O&M Operation and Maintenance in Water Supply and Sanitation

Operation and Maintenance Working Group of the Water Supply and Sanitation Collaborative Council

Report for consideration at the Rabat Meeting of the Council

7-10 September 1993

Volume 2: Main Report

Working Group Coordinator
Mr José Hueb, World Health Organization

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Acronyms

AFRO	WHO Regional Office for Africa, Brazzaville
AMRO/PAHO	WHO Regional Office for the Americas/Pan American Health Organization, Washington, D.C.
CEHA	WHO Centre for Environmental Health Activities (Amman)
CEPIS	Pan American Centre for Sanitary Engineering and Environmental Sciences (Lima, Peru)
EHC	WHO/WPRO Environmental Health Centre, Kuala Lumpur, Malaysia
EMRO	WHO Regional Office for the Eastern Mediterranean (Alexandria)
ESA	External Support Agency
EURO	WHO Regional Office for Europe (Copenhagen)
GTZ	German Agency for Technical Cooperation
IDWSSD	International Drinking Water Supply and Sanitation Decade 1981-1990
IRC	International Water and Sanitation Centre - The Hague
IWSA	International Water Supply Association
O&M	Operation and Maintenance
OMWG	Operation and Maintenance Working Group
SEARO	WHO Regional Office for South-East Asia (New Delhi)
WASH	Water and Sanitation for Health Project
WB/UNDP	World Bank/United Nations Development programme
WHO	World Health Organization
WPRO	WHO Regional Office for the Western Pacific (Manila)
WSS	Water Supply and Sanitation
WSSCC	Water Supply and Sanitation Collaborative Council

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Acknowledgements

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The Group also wishes to acknowledge the support and assistance of the Water Supply and Sanitation Collaborative Council and especially of Mr Ranjith Wirasinha its executive secretary.

Preface

Operation and maintenance of water supply and sanitation facilities in developing countries have been neglected during the past years. For this reason, these facilities which are considerably costly do not perform or are not maintained as intended and thus fail to provide the services for which they were constructed.

The present situation of the water supply and sanitation sector is characterized by lack of adequate criteria for the application of suitable technology, by institutional deficiencies, by lack of trained personnel at both managerial and operative levels, and by insufficient financial resources for both construction of new facilities and operation and maintenance. These constraints are compelling government agencies to promote policy changes in order to make the best possible use of existing resources.

In urban areas where coverage has experienced significant progress during the past years, the inhabitants of urban fringes still lack public facilities, and therefore are highly exposed to health risks. Such urban dwellers frequently have to pay the market price for insufficient amounts of unsafe water which is sold by private companies. The price of water sold by private vendors in several large cities in developing countries reaches frequently 10 or 20 times the price paid by regular customers of the water authorities. Paradoxically, within the served areas the waste of water is enormous, the unaccounted-for water is exceedingly high and tariffs subsidized. Unaccounted-for water, representing more than 50% of the produced water, have been reported in a number of large cities of developing countries.

There are important health implications associated with poor operation and maintenance practices in water supply and sanitation systems, particularly the additional risks brought about by epidemics such as cholera. There is great risk of contamination of distribution pipelines where there is a combination of intermittency in the water supply, low pressures in the distribution network, inadequate wastewater collection systems and leaks in pipes. Most water supply and sanitation systems in developing countries have these characteristics.

On the rural side, increasingly external support agencies and national governments are realizing that with somewhere between 30 and 60 percent of all rural water supply facilities non operational at any one time that management of water supply and sanitation services and adequate operation and maintenance are key concerns and are strongly influencing the standard of living and the health of the concerned populations.

Poor Operation and Maintenance has been identified as one of the major causes of this situation. Actions directed at the promotion of efficient assets management have not kept pace with the great efforts made at national and international levels to construct new systems and to increase population coverage.

The progress report of the International Drinking Water Supply and Sanitation Decade cites funding as the most serious constraint globally. The next most serious constraint is poor operation and maintenance followed by inadequate cost recovery and insufficiency of both professional and technical personnel.

Significant efforts are being made by the World Health Organization (WHO) and several external support agencies in association with the Water Supply and Sanitation Collaborative Council to promote improved operation and maintenance as a strategy to achieve sustainable water supply and sanitation services. In order to make these efforts more effective, a working group on Operation and Maintenance was established by the Council at its meeting in Oslo (September 91) to achieve joint cooperation to develop broadly applicable tools in support to national water supply and sanitation institutions and external support agencies and to promote the realistic resource allocations (financial, human and material), for the proper operation and maintenance of systems.

The objective of this document is to describe the findings of the Operation and Maintenance Working Group after a series of meetings and documents prepared, its working philosophy, its aims, its achievements and its perspectives for the future. It is important to highlight the fact that this joint work involving several water and sanitation institutions and external support agencies is holistically contributing to the promotion, adoption of policies and strategies and implementation of programmes aimed at the attainment of adequate water supply and sanitation assets management and improved services in developing countries. This is leading to accrued health benefits to those who are the ultimate targets of these efforts: the populations in developing countries deprived of adequate water supply and sanitation services.

1. Introduction

1.1 Rationale for Improved Operation and Maintenance

Since the mid-1960's investments in the water supply and sanitation sector have steadily increased, reaching a peak during the International Drinking Water Supply and Sanitation Decade 1981-1990. The principal objective of this development effort was to extend the provision of safe and adequate drinking water and appropriate sanitation to as many people as possible, as this is recognized as an essential prerequisite to the control of water-related diseases and is therefore accepted as being indispensable for the good health upon which rests personal well-being and national productivity and wealth. Such benefits will however only accrue if the water supply and sanitation facilities provided, operate correctly and are maintained so that they continue to function and are utilized to their full potential by the benefiting communities.

There is widespread evidence that though Operation and Maintenance is recognized as one of the major constraints for sector development, little support has been provided to water agencies for improvements in this field during the past decade. In the rural areas, where supply is frequently provided through point sources fitted with handpumps, a high percentage of facilities are reported as being out of order. Figures of 40%, 50% and 60% have been reported but this is an area where reliable data, perhaps not surprisingly, are not readily available.

In the urban areas, poor O&M has resulted in unaccounted for water being reported as more than 50% of produced water in many large cities in developing countries. More than half the urban water supply in Cairo, Jakarta, Lagos, Lima and Mexico City is unaccounted for. In Jakarta 51% of the water produced simply disappears. These high losses of water due to poor operation and maintenance, represent a major financial loss to cities as they must pay for the collection, treatment and distribution of this lost water.

Each year some 90 million new people are added to the population of the world. Cities in developing countries currently account for two thirds of this population increase and in the next century it is predicted that 95% of global population growth will occur in the developing world. Developing world cities are facing a crisis in water supply and one that will become more acute as population growth accelerates. Already serious water shortages are occurring in major cities as groundwater is over exploited and contaminated and surface water sources become severely polluted.

Traditionally cities have met increased demands by seeking out and exploiting new sources. However, it is clear that the costs of collecting water from increasingly distant locations are becoming less affordable. Developing world cities are facing the reality that the present excessive levels of water wastage are unacceptable and that effective operation and maintenance programmes and sound management practices need to be put in place to increase the efficiency and effectiveness of the services and to reduce the volumes of unaccounted for water.

Although few countries achieved the increases in water supply coverage predicted at the beginning of the International Decade for Drinking Water Supply and Sanitation (IDDWSS), substantial improvements in percentages of people served were made in many. However, if taken into account the high percentages of inoperative systems in rural areas and unaccounted for water in cities then the coverage levels are likely to drop dramatically.

During the IDDWSS the focus was upon increasing water supply coverage and provide a greater number of people with potable water and appropriate means of excreta disposal. Insufficient attention was directed to guaranteeing the long term sustainability of these systems. The challenge for the next decade, in addition to further extending coverage, will be to improve operation and maintenance performance to ensure that the resources and efforts which went into extending coverage are fully realized. Existing water supply and sanitation assets must function at optimal levels to reduce the financial wastage of resources and to provide the intended users with appropriate levels of service.

1.2 History and organization of Working Group

In 1988, to focus attention on operation and maintenance, WHO assisted by IRC held a one day informal working session in the Hague with ESA representatives. A working group was established with the objective of improving the performance of operation and maintenance.

The working group consists of some 70 professionals from ESAs and water agencies in developing countries actively involved in the water and sanitation sector. The working group has an Advisory Committee of about 10 members which convert the ideas, principles and priorities established by the Working Group into action plans for joint implementation. The membership of the working group is given in Annex I.

The first meeting of the working group was held in Geneva from 19-22 June 1990 following a preplanning organizational meeting of sector professionals from GTZ, WASH, IRC, WHO and the World Bank/UNDP project in February 1990 in the Hague. The February 1990 meeting identified major constraints which influence the current situation of operation and maintenance in developing countries.

In September 1991, at the meeting of the Collaborative Council on Water Supply and Sanitation in Oslo the working group was designated as one of the 7 working groups of the Collaborative Council. The working group has the mandate to develop a joint cooperation process in operation and maintenance involving External Support Agencies and developing countries. It is expected that this cooperation will result in applicable strategies and methodologies for the formulation, implementation, monitoring and evaluation of programmes for the optimization of water supply and sanitation services in developing countries. One of the priority concerns of the Group is to promote Operation and Maintenance activities in the context of a process of capacity building with emphasis on the improvement of managerial practices and human resources development, in addition to a conjunct of actions addressing the engineering aspects of the problem.

A second meeting of the working group was organized by WHO and held in Geneva from June 1st to June 4th, 1993. This represented the first time the group met as a working group of the Collaborative Council on Water Supply and Sanitation. The June 1-4th meeting was devoted to discussing the initiatives taken by the Advisory Committee since the June 1990 meeting and progress made. The meeting reviewed the documents describing the status of activities of the working group prepared for presentation at the Rabat meeting of the Collaborative Council in September and outlined a work programme describing strategies and activities to be developed from September 1993 to September 1995. The meeting also discussed strategies for the dissemination and use of the various guidelines, documents and training packages generated by the working group.

The Advisory Committee of the Working group has met on two occasions. The Advisory Committee met in Geneva from 26 February to 1 March 1991 and developed a number of priority proposals for projects to address the specific activities identified by the working group at the previous years meeting.

The second meeting of the Advisory Committee was held in Geneva from June 1st to June 5th 1992. This was a two part meeting, from June 1st to June 3rd the Advisory Committee reviewed the outline of the training package under preparation by the IRC and reviewed the terms of reference prepared by WHO for this activity.

During the period June 4th and 5th the Advisory Committee:

- ★ Reviewed the achievements and status of activities under implementation or planned for implementation;
- ★ Devised new strategies and ideas for joint cooperation and reviewed priorities taking into consideration the new condition of the Advisory Committee as part of the Collaborative Council on Water Supply and Sanitation;
- ★ Discussed and assessed funding possibilities for priority activities as yet unfunded; and
- ★ Defined and formulated country level proposals in operation and maintenance.

2. Objectives of Working Group

The overall objective of the working group is to contribute to the improvement of the global performance of operation and maintenance in the water supply and sanitation sector.

When the working group was first formed the target audience was accepted as countries in the developing world. However, recent political changes in Eastern Europe have led to the recognition that these countries would be an important secondary target group. Discussions at meetings of the working group have also prompted the realization

that the findings and initiatives of the working group have some. although admittedly lesser, relevance for the developed world.

The scope of the work of the operation and maintenance group includes the following tasks:

- ★ to promote the improvement of operation and maintenance performance and raise the level of awareness of the need for and benefits to be derived from a better level of operation and maintenance services;

- ★ to improve the profile of operation and maintenance in the sector and promote optimum management of existing assets through prepared presentations to agencies, conferences and at workshops and through promotional literature;

- ★ to consolidate work carried out to date by various agencies on guidelines, manuals and training packages on optimizing operation and maintenance of water supply and sanitation facilities, in aspects such as design, selection of technology, materials, equipment, quality control of construction and installation, management, and monitoring and evaluation and prepare guidelines, manuals and training packages for this purpose;

- ★ to improve operation and maintenance by having guidelines, manuals and training packages prepared by the Working Group included in ongoing and/or planning programmes and projects of multilateral and bilateral agencies in developing countries;

- ★ to promote and facilitate the exchange of information on operation and maintenance amongst members of the Working Group and other interested sector professionals and officials.

- ★ to promote and facilitate the use of the "tools" prepared by the Working Group amongst the members of the Water Supply and Sanitation Collaborative Council and country agencies.

3. Findings of the Operation and Maintenance Group

Since 1988 when the operation and maintenance group was formed two meetings of the group have been held; in 1990 and 1993. In addition the Advisory Committee has met twice. in 1991 and 1992, and a preplanning meeting of interested ESAs was held prior to the 1990 working group meeting in February 1990.

These meetings and discussions resulted in:

- ★ the recognition and identification of key issues and constraints to operation and maintenance

- ★ the publication of reports on the various meetings of the working group and advisory committee and other publications by members of the working group which grew out of and were stimulated by the activities of the working group
- ★ the implementation of specific activities
- ★ the development of a group philosophy for operation and maintenance.

The conclusions of the meetings of the Operation and Maintenance Working Group are as follows:

3.1 Initial Organizational Meeting of the Working Group

The initial meeting of the working group occurred immediately following the International Drinking Water Supply and Sanitation Consultation which took place from 02 to 04 November 1988 in the Hague. This one day meeting was organized by WHO with the support of IRC and was attended by representatives of ESAs interested in operation and maintenance.

The main conclusions of this first preliminary meeting were:

- ★ The magnitude of operation and maintenance issues needed to be more clearly established to create awareness and increase the status of O&M activities and organizations.
- ★ The development of country level policies and strategies required support from external support agencies.
- ★ Case studies were needed to induce the exchange and transfer of experiences on operation and maintenance and to assist in the formation of strategies to improve O&M.
- ★ A working group meeting needed to be organized in order to discuss opportunities for coordination of efforts to improve operation and maintenance.

The meeting also resulted in the recognition of the special considerations which needed to be given to O&M systems for rural and urban water supply and sanitation systems. The meeting acknowledged the need to address the O&M problem of sanitation systems, but considered the O&M of water supply systems more urgent at present.

3.2 Preplanning Meeting for 1990 Working Group Meeting

This preplanning meeting was held from 20-23 February 1990 in the Hague and was co-organized by WHO and IRC. This small meeting was attended by representatives of WASH, The World Bank, WHO and IRC.

Participants identified the main problems contributing to poor operation and maintenance as:

- ★ Insufficient Funding for Operation and Maintenance;
- ★ Inadequate External Support Agency Practices to O&M Development;
- ★ Use of Non Sustainable Inappropriate Technologies;
- ★ Poor Quality of Water Supply Systems;
- ★ Poor Sector Performance in Countries;
- ★ Inadequate Institutions for Operation and Maintenance; and
- ★ Non Involvement of Users.

Following discussions the members of the preplanning meeting proposed the following objectives to maximize sustainable water supply coverage:

- ★ Ensure Adequate Funding for Operation and Maintenance;
- ★ External Support Agencies Promote and Support Operation and Maintenance Development;
- ★ Adoption of Appropriate, Maintainable Technologies;
- ★ Ensure Proper Design and Construction of Water Supply Facilities;
- ★ Establish Operation and Maintenance Strategies for Water Supply Facilities;
- ★ Encourage Coordination and Collaboration of Government Agencies, ESAs, Private Sector and the Users;
- ★ Promote Community Management.

The meeting also established the principal aims of the June 1990 meeting of the working group and developed a programme for the meeting. The key objectives were identified as:

- ★ To obtain support from ESAs, country institutions and sector specialists for increased efforts and effective allocation of resources to operation and maintenance;
- ★ To solicit agreement on the scope of joint efforts during the decade;

- ★ To devise a joint strategy and framework to improve operation and maintenance: and

- ★ To identify specific activities to improve operation and maintenance performance.

3.3 Working Group Meeting June 19-22, 1990

From June 19-22, 1990 some 40 participants from 25 different countries attended the working group meeting organized by WHO and held in Geneva.

The objectives of the meeting were to review the key issues and problems resulting in inadequate operation and maintenance, suggest possible solutions and propose activities for implementation by ESAs, national governments and others to enhance operation and maintenance activities.

The first two days of the meeting were devoted to the participants presenting a series of case studies describing specific operations and maintenance problems and strategies from a number of developing countries. During the last two days the conference discussed the three major themes of sector performance, institutional performance and technology performance and environmental linkages.

The conference attendees identified the key issues contributing to the poor operation and maintenance performance of water supply facilities as:

1. Inadequate Data on Operation and Maintenance

2. Insufficient and Inefficient Use of Funds

3. Poor Management of Water Supply Facilities

4. Inappropriate System Design

5. Low Profile of O&M

6. Inadequate Policies, Legal Frameworks and Overlapping Responsibilities and

7. Political Interference.

The participants developed a priority set of specific activities to be implemented primarily by ESAs and national governments to address these constraints. The attendees while recognizing the importance of involving the community felt that the roles of ESAs and national governments should be accorded greater initial importance.

The activities were grouped under four main headings reflecting the priority issues identified:

- ★ Enhance Profile of Operation and Maintenance at Global and National Levels:
- ★ Management Improvement;
- ★ Data Collection and Operation and Maintenance Monitoring; and,
- ★ Policy Formulation, Collaboration and Coordination.

Enhance Profile of Operation and Maintenance

1. Preparation of a global position paper on Operation and Maintenance directed at decision makers in national governments and ESAs to promote giving the highest priority in the sector to operation and maintenance at both international and national levels.

2. Promotion of an awareness raising campaign on Operation and Maintenance at national levels through workshops, seminars and conferences.

3. Hosting of workshops at a national level to promote the maximum exchange of information on specific aspects of operation and maintenance and to develop strategies to improve operation and maintenance performance.

4. Promotion of a higher profile for operation and maintenance to professional associations, training establishments and other organizations through guidelines, workshops, seminars and conferences.

5. Preparation of guidelines for issue by ESAs to engineers preparing systems to encourage the inclusion of operation and maintenance concerns in systems design.

Management Improvement

1. At the global level to promote viable autonomous agencies which range at one extreme from a community based rural organization, through to urban utilities, to manage water and sanitation systems on a fully self financing basis for operation and maintenance.

2. To encourage ESAs and national governments to support the strengthening of agencies to enhance their ability to sustain adequate operation and maintenance activities.

Data Collection and Monitoring

1. Develop and implement monitoring systems for operation and maintenance costs and performance at the national level.

2. Implement programmes at the global and national government levels to systematically collect financial and performance data on operation and maintenance based on standard guidelines.

3. International methodologies for the establishment of performance indicators should be developed and existing WHO guidelines on evaluation should be reviewed to determine if they properly reflect requirements for adequate operation and maintenance.

4. To institute at the global level a programme to accurately determine the costs of adequately operating and maintaining various types of water and sanitation systems.

5. Studies should be initiated to determine the extent of cost saving and/or improvements to efficiency that will result from improved operation and maintenance and the use of locally or regionally manufactured spare parts. These studies could be funded possibly by ESAs and may necessitate the rehabilitation of facilities before improved operations and maintenance methods can be applied.

The working group suggested that ESAs should assist with these data collection and monitoring programmes and facilitate the exchange of cost and performance data, especially technology performance between countries. ESAs should also play a major role in ensuring feedback of information from the monitoring and evaluation of technologies to the system designers.

Policy Formulation, Collaboration and Coordination

1. A review of ESA sector policy documents should be undertaken and a set of policy guidelines established that adequately address the operation and maintenance issue.

2. A review of national government sector policies and practices on operation and maintenance should be carried out and national government policies and legal frameworks established. These should ensure that operation and maintenance concerns are included in the project design right from the projects' initiation.

3. Legislation should be enacted to restrict the discharge of pollutants and to restrict the use of materials that would cause operation and maintenance problems.

4. A forum should be established to encourage the collaboration and coordination of ESAs and national governments at the country level in order to achieve common policies, unified approaches, compatible technologies and standardized equipment within the framework of national policies.

The working group also established four overriding principles which it considered should be incorporated into the philosophy on operation and maintenance. These principles are:

1. The group recognizes that the provision of water is a service which requires a service oriented attitude by the agencies involved. To ensure long term sustainability water should be managed as a commodity in exactly the same way as any other resource. Its use and exploitation should be on financially sound and cost effective bases subject to the same legal and regulatory controls as other resources to ensure its conservation, protection and wise utilization.

2. The supply of water to consumers should normally be based on the principle of effective demand which can be defined as the standard of service that the users are willing to maintain, operate and finance to ensure adequate public health standards. The effective demand has to satisfy the priorities of the community at large.

3. Water systems should be managed and operated following the principles of good business practices. The form of management will vary depending on the local situation; ie. rural, urban, semi-urban, location, demographic structures, etc. The responsible agency will be autonomous from government but manage the system under technical, financial and administrative guidelines set by national governments. The agency will be transparent and full accountable to its consumers.

4. Sanitation is recognized as an undervalued item in the sector and emphasis is required for sanitation development and for forging closer links between water supply and environmental sanitation (solid and liquid waste management) in the planning of new programmes.

The group also recognized the legitimate concerns of government to satisfy the basic needs of the disadvantaged segments of the population. Governments may require agencies to provide service at lifeline tariffs for such groups or institute temporary subsidies to promote public health and economic development.

3.4 Advisory Committee Meeting 26 February to 01 March 1991

From 26 February to 1 March, 1991 the Advisory Committee held a meeting in Geneva organized by WHO. The objective of the meeting was to develop proposals which would address the priority activities identified by the Geneva meeting of the Working Group the previous June. The Advisory Committee concluded that it would not be realistic at this time to develop proposals for all of the activities previously identified and concentrated on preparing a limited number of proposals based on the criteria that:

- The amount of funds required for any one activity were realistic and affordable by the sponsor agencies;

- ★ The activity should lead to an immediate impact on Operation and Maintenance performance; and
- ★ The selected activities should be aimed at the production of tools to be of use to the maximum number of ESAs and national governments.
- ★ The activities should lead to a process of development of operation and maintenance.

Five priority project proposals were developed. These included:

1. Preparation of a global position paper on operation and maintenance;
2. Assessment of operation and maintenance status of water supply and sanitation systems;
3. Assessment of needs and resources, for training and human resources development in operation and maintenance;
4. Development of implementation strategies for operation and maintenance in rural and urban water supply programmes; and
5. Development of guidelines for improving operation and maintenance in the water supply and sanitation sector.

Each proposal included a project rationale, description, scope, duration, estimated costs and the expected project outputs.

Following the Advisory Committee meeting WHO presented and discussed the five proposals with a number of ESAs. Based on these discussions and internal deliberations within WHO and on the availability of financial resources for its implementation, the list of priority proposals was amended. The revised list of seven activities included:

- ★ Preparation of promotional material on operation and maintenance;
- ★ Development of tools for self assessment of operation and maintenance status of urban water supplies in lesser and least developed countries;
- ★ Development of guidelines for improving operation and maintenance in the water supply and sanitation sector;
- ★ Mobilization of resources for operation and maintenance;
- ★ Training in operation and maintenance of rural water supply and sanitation facilities;

- ★ Training in leakage control; and
- ★ Promotion of adequate managerial practices.

Some of these activities were started immediately after the meeting. These ongoing activities. as well as the overall working plan of the Group were assessed and adjusted during the meeting of the Advisory Committee, Geneva, 1-5 June 1992.

3.5 Advisory Committee Meeting of 1 to 5 June 1992

From June 1st to June 5th the Advisory Committee met in Geneva for a two part meeting. From June 1st to June 3rd the outline of the training package for Training in Operation and Maintenance of Rural Water Supply and Sanitation Facilities which was then under preparation by the IRC was reviewed.

During June 4th and 5th the committee reviewed and amended the revised list of activities and adjusted it in the light of funding constraints.

The committee also recommended that the composition of the Operation and Maintenance working group be modified to reflect the stage and progress of the work of the group. The committee realized the need to have, in addition to project managers representing bilateral and multilateral agencies, a greater representation of water supply and sanitation agencies in both industrialized and developing countries in order to obtain feedback and advice on the activities being implemented and proposed. The need for more "hands on" experience in the group was recognized together with a greater representation from developing countries. It was also felt that it would be beneficial to have a balanced "urban" and "rural" representation in the working group, as the strategies, policies and techniques vary considerably according to each case.

3.6 Working Group Meeting June 1-4th, 1993

From June 1st to June 4th 1993 the Working Group held a meeting in Geneva organized by WHO. The overall objective of the meeting was to review the progress and work undertaken by the working group and to develop a plan of action for the next several years. The meeting was attended by 36 participants from 24 countries representing water and sanitation institutions in developing countries and selected ESA's.

The OMWG, is concentrating efforts in the production of tools intended to facilitate the implementation of O&M programmes by national governments and external support agencies. In addition, the OMWG is highly concerned with aspects dealing with exchange of information and promotion and mobilization of resources for O&M at the country level.

A prime objective of the meeting was to review the status and content of these various tools (manuals, training packages, etc.) which are in different stages of implementation.

The specific objectives of the meeting were to:

- Review achievements and status of activities under implementation by the Operation and Maintenance Working Group;
- Discuss strategies for the use of products (guidelines, training packages, etc.) generated by the group;
- Review O&M constraints and priority issues for the water supply and sanitation sector development;
- Discuss strategies and activities to be developed by the Group for the period from September 1993 to September 1995;
- Review documents under preparation which will be submitted to the Water Supply and Sanitation Collaborative Council for presentation at the meeting of the Council in Rabat, September 1993;

It is a consensus within the OMWG that, a major concern of the Group for the forthcoming years should deal with the application and use of tools and materials developed during the past few years. The Group also considers of great importance to identify strategies for the application of these tools and materials at the country level. One of the key recommendations of the Group, considered of crucial importance, refers to the incorporation of the findings and tools produced by the OMWG into the programmes and activities of the water supply and sanitation institutions and the External Support Agencies. Another major concern of the OMWG deals with the need for the development of additional tools which jointly with the above would complete the set of materials of key concern to improved Operation and Maintenance.

The Working Group also discussed the constraints to O&M and the priority development issues affecting O&M to see if and how these had changed since the first Working Group meeting in 1990. A list of priority issues was identified and these were grouped into four major development issues.

- ★ Community management for improved Operation and Maintenance;
- ★ Environmental sanitation;
- ★ Influence of appropriate technology on Operation and Maintenance;
- ★ Optimization of water supply and sanitation facilities.

It has been realized by ESA's and national governments, particularly with respect to rural water supply and sanitation that community management of facilities is the most realistic and desirable approach to ensure proper operation and maintenance and long term sustainability. The issue is how to implement successful community managed projects. The Working Group is already focusing on management issues with respect to the operation

and maintenance of facilities and producing tools to improve management. The Group identified as a future activity the need to develop more specific tools to assist communities manage the operation and maintenance of facilities.

The need to focus attention on environmental sanitation, an issue which was identified by the Working Group in 1990 was reaffirmed. The Working Group felt that in future additional activities should be developed in this important area.

The need to develop tools to assist users in selecting the most appropriate water supply and sanitation system for their particular situation was identified. Too often the users are not aware of the operation and maintenance implications in choosing a specific technology and may select a technology which in the short term is cheaper but in the long term is more costly and difficult to maintain because of operation and maintenance requirements.

The Working Group also identified the optimization of existing water supply and sanitation facilities as a major issue. Tools are already being prepared by the group which cover key aspects dealing with the optimization of the water supply and sanitation services. However, additional tools are needed to assist agencies to modify and optimize their facilities.

The Working Group also recognized as a priority issue the need to develop realistic and achievable strategies to enhance the role of women in operation and maintenance. Women were recognized as key people in improving operation and maintenance performance. However, care should be taken that suggestions for involving women are acceptable to women and should not negatively impact upon them. Women must be more fully involved in the design and planning of strategies to improve operation and maintenance performance.

3.7 Reports and Publication

A series of reports were published recording the proceedings and conclusions of the Working Group and the Advisory Committee. References for these are presented in Annex III.

The report of the Working Group meeting held in Geneva in June 1990 comprises two volumes. Volume I which is the report of the meeting and volume 2 which contains a number of case studies from developing countries on operation and maintenance.

An ongoing concern of the Working Group from its inception has been to raise the level of awareness on operation and maintenance and to sensitize sector professionals, developing country water agencies and ESAs to the importance of the operation and maintenance issue. The working group has actively supported and encouraged its members to make presentations and publish papers in journals on operation and maintenance and on the activities of the working group.

Presentations describing the activities of the working group were made to the International Water Supply Association, Foundation for the Transfer of Knowledge Seminar, at its 18th Congress in Copenhagen, Denmark in May 1991 and to the Global Forum of the Water Supply and Sanitation Collaborative Council in Oslo 18th-20th September 1991.

A listing of papers presented at conferences and of other published papers by members of the working group is given in Annex IV.

4. Activities

Consequent to the working group meetings a number of activities are in different stages of advancement. Such activities are focused on the preparation of tools to support the implementation of sound operation and maintenance practices to be used by water supply and sanitation agencies in developing countries and for incorporation in projects sponsored by external support agencies. Some of the activities identified have been completed, some are ongoing and some still have proposed status. In addition, different activities were implemented by developing countries and external support agencies, derived from guidance generated during the meetings of the Group and with the support of the tools developed by its members.

This report will be focused on the activities implemented under direct management of the Group and as the result of deliberations of its members. The several activities carried out as a consequence of the Group's inputs to the sector but not decided jointly by its members or not included as part of the action plans established during the Group's meetings will not be described in this report. Under the latter category there are the numerous training activities, workshops and projects implemented by external support agencies and water supply and sanitation agencies based on the findings of the Group's deliberations and with inputs and guidance from the materials generated by the Operation and Maintenance Working Group.

The activities developed by the Operation and Maintenance Working Group and described in this document were carried out as a consequence of recommendations of the Group generated during its meetings or those of its Advisory Committee. Such activities evolved from the initial action plans outlined by the Group which, after successive adjustments, reached the present status. These adjustments were carried out as an attempt to harmonize the recommendations of the Group with the availability of resources for their implementation. Whilst the full action plans proposed through deliberations of members of the Group can be seen in the proceedings of the past meetings, the present report will focus on the work actually carried out or under implementation. The activities devised by the Group but not yet started will not be included in this document. The latter will be discussed during the next meetings and incorporated into a new action plan taking into account an update of developing countries' needs and the potentiality and limitations of the Group.

The ongoing activities are as follows:

Activity 1:	Selected Case Studies on Operation and Maintenance of Water Supply and Sanitation Systems
Activity 2:	Development of Tools For Assessment of Operation and Maintenance Status of Urban and Rural Water Supply and Sanitation
Activity 3:	Development of Guidelines for the Management of Operation and Maintenance of Urban Water Supply and Sanitation Systems
Activity 4:	Preparation of a Training Course Package on Leakage Control
Activity 5:	Preparation of guidance materials on optimization of drinking water treatment plants
Activity 6:	Development of a Training Course Package on Management of Operation and Maintenance of Rural Water Supply and Sanitation
Activity 7:	Characterization and Evaluation of Models of Management Systems for the Operation and Maintenance of Rural Water Supply and Sanitation Facilities

A summary of the above activities is given in the following sections. These activities will be completed or will be in process of implementation by September 1993. Considering that the documents prepared in the context of this process are a contribution of selected external support agencies to the Operation and Maintenance Working Group, their layout varies according to the usual procedures and standards adopted by the respective agencies.

The ongoing activities can be summarized as follows:

4.1 Selected Case Studies on Operation and Maintenance of Water Supply and Sanitation Systems

Description

Several case studies covering different aspects of assets management and sustainability of water supply and sanitation systems have been prepared by members of the operation and maintenance working group and were presented at the Group's meetings. Similarly, several case studies were presented at workshops which without being planned or organized by the Group were strongly influenced by the Q&M conceptual framework developed since the start of this process of cooperation shared by external support agencies and water agencies in developing countries. These case studies provided the basis for the definition of priority issues, structuring of the operation and maintenance working group, formulation of action plans and carrying out of development activities.

Considering that the above papers are an impressive collection of case studies dealing with many issues and relevant experiences linked to sector development aspects, it was recognized that the organization of these papers into a coherent document would be of great interest for those dealing with development activities, specially in aspects of water supply sanitation assets management. This collection of case studies should be of interest to those concerned with sector development as it contains important lessons that can orient the adoption of suitable criteria and adequate strategies dealing with projects on different aspects of operation and maintenance.

Status

This activity is under implementation and will be completed in the early autumn.

4.2 Development of Tools For Assessment of Operation and Maintenance Status of Urban and Rural Water Supply and Sanitation

Description

As a response to the lack of sufficient guidelines on how to assess operation and maintenance services in both urban and rural areas, the Operation and Maintenance Working Group decided to develop tools and methodologies to facilitate the work of those responsible for these activities. These tools and methodologies are needed particularly to:

- ★ generate adequate and reliable information on operation and maintenance;
- ★ prioritize actions based on an assessment of performance indicators;
- ★ plan operation and maintenance programmes;
- ★ justify investment in improved operation and maintenance based on an assessment of performance indicators;
- ★ monitor the progress made in these programmes which aim to improve the operation and maintenance.

The direct outputs of this activity, will be the following:

- ★ a methodology and guidelines to assess operation and maintenance for sector professionals from urban or rural water and sanitation agencies and external support agencies;
- ★ a set of annotated checklists for rapid assessment of operation and maintenance status;
- ★ a set of indicators and target figures for operation and maintenance evaluations;

The ultimate beneficiaries of the methodology and the tools for the assessment of O&M status will be the projects conducted by external support agencies and the O&M services under the responsibility of the water supply and sanitation institutions in developing countries. The methodology will have a considerable degree of flexibility to accommodate the special needs of the different potential users. Two sets of tools and guidelines will be prepared to cover the specific needs of urban and rural operation and maintenance respectively. The WEDC and IWSA are involved in the conducting of this activity.

Status

This activity is being implemented in three stages. The first stage, which is under implementation is a comprehensive desk study of the existing literature and information available. The second stage, to be developed as a consequence of this study and based on it is a proposed methodology for assessment of O&M status. The third is the testing of these tools and guidelines in selected countries and its adjustment in the light of the foregoing testing.

4.3 Development of Guidelines for the Management of Operation and Maintenance of Urban Water Supply and Sanitation Systems

Description

This document is based on the principle that the provision of adequate and safe drinking water supplies and appropriate sanitation facilities form a basis for the improvement of the health and general well being of the communities benefitting from these services.

These benefits will be maximized when the installed systems operate continuously to the extent of their capacity and in conformity with acceptable standards of quantity and quality. Accordingly, O&M must be undertaken in an effective and efficient manner. In a large proportion of cases this is not so and as a result defects such as those shown below, are common.

- ★ Many people do not receive drinking water and sanitation services.
- ★ Intermittently supplied water of inadequate quality.
- ★ Pollution from defective sanitation services and discharge of substandard effluent.
- ★ Unacceptable levels of unaccounted for water.
- ★ Low staff moral, efficiency and productivity.

- ★ High operating costs (chemicals, energy, manpower, defective equipment and poor spare parts and tool inventory procedures).

- ★ Excessive repair and replacement costs as a consequence of inadequate preventive maintenance.

Additionally, the technical options chosen for development projects are not always those best suited to the environment in which they are to operate from either the technical, socially appropriate or financial points of view. Institutional shortcomings, a lack of trained staff and inadequate financial resources all contribute to adversely affecting the performance of the agency.

Although many factors contribute to this situation, the greatest impact stems from a lack of effective management in the delivery of water supply and sanitation services. This is particularly evident in those systems which have no clearly defined objectives and where there is neither long-term planning nor short-term programming or budgeting. Other typical failings are:

- ★ Lack of operational and management tools for scheduling, evaluation of performance and control of activities.

- ★ Limitations on the quantity, quality and flow of information to guide the formulation of O&M plans and to identify staffing profiles and training needs. Critical information includes essential manuals, inventories of installed equipment, layout drawings, as-built plans and maps showing locations of other underground utilities.

- ★ Lack of consideration for O&M requirements during project planning, design and construction (e.g. definition of institutional, technical and financial responsibility for O&M, recruitment and training of O&M staff, provision of equipment for O&M such as tools, transport and stores, selection and standardization of appropriate equipment, definition of standards, etc.).

- ★ Shortcomings in the establishment of preventive maintenance procedures designed to minimize operational shutdowns because of breakdowns and to prolong the efficient working life of system components.

Whilst the foregoing and other variables all contribute to the performance problems of water supply and sanitation agencies, the prime factor responsible for poor O&M is a lack of operational and management control allied to limited leadership and directorial skills and aggravated by poor information systems on which to base sound decisions.

This document has been prepared to assist in finding solutions for the above problems which helps consolidating technical and institutional development strategies for the strengthening of O&M through development of the technical, operational and managerial capability of human resources. The application of this document should contribute to the optimization of installed capacity and the extension of coverage of water

supply and sanitation services to provide the users with sufficient water of adequate quality, with reliable systems working without intermittency and at a cost affordable to ensure the sustainability of the services.

The document describes the managerial concepts and activities involved in the O&M of drinking water supply and sanitation systems. It is intended to be used as a guide for the formulation and implementation of programmes aimed at strengthening of the technical, operational and managerial capabilities required to operate and maintain such systems. It includes issues to be considered in a process of development of water supply and sanitation agencies directed towards the achievement of improved conditions of water quality, continuity, coverage at affordable costs and thereby contribute effectively to the health, well-being and institutional development of these agencies. The main target audience are the managers in charge of the operation and maintenance systems of urban drinking water and sanitation agencies. The ultimate objective is to provide the consumer with the best quality service at the lowest cost.

The document contains four chapters as follows:

PART I. SYSTEMS APPROACH

Describes the use of the systems approach for analysis of the functions of drinking water and sanitation agencies, as a tool for solving operation and maintenance problems. Gives specific details of the Operation System and its subsystems.

PART II. THE MANAGEMENT OF OPERATION AND MAINTENANCE

Sets out the managerial levels, activities and factors that will enable users to formulate the occupational requirements and corresponding profiles of management functions in O&M for the organization of the human resources of an agency. Defines the programmes and projects which should be the priority responsibilities of O&M managers.

PART III. INFORMATION SYSTEMS

Identifies the conceptual framework, methodology, centres of decision and basic indicators for the development of management information systems and decision support systems for O&M. Suggests techniques for the measurement of effectiveness of the programmes by the use of performance indicators.

PART IV. IMPLEMENTATION

Sets out the stages to be accomplished and activities to be performed for the implementation of the concepts formulated in the document.

Status

After successive revisions, the final draft document is ready. A final revision is now

being conducted by the publications' office of WHO since this document will be issued as a WHO's official publication.

4.4 Preparation of a Training Course Package in Leakage Control

Description

This training package adopts a logical and "user-friendly" approach to training water practitioners at a range of levels, from senior managers to leak inspectors. Each module can be varied in content depending on the depth of knowledge required for a particular level of trainee. For example, engineers and managers could explore in detail the institutional and financial aspects of leakage control, and would benefit from a cost benefit exercise to select and develop an appropriate policy. Engineers and technicians responsible for managing a system and detecting leaks would benefit from an understanding of these principles, but the main thrust of their programme would be based on those modules with a more practical and technical approach to system management.

An attempt has been made to make the training material as broad as possible, with references to published work from papers, journals, seminar materials, guidelines and some textbooks so that the trainer can quickly assimilate the appropriate material, and assemble his/her own form of words for each module. The "textbook approach" to training has been deliberately avoided. Much of the material has been collated and reworked from training course notes and visual aids taken from a range of courses and workshops designed and presented by Wrc in countries world-wide. One primary textbook source has been extensively quoted. This is "Leakage Control Policy and Practice", published by the UK water industry in 1981. This report has been extensively used, with necessary updating and adaptation to local conditions, by many water practitioners and consultants world-wide, both for training and policy development purposes.

A wide-ranging literature survey has been conducted for the training package. This has identified papers which will be used both as source material and as references for delegates to keep.

The course will also benefit from a review of "state of the art" leakage control technology covering flow measurement, leakage data capture, and leak detection equipment. Commissioned by the UK water industry "Leakage Initiative", the review covers a range of manufacturers and a range of products. It will provide a database of current technology from which to select user-suitable equipment.

One of the main features of the package is the "hands on" experience gained by the trainers. This is done in two ways, and should be explained as follows:

- ★ tailoring the course to a particular utility or community's requirements by finding out current system practice, problem areas, successes and failures, etc., and then involving the trainees in producing an "Action Plan" for their system, based on local knowledge and new skills gained from the course;

- ★ having a practical demonstration of the available equipment over a range of technology, followed by field demonstration (at a pre-selected and prepared site near to the course venue). All trainees should have the opportunity to a data logger, measuring a flow profile, locating a leak).

This approach requires a little planning beforehand and during the first day of the course. Delegates are required to provide written information about their water supply, e.g. physical details like topography, population and demography, cause and magnitude of losses, etc, as well as a description of the current leakage control policy, if any. At a suitable point during the first day, when the course programme, etc., have been introduced, individual trainees, or a representative of a group, are invited to make a brief presentation on the background and current practice of their water supply department. This has three purposes:

- ★ it acts as an icebreaker;
- ★ it helps to stimulate discussion;
- ★ it provides local material and experiences.

From this point on all the points raised can be dealt with in subsequent modules, again with trainee feedback and active participation. The local knowledge thus gained is also invaluable for constructing an Action Plan at the end of the course, when the trainees will benefit from group work-comparison of different ideas and views will act as an additional stimulus to discussion.

It is important to emphasize that a leakage control programme can be initiated in any water undertaking, even in those with intermittent supply (supply can be partially restored by low-activity policy such as repairing visible leaks - a policy practised in Bombay as the first stage to their leakage programme). It is the sustained activity which is important, i.e., building a leakage monitoring and control element into a company's programme of operation and maintenance.

The sections and modules in the package are intended to be for both the trainer and trainee. Each module contains;

- ★ objectives of and introduction to the module content;
- ★ a commentary on the main issues, annotated at the appropriate point with references to source documents and texts developed specifically for the package;
- ★ a list of overhead sheets and 35mm slides, and reference material.

Status

The first draft package has been completed by the Water Research Centre, UK. After reviewing by selected specialists it will be revised and finalized before September 1993.

4.5 Preparation of guidance materials on optimization of drinking water treatment plants

Description

This document is a practical approach to the improvement of water treatment plant performance. The enormous economy that is possible by maximizing eh production potential of existing treatment plants is of special relevance to the countries in the less developed areas of the world.

This document summarizes several decades of field experience in upgrading and improving a wide range of water treatment plants throughout the world. Not only the capacity of the latter plants was substantially increased by also the quality of the effluent water was greatly improved.

The most common constraint for adequate performance of treatment plants are the following:

- ★ underutilization of the hydraulic capacity of the plants;
- ★ low efficiency of the treatment process;
- ★ nonoptimized performance of the treatment plant's units;
- ★ lack of knowledge on how to operate and maintain the treatment plants;
- ★ lack of knowledge on how to improve plant performance;
- ★ resistance of plant operators to changes from inadequate established practices to sound O&M procedures.

The lessons learned and the procedures developed apply not only to the optimization of existing water treatment plant performance but also to the design of new treatment plant units and entire new plants. Thus, it deals with a variety of applications and should be of the interest to managers, designers and operators.

The main topics included in this document are as follows:

- ★ characteristics of raw water and how it affects treatment;

- ★ coagulants and how they react with raw water;
- ★ the use of polymers;
- ★ importance of the application of coagulants, it adequate dosing and dilutions, point of application, mixing;
- ★ economical means of obtaining efficient initial mixing of coagulants;
- ★ effects of over and under flocculating;
- ★ the importance of flocculation time and effect of water temperature;
- ★ achieving maximum effectiveness in the settling basins;
- ★ ways of making economical improvements in the mixing, flocculation, and settling units;
- ★ improving filter performance and design of declining rate control;
- ★ efficient disinfection;
- ★ proper stabilization of effluent water;
- ★ design of initial mixing, flocculation, settling and filtering units; and
- ★ basic chemistry and physics of the treatment process.

Case studies presented in this document indicate that the adoption of the recommended procedures can lead to doubling or tripling the capacity of treatment plants.

Status

A draft document has been prepared. The document was reviewed at the O&M meeting, 1-4 June 1993 and is in the final stages of production.

4.6 Development of a Training Course Package in Management of Operation and Maintenance of Rural Water Supply and Sanitation

Description

The optimization of water supply and sanitation facilities would make it possible to put off investments in rehabilitation and construction of new systems. The preparation of this training package is part of the OMWG's strategy for providing water agencies and external support agencies with suitable tools to support the process of improving the performance of water supply and sanitation facilities in rural areas.

This training package has been devised to raise the level of training and to optimize the scarce resources for training activities in developing countries. Its use will drastically facilitate the implementation of training activities intended basically for professionals dealing with management of Operation and Maintenance of water supply and sanitation systems with some experience in training. The training package is expected to be an important tool for training in the design, preparation and carrying out of training courses in Operation and Maintenance. it should provide a guide for O&M courses to be held at regional and national levels, in different countries. It is intended to give hands-on material for conducting a course, adapted to local situations and make use of local resource person.

The general objective of the course based on the resource package is to contribute to improved management of programmes by enhancing the understanding of participants concerning sustainable water supply and sanitation programme and increasing their ability to sustain adequate O&M activities

The specific objectives are as follows;

- ★ To acquire skills and knowledge to assess O&M needs and constraints at programme level
- ★ To identify strategies to ensure O&M on a sustained basis
- ★ To develop an overview of tools, methods and demonstration relating to key O&M issues
- ★ To identify O&M requirements for different service options
- ★ To identify roles and actors in O&M
- ★ To develop a management information framework and indicators to monitor O&M
- ★ To help individual participants to prepare an action plan

The whole course is designed to be lasting 80 hours, about 2 weeks, with possible adaptations according to local circumstances and demand. It uses a participatory methodology, using participants own experience and problems in the context of each issue concerned.

The training is divided into three parts.

The first part, "**Facing O&M**", is oriented towards achieving a common understanding of Operation and Maintenance. It starts with a presentation of the papers the participants were requested to write before coming to the course, and/or a general presentation of the water sector of the country and its objectives for the coming years. Main issues regarding O&M will be addressed as well as the links between water and sanitation, using presentations or audio visual materials, with guided discussions. Through the Objective Oriented

Programme Planning (OOPP) exercise the key issues affecting operation and maintenance of water supply and sanitation are determined and related to each other. The methodology for developing a framework for putting up strategies to address these issues are then dealt with.

The second part "**Knowing more about O&M**", provides a summary of the most important issues through lectures and group or individual exercises. The most recent information from projects, international meetings, etc., is used to give an overview of the current views and approaches concerning the issues. The participants are provided with background materials and a bibliography for further reading.

Third part, "**Planning for O&M**", is used by the participants to develop an action plan for the strategy of attaining a proper operation and maintenance management in their programme or department. The results of the first part and the information obtained during the second part are used for this and the participants receive individual support. The plans are presented to fellow participants and course staff in order to allow each participant to get feed-back on their proposed plans.

It is important to emphasize that training materials are more effective when designed to solve problems concerning situations in which the actual performance are not in accordance with performance expectation. Thus, the preparation of training materials for each target population, designed after analysis of constraints, post profiles and personnel profiles and also after the formulation of comprehensive development programmes would be ideal. The training material prepared in this manner would be perfectly suitable for the target population. Nevertheless, most technical problems in developing countries are similar and several O&M constraints and issues can have similar treatment. This resource package covers these common O&M concerns in developing countries.

The issues developed in the package are grouped into modules, embracing the various areas of knowledge in Operation and Maintenance. These modules are expected to cover a wide range of technologies and management practices. The appropriate modules will be selected and assembled in accordance with the target population to be trained and taking into account problems and constraints faced by the involved water agencies. The preparation of additional modules or adaptation of some of the available modules may be necessary when the problem analysis shows situations and problems which differ significantly from those foreseen in the source package.

Respected the above limitations, the training packages will facilitate the conveyance and comprehension of key information, and development and consolidation of skills which are related to a better performance which should be expected from the people responsible for the operation and maintenance of water supply and sanitation facilities. They present the great advantage of being flexible and can be updated any time without disturbance to this overall framework.

Status

The first draft package was reviewed and discussed during the meeting of the Advisory Committee of the Operation and Maintenance Working Group, June 1992. A second draft package was prepared and submitted to selected members of the O&M Group which led to a revised draft. This revised draft package was then tested in Namibia. The findings of this testing exercise will be used for the preparation of the final resource package which will be ready for submission to the Water Supply and Sanitation Collaborative Council, at its meeting in Rabat, September 1993.

4.7 Characterization and Evaluation of Models of Management Systems for the Operation and Maintenance of Rural Water Supply and Sanitation Facilities

Description

The document "Models of management systems for the operation and maintenance of rural water supply and sanitation facilities" have been prepared by the Water and Sanitation for Health Project (WASH) under the sponsorship of the U.S. Agency for International Development in collaboration and coordination with the Operation and Maintenance working Group.

The document considers the many issues and actors that influence the development of operation and maintenance management systems for rural water supply and sanitation facilities in developing countries. It describes models in eight representative countries and offers guidance to planners and designers in selecting the most appropriate one.

Models for rural water supply and sanitation facilities range from highly centralized ones managed by government agencies to community systems owned and operated by local organizations. Between these extremes is a continuum of management models that includes participation by government agencies, communities, and private entities.

Management models often are characterized by the number of management tiers involved. The first tier is the government agency responsible for operation and maintenance at the national level. The second tier represents an intermediate body, either a regional government organization or a private group. The third tier is composed of local communities that operate and maintain their own facilities. The relative importance accorded to each tier defines the management model. Most countries use a two- or three-tier model, with responsibility varying from a strong central government role to a strong community role. Less common are single-tier models where either a government agency or the community has sole management responsibility.

Key issues that influence the chose of operation and maintenance management models are:

- ★ Capacity of traditional community organizations

- ★ Key community skills
- ★ Health education and community participation
- ★ Participation of women
- ★ Complexity of technology
- ★ Availability of spare parts
- ★ Standardization and local manufacture of equipment
- ★ Requirements shared with other sector (e.g. irrigation)
- ★ Capacity of private sector
- ★ Cost recovery mechanisms
- ★ Ability and willingness to pay
- ★ National and regional economies
- ★ Logistics and transportation
- ★ Government leadership
- ★ Strength of Government agencies and staff
- ★ Regional autonomy
- ★ Policies and legislation
- ★ Communication and information sharing

The role of operation and maintenance in project cycle is critical to sustainability of project benefits; indeed, operation and maintenance may be considered synonymous with sustainability. The actors involved (national government agencies, regional government agencies, the private sector, and communities) have different contributions to make and each is a key component of project success. Case studies to illustrate these roles have been selected from eight representative countries: Botswana, Yemen, Sudan, Belize, Tunisia, Indonesia, Benin, and Costa Rica.

Botswana relies on a strong national government role because of a well-endued national treasury. Yemen has a community approach that depends on capable local technical skills and an informal system of capital for repairs. Sudan is a poor country with centralized by ineffective leadership that has created a parallel management system at the

local level. Belize has a dual management system determined by the two WSS technologies in use. Tunisia represents a system in transition from highly centralized to community management Indonesia offers an example of community management that was facilitated by a nongovernment organization. Benin has established a three-tier system within a USAID project that depends on a strong private sector to provide spare parts and perform repairs. Costa Rica is a comparatively wealthy country with a strong central government dedicated to providing high levels of water supply and sanitation coverage with increasing emphasis on community management.

From this variety of management models, there are several valuable conclusions that may guide planners in letting the most suitable one for a particular situation.

- ★ Involving the communities in project decisions is essential for effective operation and maintenance.
- ★ The choice of technology must be congruent with local economic conditions.
- ★ Training in management techniques is usually a necessary component of community-managed facilities.
- ★ Willingness to pay for rural water supply and sanitation facilities is complex and variable, but individuals usually will be eager to pay for water but reluctant to pay for sanitation.
- ★ Spare parts supply rather than the availability of mechanical skills usually is a major problem in operation and maintenance.
- ★ Despite the increasing emphasis on community control, decentralization, and private sector involvement, there always will be a role for government water supply and sanitation agencies, at least to monitor and assess the effectiveness of management arrangements.
- ★ Government extension agents are a critical communication link between the government and the communities.
- ★ Strong national leadership is required to build popular confidence in the wisdom and equity of water supply and sanitation and operation and maintenance policy.

Status

The document was presented and discussed during a session of the operation and maintenance working group in June 1992. It was further reviewed by selected members of the Group who provided WASH with relevant suggestions. A revision by WASH led to the present version of the document. This activity has been completed.

5. Related Activities

There are a number of activities which although not being implemented directly by the working group have derived from the tools, guidance or collaboration and support from members of the Group. These activities involve group members active in their professional capacities.

The International Water Supply Association and the associated Foundation for the Transfer of Knowledge have been actively concerned with operation and maintenance issues in urban water supplies. The IWSA through its national membership has organized conferences and workshops on various aspects of operation and maintenance. In December 1991 a workshop on leak detection was held in Surubaya, Indonesia.

Agencies such as WHO, the World Bank, IRC and WASH are also through their various publications, conferences, workshops and projects stressing the need to improve operation and maintenance performance.

A serious constraint to programming and project implementation in the water sector is the absence of effective collaboration and coordination between ESAs and between ESAs and national Government agencies. Too often ESAs in their drive to achieve successful implementation of their own programmes have given secondary attention to collaboration with other ESAs in the sector and in some instances bypassed responsible government agencies.

There are indications however that this is changing. The Water Supply and Sanitation Collaborative Council grew out of a recognition of a need for collaboration and coordination to husband scarce resources. In line with the Council's efforts in this direction different multilateral and bilateral organizations have fostered increased cooperation and collaboration. Some countries too, have formed external support agency collaborative groups that include the national government agencies and address issues in the sector in that country.

The working group on operation and maintenance in an early meeting recognized the need for collaboration and coordination between ESAs and with national governments to institute effective operation and maintenance strategies and programmes at the national level. The working group through its members has been encouraging and supporting initiatives aimed at increased country collaboration and coordination on operation and maintenance.

Several activities of importance took place during the past few years as a follow-up or as a consequence of the influence of the Group's findings. Specific reports on these activities have been prepared by the respective organizing agencies. They include the following:

- ★ Sudan conference on operation and maintenance, Khartoum, 14-17 May 1988. Organized by the Institute of Environmental Studies, the University

of Khartoum and the World University Service of Canada and financially supported by USAID and CIDA.

- ★ Regional workshop on operation and maintenance of water supply and sanitation systems. Kuala Lumpur, Malaysia. 6-10 May 1991. Organized by the WHO Environmental Health Centre.

- ★ National workshop on management of operation and maintenance. Lahore, Pakistan, 4-8 November 1991. Organized by the WHO Regional Office for the Eastern Mediterranean.

- ★ Intercountry workshop on drinking-water leakage detection and reduction, Lahore, Pakistan, 11-14 October 1992. Organized by the WHO Regional Office for the Eastern Mediterranean.

- ★ National workshop on operation and maintenance, Manila, Philippines, 1992. Organized by the WHO Environmental Health Centre, Kuala Lumpur, Malaysia.

- ★ Conference on sustainable operation and maintenance of rural and urban water supplies in Ghana, 20-23 april, 1993. Organized by the Ministry of Works and Housing and the External Support Agency Collaborative Group comprised of CIDA, WHO, IBRD, UNDP, DANIDA, GTZ, ODA, JICA and CAISSE CENTRALE. This conference was accorded the highest political profile.

6. Future Activities

The Working Group following its review of the status of ongoing activities and the constraints to O&M performance identified the following four main development issues:

- ★ Community management for improved Operation and Maintenance

- ★ Environmental Sanitation

- ★ Influence of appropriate technology in Operation and Maintenance

- ★ Optimization of water supply and sanitation facilities.

The Group recommended that future activities concentrate on addressing these four major development issues by preparing additional tools to complement those already prepared or in process of development.

The following specific activities were identified by the group as a first step in addressing the priority issues identified.

6.1 Operationalization of Community Management

The objective of this activity is to develop tools to assist national governments and ESA's to define appropriate approaches for community management. Many national governments and ESA's are committed to community management as a means of ensuring the long term sustainability and operation and maintenance of water supply and sanitation facilities. However, limited information is available on how to implement community management in projects and create the necessary enabling environment for it.

This activity would deal with the preparation of guidelines to assist ESA's and national governments to operationalize the process of community management. This activity would include the following components:

- ★ The preparation of a series of case studies from a disparate number of countries describing experiences and approaches to community management.
- ★ A set of detailed guidelines derived from the above case studies.
- ★ Meeting of specialists in community management for evaluation and adjustment of the above guidelines.
- ★ Promotion of the guidelines.

6.2 Environmental Sanitation

The objective of this activity is to assist national governments and ESA's to strengthen operation and maintenance aspects of sanitation and hygiene education in water supply and sanitation projects. The activity would emphasize the aspects of water supply and sanitation which are of greater impact to the health of those deprived of safe water supply and appropriate sanitation facilities. Of particular interest is the development of tools directed towards prevention and control of water related diseases. These tools should explain the importance of including water supply, sanitation and hygiene education in water supply projects and discuss the technical, environmental, managerial and operation and maintenance concerns and to highlight its relationship with health aspects. These tools should rely extensively on visual material such as slides, slide sound modules, overheads and video.

6.3 Influence of Appropriate Technology in Operation and Maintenance

The objective of this activity is to inform national governments, ESA's, water and sanitation institutions and communities of the operation and maintenance implications in selecting a particular technology. Too often a technology and design is chosen without proper consideration being given to the operation and maintenance implications of the

technology. Cost is often the prime reason for selecting a technology but in the long term an initially more expensive technology may be more appropriate and less expensive because of its operation and maintenance requirements.

6.4 Optimization of Water Supply and Sanitation Facilities

The objective of this activity is to assist national governments, ESA's and water supply and sanitation agencies to optimize existing water supply and sanitation facilities. This activity will develop tools including, training packages, guidelines, manuals and videos to assist water supply and sanitation agencies in the formulation and implementation of programmes for the reduction and control of water loss, sound management practices and the development of management information systems for the permanent evaluation of systems' performance.

The optimization of facilities through the improvement of efficiency and effectiveness of water supply and sanitation agencies makes it possible to extend water supply and sanitation services to those living in less privileged urban/poor or rural areas. These populations are poorly served by public facilities and thus are highly exposed to health risks. The following are the main ultimate expected benefits to be achieved through the development of this activity:

- by reducing water losses and improving the performance of water supply services it should be possible to extend coverage to fringe and poor areas of several large cities in developing countries without constructing new production facilities;

- by increasing water revenue, by reducing operational costs and by minimizing investments for the construction of new works, it should be possible to shift financial resources to increase coverage in periurban and rural areas;

- as a result of improved Operation and Maintenance of piped networks and treatment plants, water quality should also improve. Risks of contamination in distribution systems due to intermittent services, negative pressures and inadequate operation can be greatly reduced.

As mentioned in section 3.6 tools are already being prepared by the group which cover important issues dealing with the optimization of the water supply and sanitation services. However, additional tools are needed to complement those under preparation.

7. Recommendations of the Operation and Maintenance Group to the Collaborative Council Meeting in Rabat

The Working Group during the June 1993 meeting redefined the priority issues to be addressed, identified specific activities to be pursued in the future and discussed the

future programme of the Group following the Rabat meeting of the Water and Sanitation Collaborative Council.

Recent data on operation and maintenance performance in water supply and sanitation indicates that in many countries the situation is deteriorating rather than improving. In fact this is linked with the overall global economic recession. The Working Group feels that major efforts must continue to be made to improve operation and maintenance performance and that the tools being produced by the working group will greatly assist in this.

It is the consensus of the OMWG that its mandate should be extended for a further two years and the major concern of the group for the forthcoming years should be with the application and use of the tools and materials already developed or in the process of development. A second major direction for the Group would be the development of additional tools to complement the materials already developed to address the redefined development issues identified in the June 1993 meeting.

The Working Group also considers that the Collaborative Council offers the best mechanism for the dissemination of the tools produced. Collaborative Council members are ideally placed to encourage and promote the use of the tools produced by the Working Group in water supply and sanitation agencies.

The Working Group is conscious that the tools developed as outputs of joint efforts exerted by its members should be adjusted in the light of experience gained by application and use. Council members can provide valuable feedback to the Working Group on the incorporation of these tools in their projects. This information will help refine and improve the materials.

The OMWG also makes the following specific recommendations to the Collaborative Council which it believes will help improve operation and maintenance performance. These are:

- ESA's and national institutions should organize workshops to promote the maximum exchange of information on specific aspects of operation and maintenance and to raise awareness on this issue.

- Tools produced by the OMWG should be used by ESAs to prepare tailored guidelines to engineers responsible for systems' development to encourage the inclusion of operation and maintenance concerns in systems design.

- Sector decision-makers and ESAs should promote and support action for sector development towards viable autonomous agencies to manage water and sanitation systems on a fully self financing basis for operation and maintenance.

- ESAs and national governments should support the strengthening of agencies to enhance their ability to sustain adequate operation and maintenance activities.

- Monitoring systems for operation and maintenance costs and performance should be developed and implemented at the country level.

- Programmes at the global and national government levels should be implemented to systematically collect financial and performance data on operation and maintenance based on standard guidelines.

- Performance indicators should be developed to properly reflect requirements for adequate operation and maintenance.

- A programme should be implemented to accurately determine the costs of adequately operating and maintaining various types of water and sanitation systems.

- Studies should be conducted to determine the extent of cost saving and/or improvements to efficiency that will result from improved operation and maintenance and the use of locally or regionally manufactured spare parts.

- Legislation should be enacted to restrict the discharge of pollutants and to restrict the use of materials that would cause operation and maintenance problems.

- A forum should be established to encourage the collaboration and coordination of ESAs and national governments at the country level in order to achieve common policies, unified approaches, compatible technologies and standardized equipment to facilitate O&M activities within the framework of national policies.

- The working group in implementing its activities is severely constrained by lack of funds. Of particular concern is the need for funds to ensure a better representation of developing country members in its meetings and for the preparation of tools. It is recommended that a strategy be adopted by the Council to overcome the financing constraints that Working Groups have to contend with in carrying out their tasks effectively.

Annex I

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Annex III

Reports of Working Group and Advisory Committee

WHO	Working Group on Operation and Maintenance. WHO/CWS/89.10. Geneva, 1989.
IRC	Meeting on Operation and Maintenance 20-23 February 1990, IRC, The Hague.
WHO/GTZ	Proceedings of the Meeting of the Operation and Maintenance Group, Volume I: Report of the Meeting, WHO/CWS/90.14, Geneva, 1990.
WHO/GTZ	Proceedings of the Meeting of the Operation and Maintenance Working Group, Volume 2. Case Studies on Operation and Maintenance of Rural and Urban Water Supply Systems, WHO/CWS/90.15, Geneva, 1990.
WHO/GTZ	Proceedings of the Advisory Committee Meeting of the Operation and Maintenance Working Group, Geneva, 26 February - 1 March 1991, WHO/CWS/91.6. Geneva, 1991.
WHO/WSSCC	Proceedings of the Advisory Committee Meeting of the Operation and Maintenance Working Group, WHO/CWS/92.10, Geneva, 1992.

Annex IV

Papers Presented and Published in Connection with the Findings of the O&M Working Group

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McPherson, H.J., Operation and Maintenance for Sustainable Water Supply and Sanitation Systems. Paper presented at the 18th IWSA Congress, IWSA Foundation Seminar, Copenhagen, Denmark, May 1991.

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Annex V

The Training Course Package on Operation and Maintenance of Rural Water Supply and Sanitation Facilities

Description

This training course package is designed to be a guide for the trainer/facilitator who is going to conduct this course. Its structure is flexible enough to be adapted to local circumstances and needs.

The target audience has been defined by the Working Group on Operation and Maintenance as being working level managers and/or field agents including engineers, health workers, social workers and others involved in the water and sanitation sector. Its maximum duration is designed to be of 80 hours or two weeks, and the ideal number of participants is thought to be 15 to 20.

The training package has been designed to include three different phases which reflect a process of apprenticeship.

Thinking phase	-	PART 1:	FACING O&M
Learning phase	-	PART 2:	KNOWING MORE ABOUT O&M
Planning phase	-	PART 3:	PLANNING FOR O&M

It uses as much as possible participatory methods, but also includes background information and overhead sheets which could be used for lectures and presentations, as well as individual or group exercises. Further, 2 videos are proposed in this package.

The course is composed of 8 modules, each subdivided into 2 to 4 sub-modules. Each sub-module gives indications on how to organize each session. It is up to the trainer/facilitator to make use of the information made available in this training course package.

The training course package also provides a guide for the facilitator as well as suggestions for organizing a field visit.

Finally, indications on how to get the videos and additional supporting material are given throughout the training course package.

Outline of Course

PART 1: FACING O&M

MODULE 1: INTRODUCTION

1.1 Introduction of course to participants
1.2 Presentations

MODULE 2: THE CHALLENGE OF O&M

2.1 Concepts and trends
2.2 Links between health, water and sanitation

MODULE 3: O&M ISSUES

3.1 Analysis of constraints
3.2 Identification of strategies

PART 2: KNOWING MORE ABOUT O&M

MODULE 4: O&M TECHNICAL REQUIREMENTS

4.1 A systematic approach, with VIP latrine example
4.2 Water supply
4.3 Water distribution and treatment

MODULE 5: O&M ORGANIZATIONAL AND FINANCIAL REQUIREMENTS

5.1 Actors and roles
5.2 Management models
5.3 cost estimation and cost recovery

MODULE 6: TOWARDS SUSTAINABILITY

6.1 Community management
6.2 Involvement of women
6.3 Local financing
6.4 Human resource development

MODULE 7: TOWARDS SOUND MANAGEMENT

7.1 Information and communication
7.2 Monitoring
7.3 Planning

PART 3: PLANNING FOR O&M

MODULE 8: Methodology for planning
- 8.1 Methodology for planning
- 8.2 Individual assignment
- 8.3 Writing-up and presentations
- 8.4 Evaluation and conclusion

Annex I: Guide for facilitator

Annex II: Suggestion for field visit

Field Testing and Package Revision

Upon completion it is essential that the training package be tested in order to evaluate its appropriateness and also to refine and fine tune the content of the modules.

The field testing to be valid should be carried out under conditions which are as close as possible to the expected process for implementing the training package.

The immediate objectives for the field test are to:

- ★ assess the status of Operation and Maintenance services in the test country and to define gaps and specific training needs;
- ★ assemble the required modules for a training course for managers selected from the Resource Training Package on Operation and Maintenance of Rural Water Supply and Sanitation prepared by WHO and IRC. This preparatory work will be carried out in the light of the above assessment;
- ★ identify additional training materials to cover specific requirements of the target population to be addressed during this training course;
- ★ conduct a training course for Operation and Maintenance managers and trainers and to use the experience of this activity for the reviewing and adjustment of the Resource Training Package.
- ★ establish a process for the replication of this training course recurrently within the country through the involvement of managers and trainers exposed to this first testing exercise.
- ★ use the outputs of the training course for the launching of programmes dealing with both the improvements of operation and maintenance services in the test country and optimization of existing water supply and sanitation facilities.

The field testing will include 3 major phases:

- ★ Preparatory Work
- ★ Pilot Training Course
- ★ Adjustment of the Resource Training Package

A. Preparatory Work

The preparatory work consists in the conjunct of activities to be carried out by international specialists in cooperation with national officials for the assessment of the status of Operation and Maintenance services in the test country and to define gaps and specific training needs in Operation and Maintenance.

The following are the activities to be carried out under this heading:

- ★ To conduct a rapid assessment of the status of Operation and Maintenance of rural water supply and sanitation facilities;
- ★ To identify key managers and trainers who will attend this pilot training course as trainees; and, prepare a general job profile and personal profile of these participants;
- ★ To assemble the Training package to be used during the training course using the Resource Training Package prepared by WHO/IRC and in the light of the needs and constraints identified in the above assessment;
- ★ To prepare additional learning materials where required;
- ★ To prepare the announcement and agenda of the training course;
- ★ To prepare copies of the Training package and of relevant learning materials to be distributed to the participants of the meeting.

B. Pilot Training Course

This activity consists in the organizing and conducting of a pilot training course on the management of operation and maintenance of rural water supply and sanitation facilities in the test country. This course will have a total duration of 10 working days. The number of participants will be between 15 and 20. The course will be presented by two national trainers. An international trainer will provide advice, support and guidance on the training process and provide assistance to the national instructors during the training session.

C. Adjustment of the Resource Training Package

The experience gained through the pilot training course will be used by the IRC and WHO for the revision of the Resources Training Package.

The adjustment of the resources training package will be conducted through the following activities:

- ★ Preparation of a new version of the training package in the light of lessons learnt;
- ★ Preparation of a revised version of the package in the light of the reviewers' comments;
- ★ Preparation of an evaluation report on the testing exercise.