A Quality Measurement Methodology in Public Utilities: a Water Supply Company Case

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Abstract- The present paper gives a quality measurement methodology based on a complex analysis of internal and external indicators and of the relationship existing between the two ones. The result of the proposed methodology application is to dispose of an operative tool to apply appropriate corrective actions to get the quality characteristic monitored on the nominal value. Moreover, an application of the proposed methodology to a water supply company is presented.

I. Introduction

Nowadays we are attending the continuous proliferating of Quality Systems applied in more and more several fields; but differently from some years ago, a recent trend turns the use of these models not only towards the supplying of products but also of services. This development exercises an ever-growing influence on the organization and management of those companies interested to keep step in a competitive environment like the modern one. Moreover this new approach upsets the traditional economical policy, in which the profit is in first place on the efficiency. On the other hand, presence of non-quality, results, on the whole, more onerous than to adopt a Quality Management System. So quality measurements hold an important role, proving certified information about the efficaciousness and the efficiency of a productive process.
The modernizing process is involving also the Public Organizations, as the Utilities Supplying Companies. Care must be addressed, above all, to organizations that supply indispensable public services: electric power, water, gas. In fact, often, a monopolistic management characterizes the distribution of these Utilities; this is due, in most cases, to high production costs that would make difficult the rising of a more competitive environment of small and medium enterprises. Absence of an alternative choice for the consumer could take off any stimulus at continuous improvement that instead is a typical result of the competition presence. Therefore the Quality Measurements can assure an objective valuation of the offered service quality, and the characterization of right quality indexes can assume an essential function in the definition of those criteria, that are basic in the modern process of optimization for services production and management.

II. The Methodology Proposed

Diffusion of new approach has certainly contributed to give a more managerial feature to the Public Organization, pursuing as a target the efficaciousness but also the efficiency of the service's delivery. This line of action left the hierarchic structure that put at the top the object of service and believed less important the management aspects of its delivery. The starting point is represented by a new vision of the service delivery, where a circular structure get a foothold; so the object of service represents simply a basic service that develops oneself in the delivery of an infrastructural service.
The purpose is to verify the features conformity of any supplied service at the prefixed targets [1]. So it will lead to single out a set of internal and external quality indexes; the former represent a direct measure of the quality for the infrastructural service as regards the internal process, the latter represent a measure of the quality perceived from the user. The developed procedure is characterized by two stages, which allow to make systematically a detailed analysis of the problem and to execute properly the quality measurements. The first one is the planning stage; it constitutes a preliminary step for preparing the measurement process. In this stage it needs to define the measure variables, which describe better the case examined. A useful tool is the 'processes approach', that is to single out the component processes of the internal and external activities accomplished by the Organization, with the respective responsibilities. Later on it's opportune to define the quality indexes to monitor and their ranges with the enclosed corrective actions. The last step consists on the choice of the internal and external indexes for every process with the reciprocal relations of dependence; the last allow executing the efficacious corrective actions. A particular care must be addressed also for the choice of the

informative system.
The second stage is relative to the execution of the measurement process [2], from the data collection to their interpretation. It consists also to realize a control panel for verifying the conformity of data to the fixed ranges, and if necessary for adopting the corrective actions. A positive aspect of the proposed methodology is its possible application on any Organization or Management System. In the following, is presented the validation of the proposed technique, applied to the case of a Water Supply Company of Naples City (WSCNC).

III. The Validation Field: a Water Supply Company

The process of water supply for the considered Organization can be schematized by a block, where two interfaces are present, on one hand there is the same Company, on the other hand the final service user. By the 'processes approach', it's possible to recognize three structural processes that are representative of the Organization Core Business: *(i)* management of the installations and water network; *(ii)* management of the relation with the consumers; and *(iii)* monitoring of water quality. The total output of these processes forms altogether the service delivered to the consumers, moreover by a careful analysis it's to observe a reciprocal influence among the structural processes, such interaction is schematized by other four infrastructural processes for internal services: *(i)* management of the provisions; b) management of the staff professional training; *(ii)* process of internal communication; and *(iii)* management of measure equipment.
This approach results introductory to define a set of opportune quality indexes of the several processes, in order to value the conformity of the delivered service at the fixed ranges. The indexes singled out are classified as internal ones for checking the internal service efficiency, and external ones for valuing the service efficaciousness and the customer's satisfaction. The former are the warning lights of a complex control panel, that is able to indicate possible out-control situations. The tools used for the preliminary analysis are graphic instruments, as the graphs of the index trend in comparison with the average level and control limits, histograms and radar charts. Besides by cause-effect diagram it has been possible to proceed with the Decision Making Analysis (DMA), in order to search for correlations among the indexes.

III.1 Internal Quality Measures

In Table 1 quality internal indexes for a water supply company are reported in term of effective measured value and its standard value. In Figure 1, as an example, a point to point trend of estimation time is reported; in the graph is also reported the standard value line, values measured average and trend line, and in Figure 2 its histogram is reported. The Figure 3 shows radar chart evaluated on all internal indicators and the figure 4 shows monthly average trend of each quality internal index.
Results of decision making analysis, in which, as described in the proposed methodology, internal indicators have to be associated with the interested process, are reported in table 2, 3 and 4.

QUALITY INDEX	Standard	Average Values		Absolute Values	
		Average	Average Position vs STD (%)	N° Int.	Out of STD
Estimation Time	30 days	22,64	75,47	1020	20%
Works Execution Time	60 days	12,25	20,42	1745	1%
Connection Time	10 days	6,93	69,30	1275	11%
Contract Cessation Time	30 days	17,92	59,74	2263	7%
First Intervention Time	8 hours	1,50	23,00	1865	1%
Service Restoration Time	24 hours	15,57	66,48	1378	19%
Service Reactivation Time after Payment	1 days	1,02	101,89	53	21%
Check Time of Water-meter	30 days	12,58	41,94	24	0%
Notification Time of Water-meter Operation	30 days	15,05	50,16	21	9%
Response Time for Complaint	30 days	17,86	59,53	85	0%

Table 1. Example of monitoring.

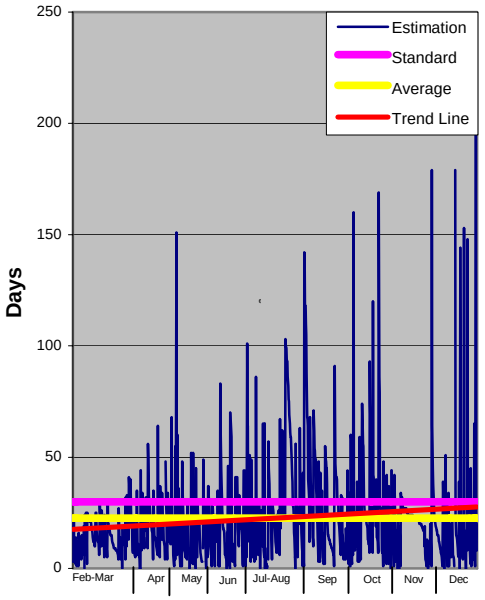

Figure 1. Estimation Time – Point to point trend.

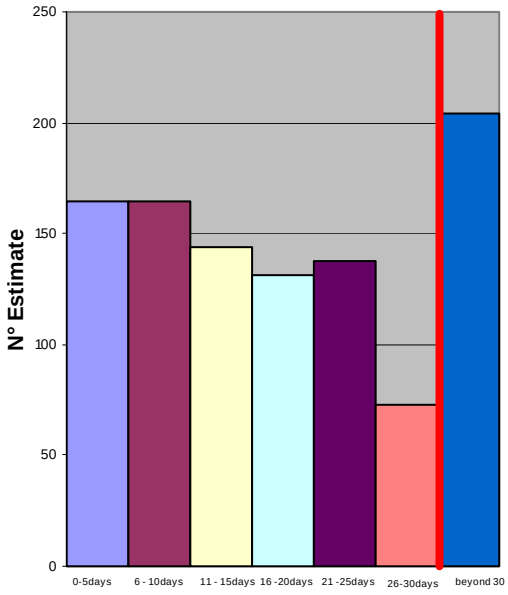

Figure 2. Estimation Time – Frequency histogram.

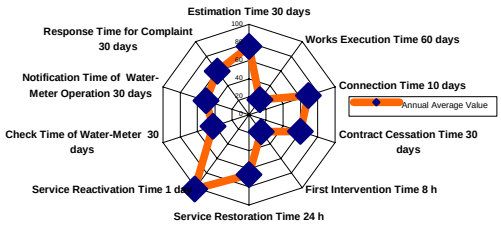

Figure 3. Radar Chart: Quality Factors.

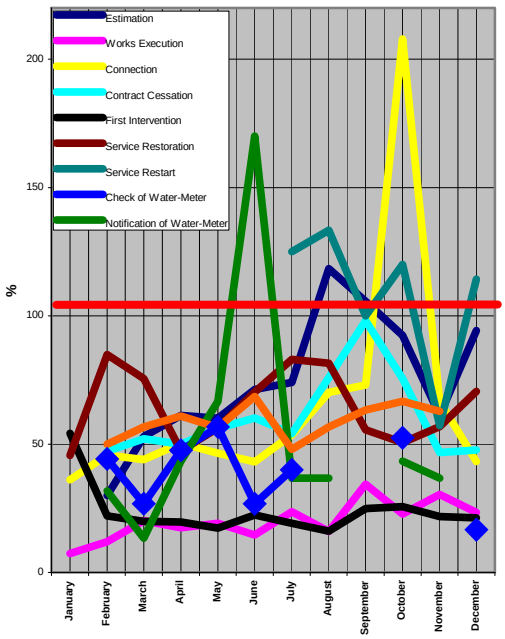

Figure 4. Monthly Average Trend.

Stages of Technical Process	Efficacy	Efficiency
Leak Search **RS**	■ N° Recognized Leak/km of inspected network ■ km of inspected network/km of total network	■ Working hours/Km of inspected network ■ Km of inspected network/year ■ Inspection km network cost/year
Emergency and Damage **RS / RA**	■ Service Restoration Time ■ Time of service cessation for emergency ■ Check of Water-Meter Operation ■ N° users involved by service cessation ■ First Intervention Time	■ N° emergency interventions/year ■ Working hours/N° emergency interventions
User request for intervention **RS / RA**	■ Connection Time ■ Average Time of Water-Meter replacement ■ Works Execution Time ■ N° installed Water-Meter ■ Time of on the spot investigation ■ N° projects of network ampliations/year	■ N° interventions/N° workers ■ N° realized projects/N° total projects
Network Management **RS / RA**	■ Average pressure of network ■ Interruption Time of intervention	■ Network maintenance cost/year ■ Km of network in maintenance/year

Table 2. Indexes of Technical Process (where: RS: Underground network; RA: Aerial network).

Stages of User-Management Process	Efficacy	Efficiency
Survey of consumptions	■ N° annual measures/Total users	■ N° measures/N° workers
Invoice/ Management of Payment and Default	■ N° of invoice errors/N° issued invoices ■ Time of invoice rectification ■ N° of defaulting users/Total users ■ N° of non-defaulting users/Total defaulting users ■ Notification of service suspension for default	■ Average time among measure and bill ■ Average time among bill and consignment ■ Average time among consignments and takings ■ Volumes of invoiced water ■ Takings/Turnover
Contracts	■ Time of estimate ■ N° new contracts ■ N° of cessation notices/N° of new contracts ■ Notice of water-meter control ■ N° contractual modifications	■ Time of contractual cessation
Informations and claims	■ Wait Time at counter window ■ N° informations requests for bill/N° of total information requests ■ N° of reached complaints/year ■ Response time to complaints ■ Response time to written requests ■ N° of information requests/year ■ Opening hours of counter windows/Week	■ N° of workers of information service/Total workers ■ N° of counter windows workers/Total workers

Table 3. Indexes of User-Management Process.

	Efficacy	Efficiency
Measurement Systems Management Process	■ N° controlled measurement systems per annum ■ Average Time of internal calibration ■ Average Time for replacement of measurement system under calibration	■ Annual Cost of calibration operation ■ Average Time among the forwarding of instrument to Metrological Institute and its return

Table 4. Infrastructural Indexes of Measurement Systems Management Process.

III.2 External Quality Measures

Servqual Method allows the measure of the external quality, i. e., the quality perceived from service users [3],[4],[5]. It consists in the data analysis through a questionnaire proposed at a statistical significative sample of customers. The Servqual index is a measure of the customer satisfaction, in terms of the measured gap between perception and expectation. The user expresses his estimate in a scale 1 up 10, subsequently by the valuation of average Servqual indexes; the zones of force and improvement are got. A vision of these zones allows recognizing the processes, which need corrective actions [6],[7].
In table 5 are reported external indexes chosen for each service parameter proposed by Servqual method, and in figure 5 are shown the results of the data acquired by questionnaires.

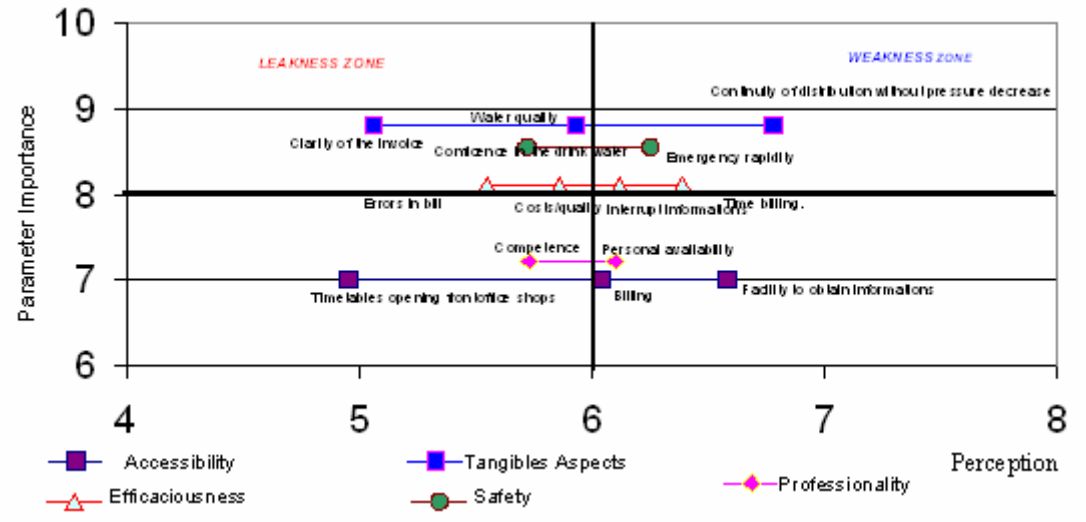

Figure 5. Weakness and leakness zones.

IV. Conclusions

The control of the provided service quality requires, as above, from a side to verify the customer satisfaction and from the other one a valid control panel monitoring the process indexes. The proposed methodology represents an integrated system of measure, where the data of efficaciousness and efficiency influence each other themselves producing the improvement corrective actions according to the Standard UNI EN ISO 9001:2000. Moreover it represents a valid solution in cases where the complexity of the measurement process or data entity is considerable.
In the paper a water supply company methodology application has confirmed the goodness of the results of its implementation.

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