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Wat. Sci. Tech. Vol. 34, No. 12, pp. 101-108, 1996.
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0273-1223/96 \$15.00 + 0.00

PII: S0273-1223(96)00858-X

STRATEGIES AND MANAGEMENT MODELS FOR METROPOLITAN WASTEWATER, IMPLEMENTATION AND EVALUATION IN THE EAST RAND, SOUTH AFRICA

A. W. Korf, J. W. Wilken and N. J. Nel

ERWAT, P.O. Box 8501, Elandsfontein, 1406, South Africa

ABSTRACT

South Africa is a country where first world wastewater treatment technology and management must take into account third world related problems. In the past, the diversity of a large number of local authorities within the PWV area of South Africa aggravated the problem of proper wastewater management.

On the East Rand in the Gauteng province of South Africa, the problem was attended to by means of a strategic analysis and strategic plan. In the evaluation of the options, the various wastewater management models in use in various regions of the world were evaluated. The investigation resulted in the formation of the ERWAT wastewater management model and implementation.

The paper also evaluates the success of the wastewater management model utilizing the tariff model and other qualitative parameters. Copyright © 1996 IAWQ. Published by Elsevier Science Ltd.

KEYWORDS

Bulk wastewater conveyance; private sector participation; regional wastewater treatment; strategic analysis; tariff structure; transfer of employees; wastewater management models.

INTRODUCTION

Traditionally within the South African context wastewater from residential and industrial areas was treated by wastewater treatment plants owned and managed by individual local authorities. In the denser metropolitan areas, the larger local authorities took initiative to build large regional plants and to render a service to other authorities.

During the mid-eighties legislation was passed for the establishment of regional governmental bodies to promote co-operation between local authorities to the benefit of the region and the participating authorities. Soon after the implementation of the legislation, the East Rand regional governmental body responsible for the execution of the legislation, took the initiative to evaluate other alternatives for the management of the wastewater treatment function. This evaluation included the status quo and other models that could achieve the strategic goals set.

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The East Rand is part of the Gauteng Province of South Africa and is situated east and adjacent to Johannesburg and it is an integral part of the Witwatersrand metropolitan complex. The East Rand sub-region has approximately 2.5 million residents and receives and treats approximately 13% of all wastewater generated in South Africa.

This paper describes briefly the establishment and development of a metropolitan wastewater treatment organization for the management of wastewater treatment from the then diverse management system, in a changing economic and political environment. This was achieved through a process of strategic analysis, modeling and evaluation of the constraints and opportunities and dedicated implementation, within the system that was considered.

STRATEGIC ANALYSIS

In order to optimally decide on future extensions and functional responsibility, in 1989 the regional governmental body decided that a comprehensive strategic plan for wastewater conveyance and treatment be developed for the region to provide for the then situation and for the future development of the system, up to the year 2010. The main objectives were set as follows:

- To develop and compile a long term **strategy** and **strategic plan** for the management of wastewaters in the East Rand region.
- To investigate and to make recommendations in respect of the most feasible **management structure** for implementing and execution of the wastewater management strategy.
- To investigate and to make recommendations in respect of a feasible sewage treatment **tariff structure**.

The project commenced with the definition of the system, its boundaries, environmental forces, sub-system elements and interdependencies. A formal strategy formulation process model was used and the analysis included the following detailed actions :

- strategic environmental analysis - direct and broader
- resources analysis
- system analysis
- mission and objectives definition and description
- SWOT analysis (strengths, weaknesses, opportunity, threats)
- mission success factors determination
- development of generic strategic alternatives
- decision modeling, risk and sensitivity analysis
- management structure, analysis and design
- compilation of strategic plan
- development of tariff structure model.

The most important and far reaching finding of the study indicated that the function of wastewater management should be regionalized due to the financial benefits projected over the planning period of twenty years for the region. By decreasing the then existing 22 treatment works to 4 regional plants in future, a saving of R300 million in present value would be realized over the planning horizon of twenty years.

Due to the capital intensity of the function and the relatively large amounts to be spent for the provision of spare capacity at plants to provide for future growth, it is of prime importance that the strategic issues be addressed properly and to do "the right things" versus "doing things right". The latter part receives attention with further detailed investigations before implementing any of the detailed proposals of the strategic plan.

After the development of the first strategic plan, which was initiated in 1989, it was updated during 1992 and again in 1994. As a result of the strategic investigations, as well as other detailed studies with relation to

the transfer of personnel and negotiations with the participating local authorities, a regional organization was established to manage wastewater treatment as well as the bulk conveyance of wastewater on the East Rand. The company formed was called the East Rand Water Care Company or in short ERWAT.

The ERWAT mission statement as developed by means of a participation process and reviewed during 1994 states : *"The conveyance and treatment of municipal wastewaters at the lowest operating and maintenance cost, through effective employment of all resources and in compliance with legal, social and environmental constraints to the short and long term benefit of the whole East Rand region and other participants."*

THE ERWAT WASTEWATER MANAGEMENT MODEL

The initial analysis for the establishment of a management organization for wastewater conveyance and treatment was based on the application of the fundamental theories of management and organizational design, which resulted in the development of quantitative and qualitative design criteria. Several alternative management structures and wastewater management models were investigated and evaluated during the strategic analysis process. In the South-African context the non-payment of essential services by a large proportion of the population is a critical factor. Although a critical factor from the beginning, it was a common denominator and not specifically addressed with the evaluation of different models.

Twenty-one out of twenty-two local authorities on the East Rand region accepted the strategy and management structures proposed, which resulted in the establishment of a Section 21 company, a non-profitable organization currently managed by a small board of directors, representing the participating local authorities and the regional body. The East Rand Water Care Company (ERWAT), carries out the metropolitan function of wastewater conveyance and treatment on behalf of the local authorities of the East Rand. The company restructured the function into a competitive system, whilst also accommodating the important political, constitutional and institutional issues during the transition to a non-racial and democratic society.

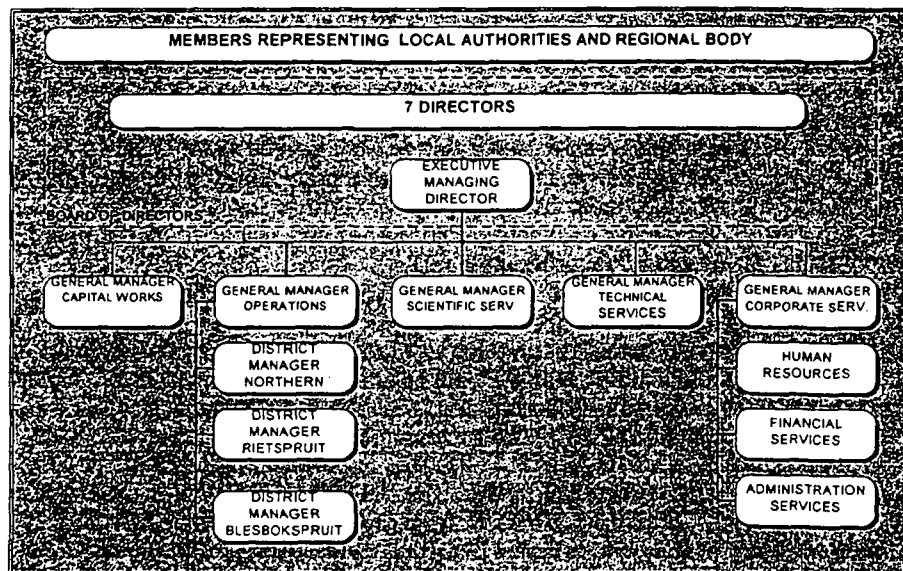


Figure 1. Management Structure of the ERWAT MODEL.

The top management structure of the ERWAT model is detailed in *Figure 1*. The features/characteristics of the ERWAT management model are the following :

- All permanent wastewater treatment facilities are owned by ERWAT
- Non-profit organization
- Company is managed by a small board of directors
- Directors are elected by local authorities
- The members of the company, who are the municipalities, have full control over the company.
- ERWAT is responsible for the bulk collection of wastewater, conveyance thereof and treatment at the water care plants.
- Continuous strategic adaptability.

To achieve the goals of the company the area of the East Rand region was divided into six drainage districts which are grouped into three regions. It was further decided to manage the company in a competitive way, in that the three regions act as business units, and simultaneously the company's performance can be compared with the adjacent operators of wastewater treatment plants.

OTHER WASTEWATER MANAGEMENT MODELS

The ERWAT management model implemented is continually evaluated against other wastewater management models in use in various countries and regions of the world. As with the ERWAT model, the wastewater management models implemented and active in other regions are based on the needs and requirements of the specific set of circumstances of the region in which it operates, and could be evaluated in that perspective as indicated below in *Table 1*. The challenge would be to find the optimal public-private sector mix based on the specific local conditions pertaining at the time. Modern management restructuring should be considered as a dynamic process.

Table 1. Wastewater management models

MODEL	DESCRIPTION (TYPE)
AGENCY	Operation and management of water care works by selected local authority(s) on an agency or contract basis
PRIVATIZATION	Wastewater treatment plants fully owned and managed by private sector .
METROPOLITAN BOARD	Transfer of all water care works and systems to a water care corporation similar to the Metropolitan Boards in the USA.
LOCAL GOVERNMENT	Wastewater treatment facilities managed by the local authority and owned by the public .
CENTRAL GOVERNMENT	Wastewater treatment plants owned and managed by the public sector at central government level .
PS & PSP	Wastewater treatment facilities owned by the public sector, but managed by private enterprise.
RIVER BASIN	River basin management system which includes stormwater and natural water management, water treatment, bulk water supply, bulk wastewater collection and wastewater treatment plants owned and managed by the public sector at government level.

Several generic alternatives are possible and should include assessment in terms of level of government, including local government, metropolitan government, regional (state) and central (federal) government. It is further possible to allow private partnerships in any combination of the facility management process, including planning, design, project management, construction and erection, commissioning, all aspects of operation and maintenance, financing and ownership.

A critical success factor was to find an acceptable balance between political expectations and business practice. In addition, detailed effort was required to institutionalize the transformation of the management structure.

ERWAT is a non-profit company, with a long-term service vision of rendering a service to the community at a twenty year planned and published annual cost. In order to manage this commitment, ERWAT developed and operates a strategic management information system (SMIS). The main purpose of the SMIS is to monitor strategic environmental information and key organizational outputs such as:

- Long term (annualized) cashflows and tariffs
- Input flows and organic loading, including COD, ammonia, suspended solids and phosphates
- Plant performance in terms of effluent quality and biosolids production
- Human resources deployment
- Other important resources deployed including, energy, chemicals, equipment utilization

If the design of the original ERWAT management model is compared to the various identified models in operation in their respective regions, then the model implemented on the East Rand could still be considered the most appropriate for the indirect and direct environment in which it operates. With the latest strategic revision, "Strategic Plan 2015" it has been identified that the product-market base of ERWAT should be extended to take into account numerous market related opportunities. The members of ERWAT confirmed the continuation of the model implemented and approved the extended product-market scope. This decision allows ERWAT to enter into strategic alliances with other role players, locally and internationally, provided that it is to "communal benefit". This now also allows for ERWAT to participate fully in the Reconstruction and Development Program of the Government. Further, the development and contracting with micro business can contribute in a meaningful way to educate and empower people resident in the East Rand region. The need for the further involvement of the private sector was identified, together with a number of other market sectors, that can be developed in collaboration with ERWAT.

RESOURCE DEPLOYMENT AND HUMAN RESOURCE DEVELOPMENT.

One of the conditions of regionalizing the function was that no employee should be worse off after takeover than before. This made the transfer of the employees a critical success factor, coming from 7 different organizations with different pay scale gradings. Several Trade Unions were involved, the total cost of the human resources with relation to total cost was high as indicated in *Figure 2* and the workers morale was low. A detailed transfer program and capacity building policy was developed in order to effect smooth transformation. To integrate the people into one organization called for proper planning on a strategic and detailed level.

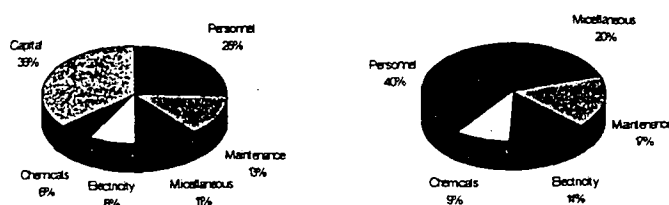


Figure 2. Costing structure of East Rand Water Care Works.

Specific strategic needs were identified in respect of the implementation and execution of the strategic plan for the Human Resources:

- Develop and finalisation of a detailed Human Resources Plan for the Company.
- Communication of the Human Resources Plan to all parties and individuals concerned.
- Discussion and agreement of the strategy to ensure successful implementation.
- Continuous updating of the plan, as and when necessary will be required.
- Pro-active steps to be taken to ensure economic transfer, employment of personnel for the organization.
- Observations, feedback and discussions confirmed a high presence of uncertainty amongst personnel and their representatives before transfer.

The advantages obtained by the transfer of the human resources to the company are as follows:

- People with a common interest were combined together.
- Recognition was given to a specialized chemical industry
- Employees were given a new career vision.
- Appropriate conditions of service could be implemented with appropriate bonus systems.
- Rationalization of the job grading system by introducing a broad band pay grade and reducing the number of job levels from 21 to 8.
- Training enhanced.

Overall organizational improvement was observed in dedication and commitment of the work force. Organizational climate surveys were conducted before and after the transition, which indicated substantially increased positive perception of the climate of ERWAT.

QUANTITATIVE EVALUATION OF THE SUCCESS OF THE TRANSFORMATION

During the original investigation period in 1989, various operational and process problems were experienced which resulted in an unacceptably low compliance of effluent in terms of the General Standard of the Water Act. Only 37.3 MI/d (12%) of the 318 MI/d waste water treated resulted in more than 95% of compliance.

Table 2. Salient features

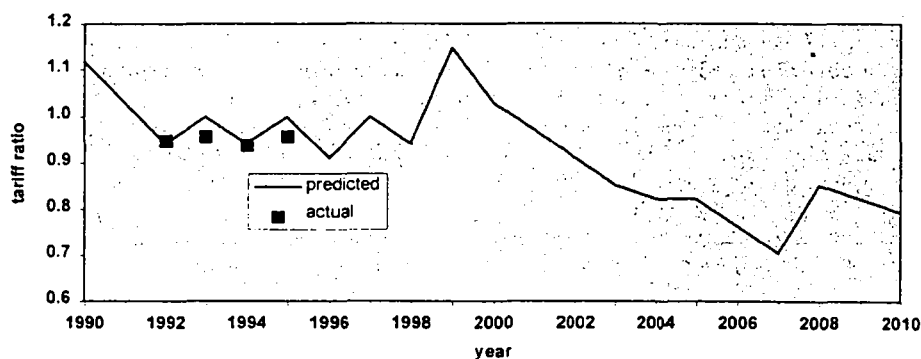
RESOURCE	AVERAG AVERAGE	
	1989/90	1994/95
Treated waste water MI/d	318	378
Human resources (No) employed	545	517
No. of employees / MI/d treated	2,05	1,36
Total perceived plant capacity MI/d	460	595
Average annual rate of inflation	15	11
Average total unit treatment cost in 94/95 present value of ERWA	64.5 c/kl	53 c/kl
Average total unit treatment cost in 94/95 p.v. of benchmark metropolitan authority	46 c/kl	89 c/kl

Table 2 summarizes some of the important salient features with respect to the treatment of wastewater in the East Rand region before the re-organization of the management of wastewater treatment in the region, and the comparative results five years later.

CRITICAL SUCCESS OBJECTIVES OF ERWAT IN SERVING THE COMMUNITY

Presently, the clients and members of ERWAT are the local authorities from whom domestic and industrial effluent (of an acceptable quality), is received for which service they pay based on **flow volume and combined organic loading** of the wastewater. The local authorities are still responsible in the areas under their jurisdiction for the internal collection network and industrial effluent control.

Figure 3 illustrates the predicted change in tariff structure for the East Rand region, as a ratio of the 1995 present value tariff. The graph details the downward trend in the tariff, as well as the achievement that the actual tariff charged is below the predicted values.



Ratio based on 1995 tariff = 1

Figure 3. Predicted and actual tariff ratio.

The success of ERWAT in its area of responsibility can be evaluated against those critical objectives which played a major role in the measurement of the success of the ERWAT model and which can be used for the possible adjustment or change in the model. In contrast with the previous individual management systems operated by the various local authorities in the region, these objectives are attended to in a coordinated and business like manner.

The key success factor objectives are as follows.

- Complying 95% of the time with the General Effluent Standards as required.
- To render the service at the lowest cost
- To be role player in research and development in wastewater treatment technology
- To satisfy the needs of the clients
- To be an environmentally responsible company
- To promote small private sector participation
- To participate in the country's effort to utilize a scarce resource - water
- To develop and apply appropriate technology.
- To provide and exchange technical know-how to other organizations and countries
- To promote community participation
- To assist other similar organizations with the establishment of a metropolitan wastewater treatment organization

The unified tariff structure implemented is based on the allocation of a proportion of a local authority's flow and load (suspended solids, COD, ammonia and phosphates) of the total of the whole region. A phasing in period was necessary to accommodate inequalities of the various tariffs charged by the municipalities at the time of the implementation. A facilities planning development model (FDP model) has been developed to determine the effect on the tariffs of various options evaluated, and could be used as an early warning system to indicate tariff changes and to generally support the budgeting process. The FDP model could be used to evaluate any complex wastewater management system elsewhere in terms of strategic alternatives, management options and multiple scenarios.

The strategic plan of ERWAT is dynamic and is subject to the realization of growth expectancies and economic changes.

CONCLUSION

The project emphasized the importance of the effective optimization of the economy of scale function of wastewater treatment against the cost of providing spare capacity at various sensitivities of growth rates, supported by software and other management tools. It demonstrated the benefits of effective application of strategic management methodologies with a multi-disciplinary approach in order to decide if a function should be regionalised. The methodology employed for the strategic planning process and implementation, achieved the desired objectives and is recommended for future use. The successful transformation from public administration to business management takes time - the project investigation and implementation took 4 years. Adequate time should be allowed for this process, but one should also be careful not to lose initiative, and to allow for adjustments during the process and take the political climate into account.

For a similar project, be prepared to get actively involved in institutional change; dedicated and effortless implementation will be required and in general - no committees, long live the team.



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