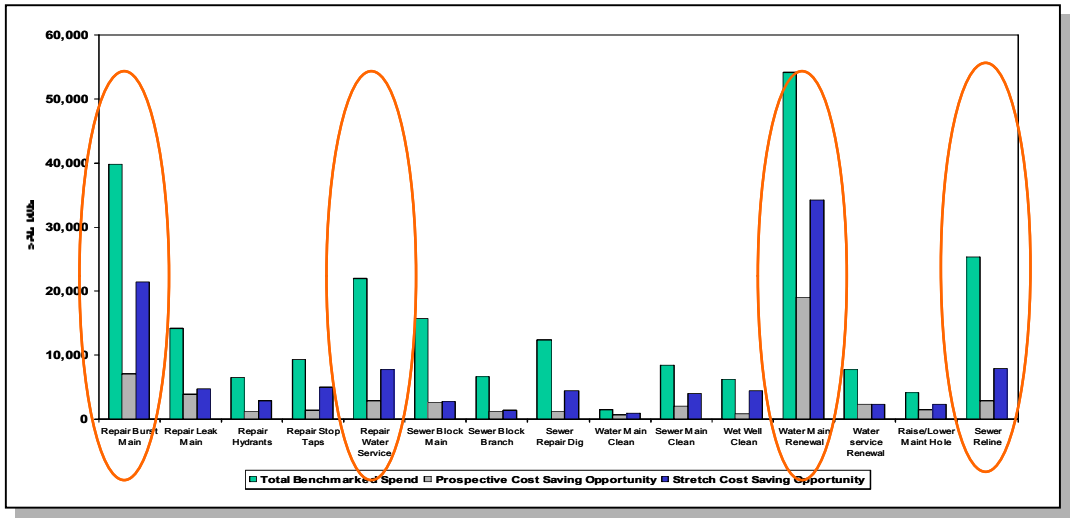



**Fig. 3: Spend Levels and "Prospective" and "Stretch" Saving Opportunities by Activity**

In terms of percentage of total benchmarked spend, a 22% to 46% potential range has been identified. This includes several laggard performers with particularly large spend levels.

**Key Themes and Leading Practice Attributes of Low Cost and High Service Level Utilities**

Based on quantitative performance analysis and practice observations in managerial tasks, reactive, preventative and renewal civil maintenance, four key industry themes were identified. These themes, along with corresponding sub themes, highlighted the attributes of many of the best performing utilities that demonstrated low cost and high service levels.

**1. Human Resources and Resource Strategy,** comprising the following sub themes.

*Asset Management Structure and Investment Planning:* Asset management functions are centralized and joint decisions are made on OPEX and CAPEX (as opposed to decentralized or split (OPEX & CAPEX) asset management, which leads to a lack of understanding of OPEX and CAPEX relationships and the

relevant trade-offs). Utilities operating under intrusive economic regulation place an importance in understanding such OPEX and CAPEX trade-offs.

*Succession Planning:* The average age of water utility workforces today is 40-45 years and higher, adding to the challenge of all utilities to develop strategies for recruitment and retention of high calibre staff.

*Resource Mix:* The optimal internal versus external resource mix is still not clear based on empirical results. Fig. 4 shows varying resource mix options being adopted in order to achieve low cost outcomes, but companies with a high degree of contractor resources do not have consistently lower costs.

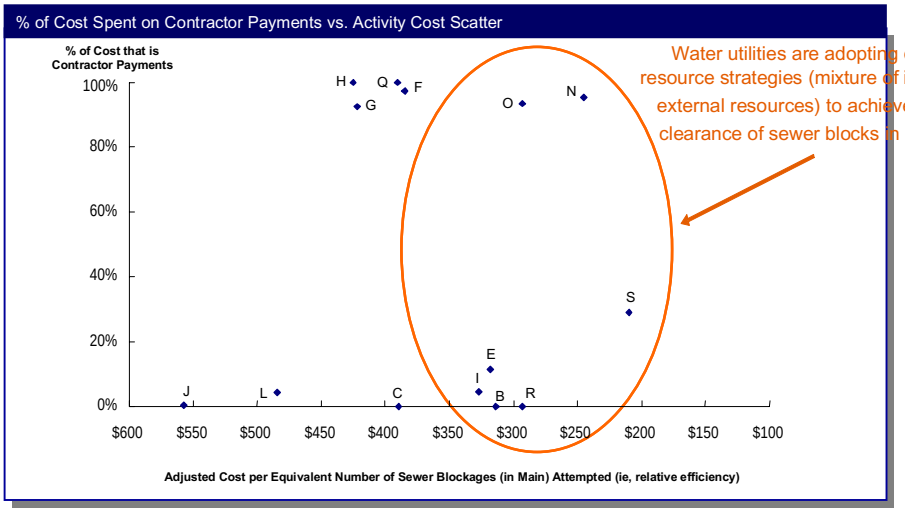


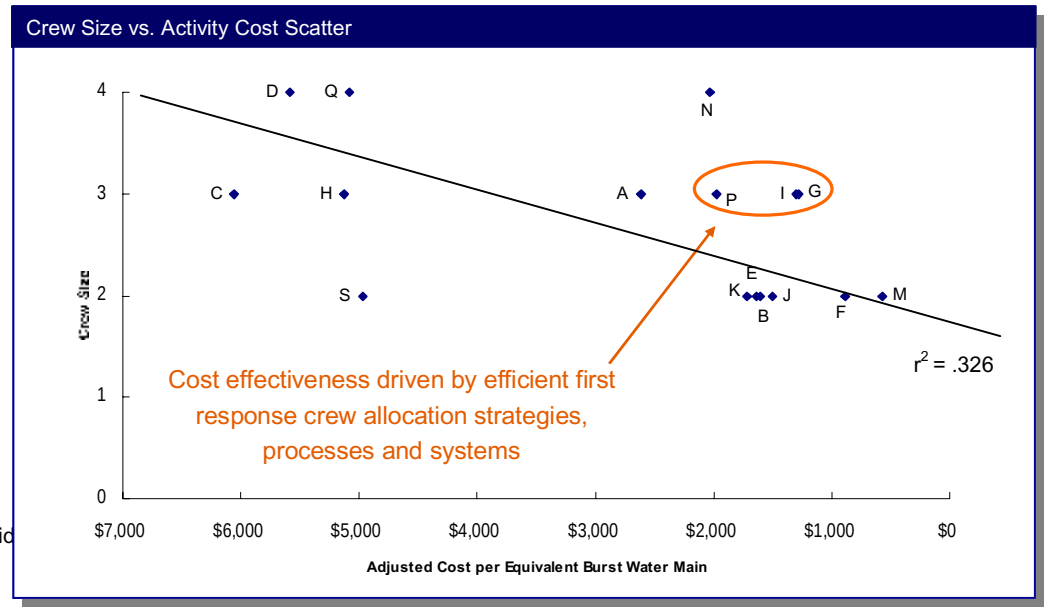

**Fig. 4: Resource Mix vs. Unit Cost for Clearance of Sewer Main Blockage**

Significant increases in use of external resources and alliance partners have increased the strategic resource mix options available to the industry, but more work is required before any strategy is clearly superior.

*Partnering:* There is an increased prevalence of partnering in the industry, as exemplified by some of the leading utilities having contract workforces well integrated with their internal organizational structure. However, leveraging the benefits of the use of external partners has yet to be fully explored by the industry.

*Crew Strategy:* Crew sizing does not always correlate directly with unit cost, but for several key activities, including burst water main repair, smaller crews generally yield lower unit costs (see Fig. 5). Effective first response crew allocation strategies, processes and systems can overcome the impact of larger crew sizes and still achieve low cost service provision.

**Fig. 5: Crew Size against Unit Cost for Repair of Burst Water Mains**



*Overtime:* Overtime remains a significant issue in some utilities where overtime costs are a significant portion of the average salary. In some cases, Industrial Relations requirements are forcing the adoption of overtime labor during peak reactive workload periods. Several leading utilities, however, have adopted innovative strategies, including annualized salary arrangements, flexible local workplace agreements, and contractor schedules of rates for out-of-hours work in order to minimize overtime costs.

**2. Service Level and Cost Focus,** comprising the following sub themes:

*Business Drivers:* Cost and service level performance varies across the benchmarked group, and is significantly influenced by differing business drivers such as level of corporatization and intrusiveness of the regulatory environment. Nonetheless, key leading practices include well defined business strategies that are strongly linked to the business environment, and adoption of sophisticated customer willingness-to-pay models in order to better understand the balances between regulatory cost, service levels and customer expectations.

*Performance Management:* Performance management systems are in place across the industry, but the level of complexity and effective deployment varies greatly. Leading performers are characterized by a number of performance elements including strongly aligned KPIs to business and regulatory environment, regular KPI review and reporting processes, formal continuous improvement processes and programs, activity-based costing, productivity measurement programs to drive lower cost, and employee incentive programs.

**3. Defining the Reactive versus Preventative versus Renewal Mix,** comprising the following sub themes:

*Maintenance Planning:* Some leading performers and those utilities operating under more intrusive economic regulation are attempting to quantify the benefits of preventative programs in terms of cost savings and service level impacts, and to use this information to determine the optimal reactive versus preventative versus renewal mix. Many utilities across the industry do not have the necessary information to develop a robust assessment framework to quantify such preventative program benefits, and this is limiting their ability to define the optimal reactive/preventative/renewal mix. This may be an opportunity for more formal industry collaboration and data sharing.

*Investment Decision Tools:* Few within the industry have formal processes and automated systems for the collection, storage and retrieval of good asset condition data. Some are adopting integrated investment decision tools, but acknowledge they lack the necessary asset condition data to make these tools truly robust. Investment decision tools incorporating risk probability and consequence, asset criticality and prioritization based on triple bottom line are being adopted by many utilities for renewals programs.

**4. Processes and Systems,** comprising the following sub themes:

*Data Capture and Management*: Several participating utilities were data rich, but information and knowledge poor. The better performing utilities tended to determine and evaluate critical data requirements and actively collect critical cost by function and service level data. These utilities also tended to have the analytical expertise to validate this data and extract valuable insights for asset planning and work management purposes.

*Field Based Systems and Processes:* Some leading utilities are adopting low cost Contact and Operation Centers arrangements based on centralizing these two functions. Other utilities have adopted de-centralized arrangements and have still managed to achieve low cost through efficient contact and operations center processes and systems, and accurate fault diagnosis and prioritization.

In order to comply with regulatory service level requirements, water utilities operating under intrusive economic regulation have systems in place that are able to accurately identify the number of customers affected by repair and replacement work. This has allowed these utilities to focus on service level targets and accurately prioritize work by customer criticality and impact.

Furthermore, utilities are becoming more sophisticated with their field based systems and are installing laptops in vehicles, in order to capture comprehensive data such as travel time, repair time, interruption time, type of fault, type of repair, asset location and condition data.

*Integration of Asset Management and Field Based Systems*: Some leading utilities are adopting and leveraging the benefits of fully integrated and automated Asset Management (GIS), Works Management

and Customer Information Systems (CIS). But many others within the industry have retained a combination of manual and automatic systems to link their asset management, works management and performance management systems. Some of these utilities have compensated for lack of automation with stringently defined end-to-end processes in order to deliver reactive tasks as cost effectively as utilities with fully integrated and automated systems.

**Specific Policies, Practices and Technology: Reactive, Preventative and Renewals**

Table 3 provides a summary of specific policies, practices, and technologies as utilized by the leading performers in the benchmark peer group. This summary may be viewed as a series of actions that can be readily implemented, with a realization of benefits in the short term.

| **REACTIVE** | |
|---|---|
| **Policies** | **Technology/Practices** |
| ▪ Minimum shutdowns and more extensive clamping techniques.<br>▪ For sewer repairs requiring dig out, location markers from previous clearing attempts.<br>▪ For clearing sewer blockages, define the optimal level of bore clean and/or escalate to routine cleaning or sewer relining as required. | ▪ Targeted use of “mini” style plant and equipment.<br>▪ “Infra-stop” bladder valves for mains isolation.<br>▪ Advanced leak detection equipment for repair of leaking water mains.<br>▪ Hydro-excavation for repair of burst and leaking water mains.<br>▪ Pipe freezing for water service repair.<br>▪ Ball valve technology for repair of stop taps and water services.<br>▪ Jetting, cutting preferred to rodding, and small equipment to facilitate ease of access.<br>▪ Sophisticated jet designs incorporating different nozzles, flow rates, etc. |

| PREVENTATIVE | |
|---|---|
| **Policies** | **Technology/Practices** |
| ▪ High focus and commitment to regular flushing having a significant impact on business outcomes.<br>▪ Developing proactive cleaning and flushing policies to meet drought conditions and changing legislation.<br>▪ Water sampling prior to flushing main.<br>▪ Define the optimal level of sewer main cleaning and optimal level of bore clean. | ▪ For water main cleaning, defining optimal flushing point techniques.<br>▪ For sewer main cleaning, targeted use of root foaming, jet designs incorporating different nozzles, flow rates, etc. and on board CCTV and cleaning equipment.<br>▪ For pump wet well cleaning, use of float sensors isolated via submerged tube to reduce failure rates and risk of inoperability. |
| **RENEWAL** | |
| **Policies** | **Technology/Practices** |
| ▪ Contract Strategy based on either a turnkey approach or hiring of project management, design and construction specialists.<br>▪ Effective use of contractors based on innovation, credible delivery, quality, cost and safety records.<br>▪ Where practical, full commercial scrutiny, and generation and application of the best options. | ▪ For water main renewal, optimal mix of trenching and trenchless technologies, minimum interruptions achieved through water supply bypass or alternative water supplies, use of pipe bursting or slip lining technologies.<br>▪ For water service renewal, adoption of polyethylene pipe lining.<br>▪ For raising or lowering maintenance holes, 100% use of pre-cast, prefabricated components or biodegradable formwork materials, and maneuverable lifting equipment (Hiab crane and Bobcats) for work in restricted access areas. |

**Table 3: Specific Leading Attributes for Superior Performance in Reactive, Preventative and Renewal Activities**

**Industry Improvement Initiatives**

Based on the findings of the study, four key improvement initiatives hold the greatest improvement potential for the industry:

*1. Review of the Technology and the Contracting Arrangements for Water Main Renewal:* The industry challenge is related to determining whether trenchless technology is applicable to specific utilities, optimizing the mix between trenching versus trenchless technologies, and the contracting arrangements that need to be put in place for conducting trenching and trenchless work.

*2. Managing the Mix of Reactive Tasks:* Improved reactive workforce management of Repair of Burst Water Main, Repair of Leaking Water Main and Repair of Water Service Pipes by adopting better allocation processes and systems to optimize the mix between these reactive tasks.

*3. Proactive Development of Preventative Programs:* Many across the industry believe the right mix of reactive, preventative and renewal work is not yet well addressed and a need exists to be more proactive in the area of preventative maintenance program development.

*4. Managing The Trouble Response Process:* The industry is managing the trouble response process in a variety of ways, and the cost and service level implications of the current techniques in place and the opportunities for improvement may not be fully understood across the industry. The water utilities need to gain more knowledge of leading trouble response processes, practices and systems and their potential for driving sustainable performance improvement.

These four improvements coalesced from a wide range of analyses and practice discussions and are believed can provide scope for major cost savings across most utilities.

**Further Program Developments**

International interest and participation in WSAA's benchmarking programs is certainly not new, and a great deal of national and international interest has been generated as a result of this particular benchmarking study, which for many in the participating group has been one of the more incisive and challenging benchmarking programs conducted. A growing number of domestic and global enquiries are therefore currently being addressed. A presentation of the project approach and outcomes will also be held at an International Water Association (IWA) conference in China in 2006.

Furthermore, arrangements and protocols are in place for those utilities seeking improvement insights from specific utilities that did particularly well in certain areas. UMS and GHD have put in place communication protocols to allow industry participants to share process, practice and technology information on a confidential basis.

Given industry commitment to these programs, WSAA is now progressing to tender the following benchmark programs:

| | |
|---|---|
| 2006 | Mechanical-Electrical Maintenance |
| 2007 | Customer Services |
| 2008 | Asset Management |
| 2009 | Civil Maintenance |

IWA has shown considerable interest in participating in these programs and has been included in the Steering Committee for the 2006 program, with the objective of the IWA to bring even greater international participation in the benchmarking programs. This complements WSAA's strategy to make this program truly global, which began with New Zealand involvement in "WSAA Facts" several years ago, and more recently, participation of two North American water utilities in the Asset Management and the Civil Maintenance benchmarking projects.

*Author's Contact Details*
Paul Harris, Managing Director – Asia Pacific, UMS Group Australia
Email: pharris@umsgroup.com
Phone: +61 3 9629 3622

Tony Saker, Director of Consulting, UMS Group Australia
Email: tsaker@umsgroup.com
Phone: +61 2 9221 9922

Don Vincent, Asset Management Service Line Leader, GHD Australia
Email: Donald_vincent@ghd.com.au
Phone: +61 3 8687 8000