

A methodology to evaluate water use management programs in companies

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Abstract

This paper presents a methodology employed to introduce the water use management programs in different types of buildings. The purpose of this methodology is to supply adequate tools to evaluate the implementation of water conservation programs in buildings.

The presented methodology considers technological, behavioral, and managerial aspects and involves 8 different systemic requirements that are audited and assessed:

Planning and Coordination; infrastructure and organization; people's mobilization; process' procedures; applied technology; maintenance and updating; control and management; obtained results.

Three case studies were developed in year 2000 and they are presented here as well as are the results and the expected evolution of said methodology.

Keywords

Water conservation; water conservation management.

1 Introduction

There is a major concern towards the reduction of hydraulic resources to supply water to the big urban centers and the consequent raise in the production and distribution costs to fulfill this demand. The Brazilian government (at state and federal levels) as well as the organized society is mobilizing efforts not only to minimize the undesirable implantation of water ration procedures but also to ensure the supply of water in the cities according to sustainable development principles.

The development of water conservation programs in buildings has been increasing in the last few years with the participation of governmental and private institutions. This scenario leads to the development of new methodologies and new technologies aiming at water savings by means of reduction of consumption using efficient equipment leak detection and correction, use of rainwater and reuse of gray water.

Two institutional programs became fundamental to structure the knowledge of water conservation in buildings: The PURA - Water Conservation Program of the State of São Paulo, and the PNCDA - National Water Conservation Program.

According to GONÇALVES, OLIVEIRA [1], the PURA Program which began in 1996 comprised 6 macro-projects: data files of technologies, documentation and case studies; institutional laboratory system - LIPURA; program of evaluation and adequacy of technologies and procedures; characterization of the water demand and the impact on the water saving actions in the residential sector; documentation development - laws, regulations and quality programs; and water conservation programs for different types of buildings (not residential).

The results that are being obtained by the actions of PURA program are significant. As an example, the implantation of PURA in the Campus of the University of São Paulo resulted in a reduction of consumption of approximately 39%, representing savings of US\$3.5 million per year.

The other program, the PNCDA began in 1997 when several DTAs - Technical Support Documents, SILVA, CONEJO and GONÇALVES [2] related to water conservation in both public systems and building systems were elaborated. The two main focuses of these documents gave structure of the knowledge of water conservation and enabled the access to water conservation methodologies and technologies to professionals such as engineers, architects, researchers, etc. (www.pncda.gov.br).

In the year 2000 the Non Governmental Organization "Água e Cidade" (Water and City) "NGO A&C" in partnership with CEDIPLAC (Center for Development and Documentation of the Plastic Industry for Civil Construction) established a methodology based on the contents of PURA and PNCDA Programs. The focus of NGO A&C was to propose procedures to implement and evaluate water use management program in companies, dealing not only with technological, behavioral and organizational aspects as well as with the motivation of the members of the company by means of scoring based recognition system.

2 Principles, objectives and actions

It is undeniable the success achieved by rewarded systems based on the motivation of an organization: industries and services companies. The evaluation of quality and quantity of commitment with environmental management should be included in the quality systems as a progressive goal, focusing the water conservation of the environment.

The organizations, regardless of its size, a factory or its headquarters, a hotel or its guests, are more and more being requested to demonstrate that they are environmentally responsible for its actions. The quality of their products and services, by itself, is not enough anymore.

Nowadays, they have to provide strong evidence of being harmonized with the environment beginning by the “Human Habitat” which surrounds them. The remaining organizations competing in a particular sector – hotels sector for instance – must be equally interested in being audited to obtain an environmentally responsible status.

NGO A&C proposed a methodology to implement and evaluate water use management programs considering the following vision based on principles of management excellency [3]:

The service companies and industries, besides of the commitment in providing products and services with quality assurance, should also invest management efforts and resources to use water properly. Therefore, minimizing environmental impact from its activities contributing to the conservation of the environment, to the sustainable development and to the improvement of society's life quality as well.

Thus, the mission of this methodology proposed by the NGO A&C is

To make entrepreneurs and their collaborators mobilized towards the adoption of a methodology with measurable requirement (indexes) which allow them to evaluate the commitment level of their organization, considering water and environmental conservation;

Its scope is:

- to develop a “Base Methodology” which leads an organization to the voluntary engagement;
- To set up and to carry out periodic audits in order to determine a minimum score in accordance with evaluation criteria;
- To award successful companies and industries in implementing the methodology of water use management program and in obtaining good results with water and environment conservation.

“Water teams” should be created for the implantation of NGO A&C methodology involving companies, entities or organizations and should comprise the water volunteers. The “water volunteers” should be elected or indicated among company’s collaborators to work with “water handling”. Each organization should name its “water manager” who will be responsible for the coordination of the assignments.

The “water manager” is prepared to use the Audit Handbook of A&C Methodology and he will become “ self-auditor” when he will also evaluate his company.

Two other auditors “external auditor” (independent and voluntary) will carry out the audit assignment. The external auditors are qualified by a specialized entity and are specially chosen by the NGO A&C Professional Team which coordinates the Award.

Hence, each company will be audited three times: once by the “water manager” and twice by the “external auditors”.

During its first year (2000) the NGO A&C Team focused its activities in the learning and structuring process.

A committee of Judges, specially chosen and trained, with no contact with the companies whatsoever, indicates the companies which should be awarded based on the

information of the evaluation coming from both the self-auditors (water managers) and external auditors.

A “Base Methodology” involves a group of indexes that enables the evaluation of the water use management programs developed by the companies.

3 Base Methodology – Performance Indexes

The proposed methodology is based on the establishment of requirements and performance criteria to be fulfilled by the Water Use Management Program (WUMP) implemented by the company for its buildings. Numerical indexes are associated to these requirements and criteria which in function of internal and external audit processes enable to evaluate the level of the program as well as its weak points and their corrective and progressive actions which must be implemented.

This methodology comprises behavioral, technological and managerial aspects of the WUMP involving 8 different system requirements based on excellency in management criteria [3]: *Planning and coordination; Infrastructure and organization; People's mobilization; Process procedures; Applied technologies; Maintenance and updating; Control and management; and Obtained results.*

In the first requirement *Planing and coordination* the entrepreneurial leadership activities are considered, focusing and elaborating the water conservation project. The commitment of the main executives of the company with the subject is a key factor in the coordination of the project. Five items are studied with objective criteria as follows: leadership commitment, water use policy; present situation diagnosis; expected results and water conservation structure project.

The second requirement *Infrastructure and organization* considers the issues related to the designation of the water manager, its capacity, planning process and availability of the necessary resources in order to implement the project. The following two items are evaluated under objective criteria: water manager and resources for the project.

The third requirement *People's mobilization* is related to the organization and its role which is not only to integrate and to prepare the company's community to take part in the developed project as well as to encourage the community outside the company to adopt the basic concepts of water conservation. The following two items are evaluated under objective criteria: focus on the internal public and focus on the external public.

The fourth requirement *Program procedure* analyzes the records related to the actions and to the activities that have influence over the consumption of water. This step also checks how those records were developed, revised and distributed to the people of the company. The following two items are evaluated under objective criteria: development, control and distribution of records and revision and updating.

The fifth requirement *Technology* considers the preparation of a study to analyze the technological possibilities that could be adopted as alternative solutions in order to obtain water conservation as well as the use of said technologies in the companies' buildings. Bibliographic reference suggests the documents of PNCDA Program: DTA E1 [4]; DTA E2 [5]; DTA F1 [6]; DTA B3 [7]. The following two items are evaluated

under objective criteria: feasibility analysis and the effective use of technologies in order to reduce water consumption.

The sixth requirement *Maintenance and updating* considers the efforts to maintain and to update the technologies used to reduce the consumption of water as well as to take advantage of the potential and the benefices of these technologies. The following two items are evaluated under objective criteria: accessibility and systematization.

The seventh requirement *Control and management* examines the issues related to water conservation and water consumption project management, including acquisition and availability of database. The following two items are evaluated under objective criteria: water consumption database acquisition system and database management and treatment.

The eight and last requirement *Obtained results* checks not only the results that the organization obtained in relation to the water conservation and water consumption project but also the tendency of improvement of said results. The following two items are evaluated under objective criteria: integration with water conservation project and the improving tendency of the consumption rates.

For the eight different performance requirements two items are proposed: quantitative indexes that enables to evaluate whether the requirement had been fulfilled; and its effective improvement actions. Table 1 presents the quantitative indexes, which vary in a 1 to 100 points, scale.

Requirements	Scoring
1. Planning and coordination	20
2. Infrastructure and organization	10
3. Mobilization	10
4. Procedures	10
5. Technology	10
6. Maintenance and updating	10
7. Control and management	10
8. Results	20
Total	100

Table 1 - Quantitative indexes (score) attributed to the performance requirements of the evaluation process of the year 2000.

The score is attributed to each requirement and are divided into the different aspects to be evaluated, as previously mentioned. For instance, the 20 points attributed to *Planing and coordination* requirement are divided as follows: 6 points for item "commitment of leadership", 5 points for item "water conservation policy"; 3 points for item "diagnosis of present situation", 4 points for item "expected results" and 2 points for item "water conservation project".

The items of each performance requirement are evaluated regarding its degree of fulfillment, and can receive integral, partial or null punctuation. Thus, for instance, the item "water conservation policy" that belongs to *Planing and Coordination* performance

requirement receives 5 points when the requirements were fulfilled integrally, 2,5 points when they were partially satisfied and 0 points when they were not satisfied at all.

The internal and external auditors apply the performance requirements and the established criteria of each item in order to evaluate the companies WUMPs.

With the results of the performed evaluation it is possible to recognize both the weak and the strong points of the implemented program and consequently establish progressive improvement procedures of the worst requirement's performance (PDCA-Plan, Do, Check and Act).

Seven companies volunteered to the Water use management program evaluation process in the year 2000 by means of external auditors. Three of them were distinguished at the final judgement process and will be presented later in this paper.

4 Case Studies

The three case studies employing the utilization of the methodology developed in this paper are the following:

WUMP of Docol – Faucets and valves, implanted in the unit of galvanization – Joinville City – SC;

WUMP of Tigre – Plastic pipes and fittings, implanted in the Operational Center of Rio Claro City – SP;

WUMP of SABESP – São Paulo water utility company, implanted in the Industrial kitchen of its headquarters – São Paulo City – SP.

We present below a succinct description of base methodology applied in the evaluation of the above mentioned WUMPs.

4.1 Case WUMP Docol

Docol is a traditional Brazilian manufacturer of faucets and valves. The presented WUMP was developed by Docol in its Galvanization Unit (Docol III) which is situated in Joinville, State of Santa Catarina, southern region of Brazil. In 1997, the previous year of the WUMP implantation, the Docol III used to consume 140 million liters of water per year, where 80 millions of liters were utilized in general activities and 60 millions of liters used in the galvanization process.

The main purpose of the WUMP implantation was to reduce the total consumption of water in 50% in a 3 years period. This reduction could be achieved by means of the following actions: reduction of 70% of the consumption of water in the general activities of Unit Docol III (people use, cleaning activities, restaurant, etc.), reuse of water treated at the Sewer Treatment Plant for the galvanization process (25% to 40%) and employees awareness campaign towards water conservation.

WUMP evaluation performed by external and internal auditor by means of base methodology, following the steps presented in item 3 of this paper led us to a scenario presented in Table 2, related to the fulfillment of the performance requirements.

Performance Requirements	Evaluation of the internal auditor		Evaluation of the external auditor	
	Score	%	Score	%
1. Planning and coordination	20/20	100	10/20	50
2. Infrastructure and organization	10/10	100	10/10	100
3. Mobilization	10/10	100	10/10	100
4. Procedures	10/10	100	10/10	100
5. Technology	10/10	100	10/10	100
6. Maintenance and updating	10/10	100	10/10	100
7. Control and management	10/10	100	10/10	100
8. Results	20/20	100	10/20	50
Total	100/100	100	80/100	80

Table 2 – Quantitative indexes (scoring/percentages) attributed by internal and external auditors to the requirements of Docol III WUMP

Thus, according to external audits, the requirements that deserve improvement are *Planning and coordination* as well as *WUMP Results*.

The general results obtained till the year 2000 were the following:

General consumption of water in Unit Docol III:

1997 – 80 million liters; 1998 – 57 million liters;
 1999 – 33 mi liters; 2000 – 25 million liters.

Consumption of water during one of the galvanization processes:

1997 – 45.000 l/day; 1998 – 20.000 l/day;
 1999 – 5.000 l/day; 2000 – 0 l/day – reuse of treated water

Economic Indexes:

Annual savings R\$440.700,00 - US\$180,000.00;

Investment R\$ 34.000,00 - (US\$13,000.00)

Payback period – approximately 26 days

4.2 Case WUMP Tigre

Tigre is the largest Brazilian manufacturer of plastic pipe systems in PVC, CPVC, and PE for civil construction. The WUMP presented was implanted in the operational center of Tigre Industrial Facility, located at Rio Claro City, in the state of São Paulo, southeast of Brazil.

The main objective of the WUMP implementation in Tigre's Operational Center was to reduce the unit water consume in 10%, relating this reduction to the monthly liquid production in PVC kg. For example, in august/1999, the unit water consumption was 1,75 l/PVC Kg. The performed actions involved activities of different nature: technological actions and social mobilization.

The WUMP evaluation performed by internal and external auditors, by means of the base methodology, according to the steps presented on item 3 of this paper, is showed on Table 3, related to the accordance of the performance requirements.

Performance Requirements	Evaluation of the internal auditor		Evaluation of the external auditor	
	Score	%	Score	%
1. Planning and coordination	20/20	100	20/20	100
2. Infrastructure and organization	10/10	100	9/10	90
3. Mobilization	10/10	100	10/10	100
4. Procedures	10/10	100	9/10	90
5. Technology	10/10	100	10/10	100
6. Maintenance and updating	10/10	100	10/10	100
7. Control and management	10/10	100	10/10	100
8. Results	20/20	100	20/20	100
Total	100/100	100	98/100	98

Table 3: Attributed indexes (scoring and percentages) by the internal and externals auditors

According to the external auditors, only in the *Procedures* and *Infrastructure and organization* requirements there was a small loss of scoring, representing an excellent performance of the developed WUMP.

The unit water consumption- liter/PVC kg obtained till October/2000 are presented in Table 4.

	July	August	September	October
1999	1,43	1,75	1,37	1,51
2000	1,23	1,44	1,18	0,80
Reduction %	14,0	17,7	13,9	47,0

Table 4 – Unit water consumption in 1999 and 2000 and percentage reduction obtained in Tigre WUMP– Rio Claro.

It can be observed that the objective of unit consumption reduction of 10% was exceeded and that there is a tendency of reduction of values higher than 10%, as the value of 47% of consumption reduction that occurred in October 2000

4.3 Case WUMP SABESP

SABESP is the Water and Sewer Utility Company of the state of São Paulo, responsible for the water production and distribution, and sewage collection and treatment, serving approximately 30 million people.

The presented WUMP was implemented in the industrial kitchen of the SABESP headquarters, located in the city of São Paulo, in the state of São Paulo, southeast of Brazil. Before implementing the WUMP, the consumption per meal of SABESP industrial kitchen was 32,2 l/meal spent as follows: 25,0 l/meal (77,6%) to clean

chinaware, silverware and trays; 5,0 l/meal (15,6%) to sterilize food; 2,0 l/meal (6,2%) to prepare the food and 0,20 l/meal (0,6%) for the kitchen WCs and drinking water. The main objective of the WUMP was to reduce the unit consumption value to less than 25 l/meal, keeping the minimal hygienic requirements for industrial kitchen established by the Health Ministry.

The WUMP implemented actions of technological characteristic – detection and correction of visible and non visible leakage and the replacement of conventional equipment by water saving ones – besides actions of behavioral characteristic – lectures of general information of this program and lectures for changing procedures in the disinfection of the industrial kitchen.

The WUMP evaluation performed by internal and external auditors, with the use of the base methodology, according to the steps presented on item 3 of this paper, is showed on Table 5, related to the fulfillment of the performance requirements.

Performance Requirements	Evaluation of the internal auditor		Evaluation of the external auditor	
	Score	%	Score	%
1. Planning and coordination	20/20	100	2/20	10
2. Infrastructure and organization	10/10	100	10/10	100
3. Mobilization	10/10	100	10/10	100
4. Procedures	10/10	100	9/10	100
5. Technology	10/10	100	10/10	100
6. Maintenance and updating	10/10	100	8/10	80
7. Control and management	10/10	100	8,5/10	85
8. Results	20/20	100	20/20	100
Total	100/100	100	78,5/100	78,5

Table 5: Attributed indexes (scoring and percentages) by the internal and externals auditors to the WUMP requirements of the SABESP Industrial Kitchen.

According to the external auditors, the requirement *Planning and coordination* must be greatly improved. The requirements *Maintenance and updating* as well as *Control and management* still deserve a very special attention of the WUMP coordination.

The unit water consumption results obtained after the implementation of the WUMP in SABESP Industrial Kitchen is:

Unit Water Consumption in the beginning of the program = 32,2 l/meal

Unit Water Consumption after implementing the WUMP = 16,00 l/meal

Unit Water Consumption Reduction = approximately 50%

Pay back period = 16 days

It is possible to observe that the result obtained, 16 l/meal exceeds sensibly the expected result of 25 l/meal, representing an over expectation of approximately 36%.

5 Final Considerations

The developed methodology, which enables to evaluate the Water Use Management Program, implemented by companies in Brazil, proved to be adequate, enabling to verify the aspects that need to be improved by means not only of the requirements but of the quantitative indexes proposed as well.

The scoring obtained by participating in the NGO A&C Evaluation Process at different categories can be exhibited by the competing organizations as a form to demonstrate and divulge the quality of its WUMP.

The scoring is a way that NGO A&C found to recognize the efforts of each organization regarding water management issues.

NGO A&C grants those companies that wished to have comparative classification with the certificate of the *Aware Company*. This is a way by which the society becomes aware of not only of water conservation but as well as of the conservation of urban river.

The “Base Methodology” of the evaluation process helps those companies that wish to obtain ISO 14000 Certification. The certification is not the main issue of NGO A&C methodology, however it helps companies to structure a consistent and profitable WUMP.

6 References

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