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DIVISION OF ENVIRONMENTAL HEALTH

COMMUNITY WATER SUPPLY AND SANITATION

PROPOSAL FOR A STRATEGY ON
OPERATION AND MAINTENANCE DEVELOPMENT AND OPTIMIZATION
OF WATER SUPPLY AND SANITATION SYSTEMS

GENEVA, MARCH 1988

202.6-88PR-4197

LIST OF ABBREVIATIONS

AFRO	WHO Regional Office for Africa, Brazzaville
AMRO/ PAHO	WHO Regional Office for the Americas/Pan-American Health Organization, Washington, D.C.
CEPIS	Pan-American Centre for Sanitary Engineering and Environmental Sciences
CWS	Community Water Supply and Sanitation
EHE	Environmental Health Division of WHO
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
HPE	Environmental Health Programme (AMRO)
HQ	WHO Headquarters, Geneva
HRD	Human Resource Development
IDWSSD	International Drinking Water Supply and Sanitation Decade 1981-1990
O & M	Operation and Maintenance
SEARO	WHO Regional Office for South-East Asia, New Delhi
UNDP	United Nations Development Programme
WB	World Bank
WHO	World Health Organization
WPRO	WHO Regional Office for the Western Pacific
WS	Water Supply
WSS	Water Supply and Sanitation

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Tel. (070) 814311 ext. 141/142
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CONTENTS

	Page
1. Introduction	5
2. Background	6
3. Objectives	7
4. Programmes and Projects	8
4.1 Operational Development Programme (Unaccounted for Water Programme)	8
4.1.1 Operation of Water Supply Systems	8
4.1.2 Maintenance of Water Supply Systems	8
4.1.3 Metering and Billing	8
4.2 Programme for the improvement of operation and maintenance of sewerage systems	9
4.3 Programme of operation and maintenance and optimization of treatment plants	9
5. Support Projects	9
6. Training Material	10
7. Formulation Implementation and Support of the O & M and Optimization of Water Supply and Sanitation Systems Programmes	11
7.1 Promotion of O & M Programmes	11
7.2 Formulation of the O & M Programmes	12
7.3 Implementation of O & M Programmes	12
7.4 Training Activities	12
7.5 Required Financial Resources	13
7.6 Monitoring of O & M Programmes Progress	13
7.7 Resources Mobilization	13
8. Study Group on Operation and Maintenance and Optimization of Water Supply and Sanitation Systems	15

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The basic aspects of this approach are based on the experience developed over many years by a number of professionals from water agencies, private consulting companies and international institutions.

The first draft of the document was presented and discussed with staff of the Community Water Supply and Sanitation Unit (Division of Environmental health) and their important input has been included in the present draft.

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PROPOSAL FOR A STRATEGY ON OPERATION AND MAINTENANCE
DEVELOPMENT AND OPTIMIZATION OF WATER SUPPLY AND SANITATION SYSTEMS

1. Introduction

Poor operation and maintenance has been identified as one of the major constraints of the water supply and sanitation sector development. Despite the great efforts made at national and international levels to construct new systems and to increase population coverage, little has been achieved in terms of improving the efficient use of existing facilities. The consequences of the government agencies' lack of interest in O & M are reflected mainly in the following:

- poor operation and maintenance of the network systems
- inability to extend water supply coverage to fringe areas due to waste of water by already connected consumers
- poor use of existing facilities in urban and rural areas.
- unaccounted for water frequently representing more than 50% of the produced water;
- extremely high operational costs directly influencing the tariff rates;
- poor quality of delivered water

Beyond the specific aspects of O & M it is possible to relate this situation to the following:

- institutional deficiencies;
- lack of training programmes and adequate personnel development policy;
- insufficient and poor use of financial resources;
- lack of planning and programming;
- lack of operational and managerial instruments for programming, evaluating and controlling activities;
- inadequate information flow;
- poor quality of information;
- lack of community participation;
- lack of manuals and inventories of technical information.

The importance of O & M is widely recognized by external support agencies and such concerns have been registered in the reports on Regional External Support Consultation of Asia, America and Africa in connection with

the International Drinking Water Supply and Sanitation Decade. These reports emphasize lack of adequate O & M as one of the major constraints to Sector development:

- The Americas Regional Consultation (Washington, D.C., 21-24 April, 1986) identified six key constraints related to progress in the water supply and sanitation sector development in the Latin American and Caribbean Regions. Among them was found: "insufficient attention to operation, maintenance and rehabilitation of existing water supply and sanitation systems". (page 2, item 1.7).
- The Asia Regional Consultation document (Manila, 21-25 October, 1985) states on page 7, item 4.3, when referring to the Sector's major constraints:
"... while analysis has shown improvement between 1980 and 1984 in the percentage of people having access to safe water supply and sanitation, the functioning of water supply and sanitation systems was often disrupted by inadequate operation and maintenance..."
- The Africa Regional Consultation document (Abidjan, 25-29 November, 1985) recognizes that "many installations were out of order soon after their implantation, mainly due to lack of local expertise to adequately operate and maintain them". The same document referring to the second half of the Decade strategies and approaches points four major issues on which future sector inputs should concentrate. One of them is: "Rehabilitation and maintenance of existing water supply and sanitation installations, rather than investments in new capacity, to maximize the output of limited resources and to prevent recurrent project costs from soaring to unaffordable levels".

The approach presented in this document considers the development of Operation and Maintenance and the Optimization of Water Supply and Sanitation Systems as an important stage of an institutional development process. By this approach it is possible to recognise and minimize not only the effects of lack of efficiency and effectiveness but also the causes.

2. Background

The actual situation in the water supply and sanitation sector is characterised 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. These constraints are forcing government agencies to promote policy changes in order to make the best possible use of existing resources (human resources, equipment, installations).

The approach presented in this document aims to improve the water agencies efficiency and effectiveness. It is the result of successive experiences accumulated over several years in several countries. The approach is flexible and is to be adapted to meet the requirements of each institution in which it is adopted.

There are many successful experiences reported, one of the most impressive coming from Sao Paulo, Brazil. From the beginning of the programme's implementation in 1977 to the end of its first phase in 1982, the unaccounted for water was reduced from 36% to 26%. The number of house connections increased from 1.023 million to 1.423 million. This means an extension of coverage to an additional 2.0 million inhabitants in fringe and

poor areas. The water produced increased slightly from 22.3 m³/sec in 1977 to 25.4 m³/sec in 1980, but the produced water was subsequently gradually reduced until it reached 25.1 m³/sec in 1982. The amount of financial resources invested in 1982 was US\$ 6.25 million and the additional water which was accounted for in the same year reached allowed the company to have a positive balance of US\$ 16.0 million (reduction of costs and increment in revenues).

Sao Paulo's experience was part of the government's national policy of optimizing the existing sector capacity. Similar programmes were implemented in all the Water and Sanitation State Authorities of the country.

Other important experiences where the approaches used have points in common with the one proposed have been developed successfully in other institutions around the world.

In 1981 the Pan-American Health Organization (Environmental Health Programme), through the Pan-American Center for Sanitary Engineering and Environmental Sciences (CEPIS), started work on promotion and awareness of the importance of operation and maintenance in Sector development. Since 1983, CEPIS has been actively promoting and supporting programmes aimed at improving operation and maintenance and optimization of water supply and sanitation systems in Latin American Countries.

3. Objectives

Programmes of O & M and optimization of water supply and sanitation systems are aimed at improving the efficiency of institutions to achieve the best possible utilization of the existing capacity of the systems. Such programmes, despite being focussed on management and operative aspects related to operation, maintenance and rehabilitation, also involve specific projects related to other areas (cost recovery, planning, financial, administrative).

The development of an institution's operational capability cannot be accomplished through self-contained projects. The global perspectives of the cause/effect relationships and the harmonized development of intersystemic projects are required.

The specific objectives of the O & M programmes are:

- To promote and support the efforts for strengthening the managerial and operational capability of water supply and sanitation institutions in order to improve their efficiency and effectiveness.
- To improve O & M services and related support areas.
- To optimize the installed capacity of the services and to seek for the financial autosufficiency of the sector.
- To extend the coverage, regularize the service rendered to the population and delay investments for new constructions.
- To achieve control and reduction of unaccounted for water.

The implementation of the programme for the improvement of O & M and optimization of existing capacity represents an important phase in an institution's development process. At this stage a thorough survey of the water and sanitation agency would point to the direct causes of inefficiency and ineffectiveness of the institution. The identification of causes and their correlation with poor operational performance would support the formulation of priority projects, which could be grouped into the programme's implementation to achieve adequate operational performance.

The surveys would be conducted by experienced professionals, including the same ones who would comprise an ad hoc group for the formulation of the O & M programmes. Guidelines are being prepared to support the undertaking of these surveys. From the analysis of results it will be possible to evaluate the performance of the water agency and design more accurate strategies, programmes and projects.

After the process has been established or developed simultaneously with the implementation phase of the O & M programme, a more comprehensive institutional development programme should be formulated and put into action. This second phase would be the final adjustment of the institutional development process.

4. Programmes and Projects

The improvement of O & M and the optimization of water supply and sanitation systems usually represents one of the most important steps in the institutional development process and its attainment includes the implementation of the following programmes and respective projects:

4.1 Operational Development Programme (Unaccounted for Water Programme)

This programme comprises projects on the following areas:

4.1.1 Operation of Water Supply Systems

- Hydraulic Survey (Pitometric Survey)
- Control of Leakage
 - visible
 - not visible
- Macromasurement (production and distribution systems)
- Network Mapping
- Control of Operation
 - telephonic centre for public enquiries
 - operational control centre
 - mathematical model for operational simulations
- Revision of Design and Construction Criteria

4.1.2 Maintenance of Water Supply Systems

- Preventive and Corrective Maintenance (electrical, mechanical, civil and instrumentation)
- Distribution Network Maintenance
- Maintenance of Flow Meters (including house meters)
- Improvement and Rehabilitation of House Connections, Transmission Lines and Network's Pipelines
- Improvement of Material and Equipment Quality

4.1.3 Metering and Billing

- Commercialization of the Service
- Customers' Register
- Metering
- Billing and Collection

4.2 Programme for the improvement of operation and maintenance of sewerage systems

This programme comprises projects on the following subjects:

- Operation of sewerage systems
- Maintenance of sewerage systems

4.3 Programme of operation and maintenance and optimization of treatment plants

The treatment plants programme comprises projects on the following:

- Evaluation and upgrading of Treatment Plants
- Operation of Treatment Plants
- Maintenance of Treatment Plants
- Adequacy of Treatment Plants Design Criteria

5. Support Projects

The adequate formulation of programmes for the improvement of O & M and optimization of water supply and sanitation systems should possibly include actions to support and facilitate their implementation, as follows:

- Reorganization of the Institution, particularly in the fields of O & M and metering/billing
- Development of Human Resources, including the improvement of managerial performance; training courses; elaboration of post profiles and personnel profiles and reorientation of cadres; improvement of Human Resources Development service
- Development of an Information System, destined to collect, process and disseminate information on operation, maintenance and related areas
- Improvement of the Transport Service, including the adequacy of the transport facilities, in terms of quality and quantity, and the improvement of the vehicles' maintenance service
- Improvement of the Material and Equipment Supply, in order to guarantee a timely delivery of spare parts and maintenance material
- Community Involvement and Participation, in O & M programmes.

These programmes and projects usually meet the requirements of most institutions in developing countries. Although the formulation of the projects are based on the same concepts and their objectives are basically the same for all institutions, the constituent elements, strategies and resource requirements can vary widely from one institution to another. In

addition, the priority projects and programmes should be selected, formulated and implemented to meet the particular requirements of each institution.

The programmes are multidisciplinary. At the various stages of their promotion, formulation, implementation and monitoring, a large amount of work involving different skills and a comprehensive range of knowledge will be required. Therefore, input based on expertise of several WHO staff members will be required.

It is important to emphasise that it is not our objective to prepare rigid training packages or standardised projects for application in all cases. Although an attempt should be made to foresee all possible, frequent and common problems and to design similar solutions to them, each programme formulation should be adapted to meet the specific requirements of the respective water agency.

6. Training Material

In order to facilitate and provide a uniform level in personnel training, the development of instructional material is required. This material will be prepared to avoid the quality of the training dependent exclusively on the personal skills and capacity of the trainers and facilitators. It will minimize surprizes and the possible negative influences of personal tendencies due to lack of experienced trainers acquainted with the agreed approach. Efforts will be made by WHO to prepare such training packages. These could support the undertaking of courses/workshops/seminars such as the following::

- Operation and Maintenance Management (40 hours)
- Hydraulic Survey (Pitometric Survey) (80 hours)
- Control of Leakage (80 hours)
- Macromasurement (80 hours)
- Network Mapping (40 hours)
- Control of Operation (80 hours)
- Preventive Maintenance (80 hours)
- Instrumentation (80 hours)
- Pipe Network Maintenance (40 hours)
- Maintenance of Consumption Meters (40 hours)
- Metering and Billing (80 hours)
- Operation and Maintenance of Sewerage Systems (80 hours)
- Operation and Maintenance of Treatment Plants (80 hours)
- Evaluation and upgrading of Treatment Plants (80 hours)

Each package might include the preparation of the following groups of elements:

- Manual
- Transparencies and slides
- Working material for office practice
- Working material for field practice
- Microcomputer software
- Video cassettes

The terms of reference for preparing each training package will be presented in other specific documents

The instructional packages will act as a guide for the courses' coordinators and facilitators and will aim to guarantee the conveyance and comprehension of the required amount of information and skills in each course at a high quality level.

The training packages will be prepared and assembled for each specific application. It will thus be possible to assemble a complete set of packages which will meet the requirements of a specific water agency by selecting the required modules.

The number of hours associated with each training event is tentative and will be stated more precisely at the time of application.

The courses/workshops/seminars will be directed to managers, engineers and technicians. This initial target population is expected to become a core group for developing human resources, which would create a multiplying effect in disseminating the proposed technology to the water agencies involved.

Substantial efforts have been made during the last few years to generate training material on O & M. Sets of excellent quality material have been developed concerning some of the issues mentioned above. These are already available and have been successfully utilized. Unfortunately, some packages have not yet been developed and others do not contain all of the elements mentioned. Therefore, the organization of existing material and preparation of other required elements will involve considerable efforts and important financial resources.

To make the situation more feasible the training material will be developed gradually and in the initial stage will be applied to meet the priority requirements of the countries and institutions involved.

7. Formulation Implementation and Support of the O & M and Optimization of Water Supply and Sanitation Systems Programmes

The complexity and quantity of activities involved in the operational development process require very well coordinated efforts. The proposed strategy will be very flexible and will be suitable for application in most cases. The following are the main elements of the strategy:

7.1 Promotion of O & M Programmes

The dissemination and adoption of adequate O & M procedures as proposed in this document require the willingness and active participation of Sector authorities. Hence, the first important action to be taken before beginning such work in the country's water authorities is to organize a seminar for managers with the objective of improving Sector awareness and involvement. In this seminar, the proposed approach for O & M development would be outlined explicitly, discussed, analyzed and adjusted to meet the country's requirements. An additional part of the seminar's strategy would be to seek political decision and official support for the launching of the programme. This would require the following conditions:

- a group of managers who are aware and willing to implement the O & M programme;
- awareness of the approach and motivation at a political level so that decisions could be taken in a meeting supported by WHO.

- the confirmation of agreement before the seminar in order to seek government commitment to support the O & M programmes.

7.2 Formulation of the O & M Programmes

The O & M programmes should be managed at a national level under the coordination of a leading Sector institution. Despite the programmes' national character, their formulation and implementation should be selective and gradual. The first phase of the programmes should cover only a few water services. During the first phase the infrastructure of technological and human resources will be established and then expanded on a national level.

The formulation of the O & M programmes should be undertaken once a political decision supporting such an initiative has been achieved. The formulation comprizes the identification of a national coordinating agency, the Sector organization to implement the programme, the existing water supply services; and the definition of priority programmes, projects and activities with respective costs and required resources (human, financial, equipment, material, vehicles and installations).

The formulation should be undertaken by managers from the sector authorities and the leading agency, with the technical cooperation of WHO staff. A representative from the national financing authority should also participate together with a representative from an external financing agency which has expressed interest in assisting in the funding of the programme.

A two-week workshop, which the above representatives should attend, would be sufficient for the formulation of the O & M programme.

7.3 Implementation of O & M Programmes

The implementation of the programmes should be undertaken with the coordination of a leading, national Sector agency, initially in a few water services and later at a national level. Depending upon the country's experience of similar programmes, an external project manager may be required. The manager could be assigned by WHO with resources from an external support agency to assist the national institutions in the programmes' implementation.

The first phase of the implementation would last for about 3-5 years and during this period other water authorities could join the original water authorities in the development of the programme.

Once a central group of human resources has been developed and an adequate technological background has been achieved at a country level, the second phase would gradually include other water authorities until the whole Sector would interact in a common effort to achieve the programmes objectives.

7.4 Training Activities

The infrastructure to be generated in the water supply institutions will include skilled personnel, who will apply the new technology in their own institutions and also disseminate such technology to other institutions in order to have a multiplying effect.

The support supplied by the training packages mentioned in (6) will be extremely important for the technology transfer process. The training activities should be included in the programmes' implementation strategies and linked to the managerial and operational activities.

The external cooperating agencies will play an important role in the process of training trainers and creating the critical mass of resources in the base institutions for the programmes' implementation at a country level.

7.5 Required Financial Resources

Although the O & M programmes are aimed at improving the efficiency and effectiveness of the water agencies to extend the coverage to fringe and poor areas, and reducing their operational costs, a significant amount of investment is required to achieve the targets as follows:

- Training packages: preparation of training material for supporting courses/workshops/seminars. Although some base material is available, the preparation of adequate training material for the mentioned courses/workshops/seminars is required. The funds for the preparation of training packages should be provided by ESAs interested in supporting the O & M approach. It is not necessary that the same ESA would finance all the training packages. Some could be developed within existing and already funded O & M projects.
- O & M programme promotion: one-week seminar (for each country) for managers, aimed at generating awareness, motivation and a political decision in support of the programmes' promotion. The funds for the promotion of the O & M programmes should be drawn from WHO's regular budget, and supported by local government funds.
- Programme formulation: two-week managerial workshop for the formulation of programmes. National participants and advisers from external cooperation agencies should be involved. The funds for these workshops should be shared by local governments, funding agencies and WHO.
- Programme implementation: the required financial resources for the implementation of programmes will be defined by the time the programmes have been formulated. The implementation costs will be significant and external funding will certainly be required. Despite this, WHO's regular budget should support the water agencies in providing advice for the evaluation and adjustment of the programmes.

7.6 Monitoring of O & M Programmes Progress

In order to follow the progress of the O & M programmes, an evaluation proposal will be prepared and forwarded to representative water agencies.

This evaluation would have two main purposes:

- to study the effectiveness of each water agency in supporting the implementation of programmes;
- to monitor the progress of the programmes.

With the support of infrastructure developed at international and country level, the water agency would perform its operational situation diagnosis; formulate the programmes of O & M and optimization of water supply and sanitation systems; survey and strengthen the organizational structure; promote the development of human resources; develop a managerial information system for O & M and implement a process of programme implementation, evaluation and adjustment.

8. Study Group on Operation and Maintenance and Optimization of Water Supply and Sanitation Systems

WHO proposes to promote and sponsor the constitution of a Study Group on Operation and Maintenance and Optimization of Water Supply and Sanitation Systems.

With the participation of an international group of experts, the following issues will be discussed and the conclusions consolidated in a guideline document:

- Reviewing advances in technologies and WHO strategy, related to O & M and Optimization of Water Supply and Sanitation Systems.
- Identification of programmes, projects and actions to:
 - a) improve O & M and related areas,
 - b) improve the efficiency and effectiveness of water authorities,
 - c) develop the managerial and operational capabilities of the water supply and sanitation authorities,
 - d) control and reduce the unaccounted-for water.
- Identification of mechanisms to improve the exchange of information and experience on O & M and to strengthen the bilateral and multilateral cooperation.
- Analysis of perspectives and constraints for the participation of private institutions in the process of O & M development.

7.7 Resources Mobilization

In summary, the mobilization of resources and undertaking of actions would be as follows:

External Cooperation

The international support agencies will play an important role in the process of promotion, formulation and implementation of O & M and optimization programmes. Specifically their cooperation will be required on the following:

- Promotion of the O & M and optimization programmes at a high governmental level; generation of awareness, willingness and commitment at the main government levels in order to create the required conditions for the formulation and implementation of the programmes.
- Provision of the financial resources for the formulation and implementation of programmes at a national or institutional level.
- Provision of technical cooperation for the formulation and implementation of programmes.
- Development of instructional packages as described in (6).
- Promotion and coordination of inter-country seminars aimed to create awareness and motivation at managerial level and to encourage the execution of bilateral or multilateral cooperation agreements.
- Training of national personnel who would be in charge of carrying out the seminars, courses and workshops with the support of the instructional packages described in (6).
- Implementation of a monitoring system which would provide information on the progress of the O & M programmes.

National Requirements

The water supply and sanitation sector authorities will organize efforts for the O & M programme's implementation at a national level. It includes the adoption of national policies; definition of responsible institutions and managers; description of functions; promotion of training and motivation events; identification of available national financial resources; technology dissemination.

Actions of Drinking Water Supply and Sanitation Agencies

The water agencies will make use of the results achieved by international and national efforts. They will thus play the most important and complex role in the action chain aimed at improving efficiency and effectiveness of the service provided to the population.

INTERNATIONAL DRINKING WATER SUPPLY & SANITATION DECADE
REGIONAL EXTERNAL SUPPORT CONSULTATIONS

AMERICA'S REGIONAL
CONSULTATION
WASHINGTON, D.C.
21-24 APRIL 1986

Six key constraints related to progress in the water supply and sanitation sector development in the Latin American and Caribbean Regions were identified. Among them was found: "insufficient attention to operation, maintenance and rehabilitation of existing water supply and sanitation systems".

ASIA'S REGIONAL
CONSULTATION
MANILA,
21-25 OCT. 1985

"... while analysis has shown improvement between 1980 and 1984 in the percentage of people having access to safe water supply and sanitation, the functioning of water supply and sanitation systems was often disrupted by inadequate operation and maintenance..."

AFRICA'S REGIONAL
CONSULTATION
ABIDJAN,
25-29 NOV. 1985

"Many installations were out of order soon after their implantation, mainly due to lack of local expertise to adequately operate and maintain them".

AND

"Rehabilitation and maintenance of existing water supply and sanitation installations, rather than investments in new capacity, to maximize the output of limited resources and to prevent recurrent project costs from soaring to unaffordable levels."

SITUATION OF THE WATER SUPPLY AND
SANITATION SECTOR IN DEVELOPING COUNTRIES

- poor operation and maintenance of the network systems;
- inability to extend water supply coverage to fringe areas due to waste of water by already connected consumers;
- poor use of existing facilities in urban and rural areas;
- unaccounted for water frequently representing more than 50% of the produced water;
- extremely high operational costs directly influencing the tariff rates;
- poor quality of delivered water

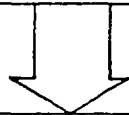
EFFECTS

CAUSES

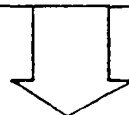
- institutional deficiencies;
- lack of training programmes and adequate personnel development policy;
- insufficient and poor use of financial resources;
- lack of planning and programming;
- lack of operational and managerial instruments for programming, evaluating and controlling activities;
- inadequate information flow;
- poor quality of information;
- lack of community participation;
- lack of manuals and inventories of technical information

OBJECTIVES OF THE PROGRAMME ON
OPERATION AND MAINTENANCE AND OPTIMIZATION
OF WATER SUPPLY AND SANITATION SYSTEMS

- To promote and support the efforts for strengthening the managerial and operational capability of water supply and sanitation institutions in order to improve their efficiency and effectiveness;
- To improve O & M services and related support areas;
- To optimize the installed capacity of the services and to seek for the financial autosufficiency of the sector;
- To extend the coverage, regularize the service rendered to the population and delay investments for new constructions;
- To achieve control and reduction of unaccounted for water.

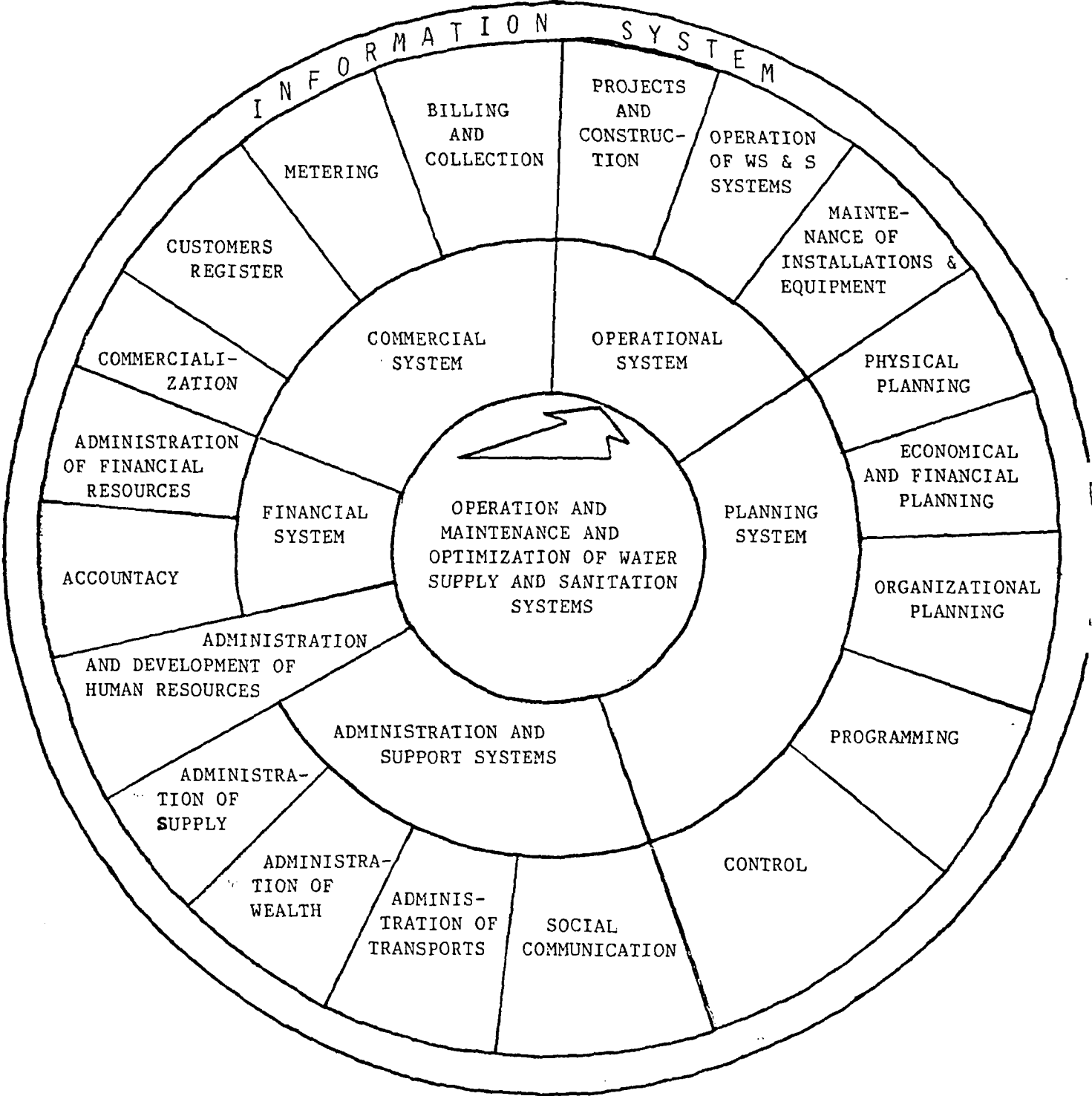


EFFICIENCY AND EFFECTIVENESS



INSTITUTIONAL DEVELOPMENT

OPERATION AND MAINTENANCE
AND ORGANIZATIONAL SYSTEMS



OPERATION AND MAINTENANCE AND OPTIMIZATION
OF WATER SUPPLY AND SANITATION SYSTEMS

OPERATIONAL DEVELOPMENT
PROGRAMME

- Projects for operation of water supply systems
- Projects for maintenance of water supply systems
- Projects for metering and billing

PROGRAMME FOR THE
IMPROVEMENT OF OPERATION
AND MAINTENANCE OF
SEWERAGE SYSTEMS

- Projects for operation
- Projects for maintenance

PROGRAMME OF OPERATION
AND MAINTENANCE
AND OPTIMIZATION OF
TREATMENT PLANTS

- Evaluation and upgrading of treatment plants
- Maintenance
- Adequacy of treatment plants design criteria

SUPPORT PROJECTS

PROJECTS FOR THE OPERATIONAL DEVELOPMENT PROGRAMME

PROJECTS FOR OPERATION OF WATER SUPPLY SYSTEMS

- Hydraulic Survey (Pitometric Survey)
- Control of Leakage
 - visible
 - not visible
- Macromasurement (production and distribution systems)
- Network Mapping
- Control of Operation
 - telephonic centre for public enquiries
 - operational control centre
 - mathematical model for operational simulations
- Revision of Design and Construction Criteria

PROJECTS FOR MAINTENANCE OF WATER SUPPLY SYSTEMS

- Preventive and Corrective Maintenance (electrical, mechanical, civil and instrumentation)
- Distribution Network Maintenance
- Maintenance of Flow Meters (including house meters)
- Improvement and Rehabilitation of House Connections, Transmission Lines and Network's Pipelines
- Improvement of Material and Equipment Quality

PROJECTS FOR METERING AND BILLING

- Metering
- Commercialization of the Service
- Customers' Register
- Billing and Collection

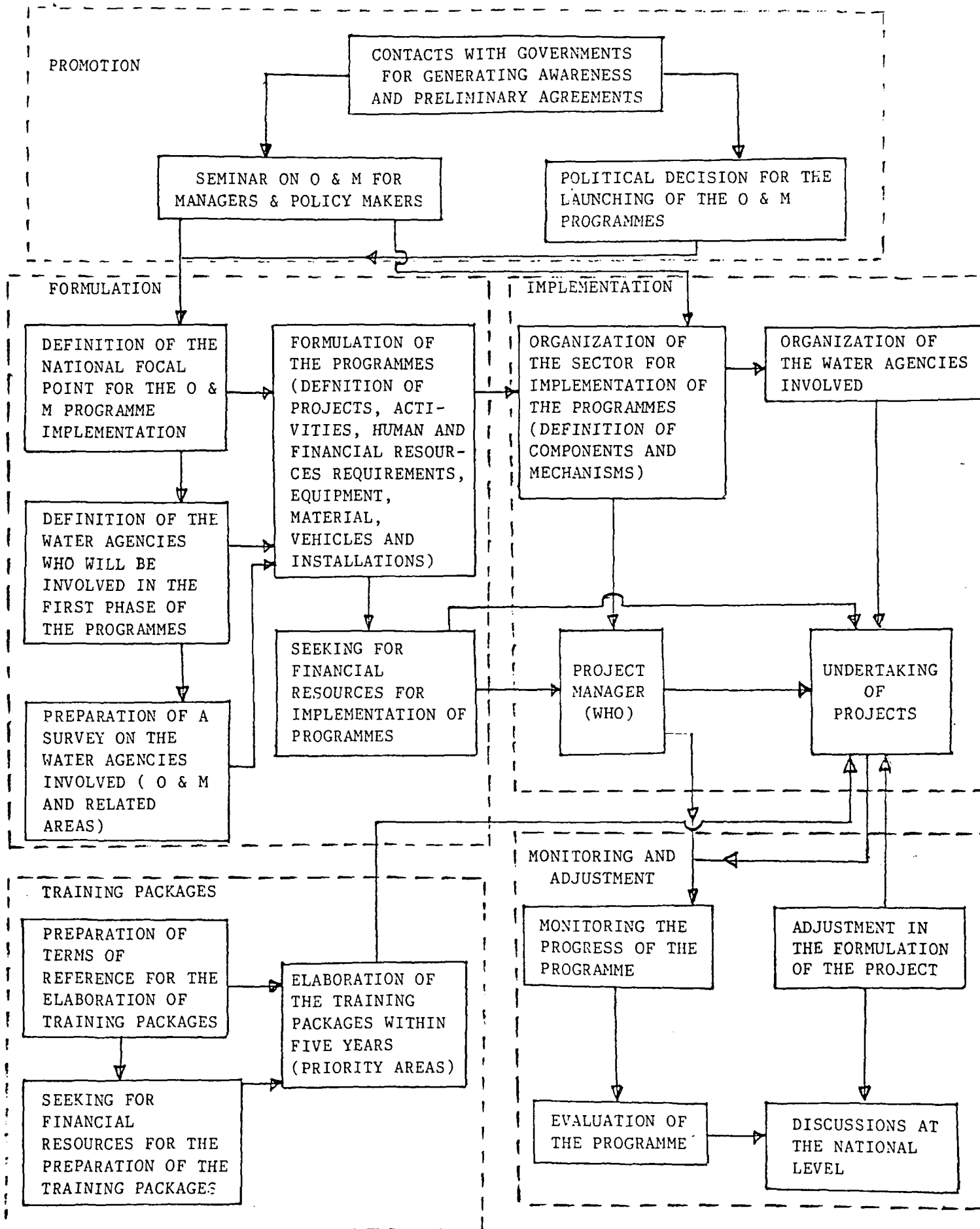
SUPPORT PROJECTS

- Reorganization of the Institution
- Development of Human Resources
- Improvement of the Information System
- Improvement of the Transport Service
- Improvement of the Material and Equipment Supply
- Community Involvement and Participation

TRAINING PACKAGES

- Operation and Maintenance Management (40 hours)
- Hydraulic Survey (Pitometric Survey) (80 hours)
- Control of Leakage (80 hours)
- Macromasurement (80 hours)
- Network Mapping (40 hours)
- Control of Operation (80 hours)
- Preventive Maintenance (80 hours)
- Instrumentation (80 hours)
- Pipe Network Maintenance (40 hours)
- Maintenance of Consumption Meters (40 hours)
- Metering and Billing (80 hours)
- Operation and Maintenance of Sewerage Systems (80 hours)
- Operation and Maintenance of Treatment Plants (80 hours)
- Evaluation and upgrading of Treatment Plants (80 hours)

- Manual
- Transparencies and slides
- Working material for office practice
- Working material for field practice
- Microcomputer software
- Video cassettes



ROLE OF INVOLVED INSTITUTIONS

EXTERNAL COOPERATION

PROMOTION OF THE OPERATION AND MAINTENANCE AND OPTIMIZATION PROGRAMMES

PROVISION OF THE FINANCIAL RESOURCES

PROVISION OF TECHNICAL COOPERATION

DEVELOPMENT OF INSTRUCTIONAL PACKAGES

INTERCOUNTRY SEMINAR FOR MANAGERS AND POLICY MAKERS

TRAINING OF TRAINERS

MONITORING SYSTEM

NATIONAL REQUIREMENTS

ADOPTION OF NATIONAL POLICIES

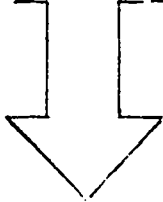
DEFINITION OF RESPONSIBLE INSTITUTIONS AND MANAGERS

DESCRIPTION OF FUNCTIONS

PROMOTION OF TRAINING AND MOTIVATION EVENTS

IDENTIFICATION OF AVAILABLE NATIONAL FINANCIAL RESOURCES

TECHNOLOGY DISSEMINATION



DRINKING WATER SUPPLY AND SANITATION AGENCIES

OPERATIONAL SITUATION DIAGNOSIS

FORMULATION OF THE PROGRAMMES

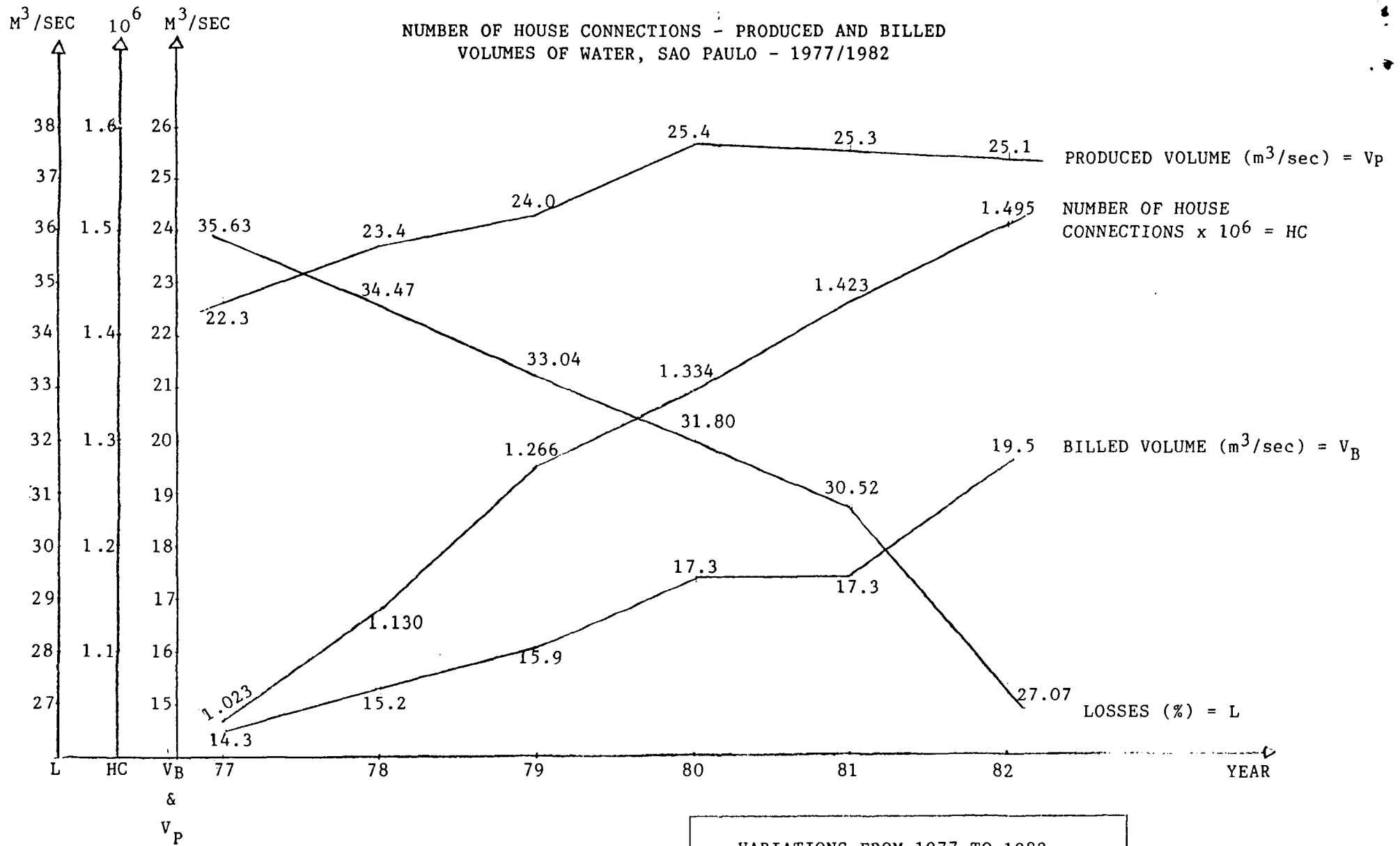
SURVEY AND STRENGTHENING THE ORGANIZATIONAL STRUCTURE

DEVELOPMENT OF HUMAN RESOURCES

MANAGERIAL INFORMATION SYSTEM

PROGRAMME IMPLEMENTATION EVALUATION AND ADJUSTMENT

NUMBER OF HOUSE CONNECTIONS - PRODUCED AND BILLED
 VOLUMES OF WATER, SAO PAULO - 1977/1982



VARIATIONS FROM 1977 TO 1982	
Δ VP	= 2.8 m³/sec - 12.5%
Δ VB	= 5.2 m³/sec - 36.4%
Δ HC	= 472,295 - 46.2%
Δ L	= - - (8.4%)