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Tele-maintenance "intelligent" system for technical plants result management

Massimo Concetti[a], Roberto Cuccioletta[a], Lorenzo Fedele[a,b,*], Giampiero Mercuri[a]

[a]*CNIM—National Italian Committee for Maintenance, Italy*
[b]*Department of Mechanical and Aeronautical Engineering, University of Rome "La Sapienza", Via Eudossiana 18, 00184 Rome, Italy*

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Abstract

The management of technical plant for productivity and safety is generally a complex activity, particularly when many plants distributed in the territory are considered (i.e. the more and more frequent case of outsourced plants maintenance by specialized companies), granted quality and cost results are required (i.e. the case of some rather innovative contract solutions) and the technology involved is heterogeneous and innovative (i.e. electro-mechanical plants).

In order to efficiently achieve the above aims an "intelligent" maintenance–management system for the distant monitoring and controlling by a remote control center has been developed. The so-called GrAMS (granted availability management system) system is conceived to give to organizations involved in technical–industrial plants management the possibility to tend to a "well-known availability" and "zero-failures" management.

In particular, this study deals with the diagnostic aspects and safety level of technical plants (such as elevators, thermo-technical plants, etc.), and with the involvement of *ad hoc* designed software analysis tools based on neural networks and reliability indicators.

Part of the research dealing with the tele-maintenance intelligent system has been financed by the Italian High Institute for Safety (ISPESL) and led to the development of a pre-industrial prototype whose realization and testing is here described.

Keywords: Maintenance; Technical plants result management; Tele-maintenance

1. Granted availability management system (GrAMS)

Within the scope of Facility Management, that is the design, organization and management of all services intended for a particular system for the purpose of achieving the expected operating conditions, the issue of maintenance, and more generally, of management of plants concerned with supplying services with a predominantly technological content today seems to be second to none in importance, compared to the past, in both the industrial and civil fields.

Currently, maintenance and/or repairs are carried out on technical plants, in most cases, when the plant fails (and is consequently out of service), or according to a mandatory preventive schedule imposed by law.

Moreover, new needs for rationalization, low cost management, safety and quality of life, have not only facilitated the diffusion of result-based type contracts, but also management solutions that bind the supplier and the bidder more closely with respect to the definition and observance of service levels.

It is clear, therefore, that the possibility of verifying the operation of a machine or plant is a considerable problem for the Companies that manage the machine or plant and for the safety of the user.

The availability of new methods and new technologies combined with on going research into quality conditions and increasing competitiveness, have led to the study of the possibility of setting up maintenance systems, on the one hand integrated to a greater extent with the goods to which the maintenance refers, and on the other hand more appropriate and flexible with respect to varying needs.

*Corresponding author. Department of Mechanical and Aeronautical Engineering, University of Rome "La Sapienza", Via Eudossiana 18, 00184 Rome, Italy.
E-mail address: iorenzo.fedele@uniroma1.it (L. Fedele).

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For this purpose, starting from past research oriented towards setting up Facility Management contract management models,[1] as well as other experimental activities that have led to the development of pre-industrial prototypes based on intelligent logics implemented though soft-computing techniques and directed towards maintenance of specific systems [1,2], the creation of a tele-maintenance intelligent system, based also on neural networks and marked by result management logic, called GrAMS (granted availability management system), was evaluated positively as a real possibility.

GrAMS is a system for the technical and administrative management of a technical plants system, with differing technical natures, distributed in the territory which gives the management and maintenance service contractor (Management Organization) the possibility of being able to guarantee, even through monitoring and control from a remote center, a service characterized by "total availability" of plants and "zero failures". This system (Fig. 1) consists of two main elements:

(1) a Plant Result Management Model, and
(2) a tele-maintenance intelligent system for the forecast of the reliability and safety level of each plant, and for the planning and scheduling of maintenance operations.

The Plant Result Management Model makes it possible to measure the service level agreement (SLA), that is, to compare the data monitored through the service in a given time interval for a certain type of plant, defined as Technological Line (e.g. Hot Technological Line), with the results defined and guaranteed at the start of the given time interval. The model, as well as measuring the SLA of each technological line, makes it possible to evaluate the service performance (ID) in terms of well-being, image, availability, safety, and to synthesize the service supplied to the entire plants system in a single indicator, the service quality index (IQ).

The second component of the GrAMS, the tele-maintenance intelligent system, is a failure (Ka) and safety level (Ks) forecast tool which allows the management organization, apart from planning and scheduling maintenance, to have in the remote control center all the "useful information" at the "right moment" for a precise analysis and to receive "warning signals" whenever the forecasted level of reliability and safety drops below a determined threshold [15].

Moreover, the tele-maintenance system, through distance detection, recording, analysis and processing of significant parameters relevant to the operation of the plants, permits more effective management and maintenance actions, such as for example, the prompt response of interventions when the supplier is responsible for managing a large number of difficult-to-access plants systems.

The two complementary elements, used in an integrated manner have led to the definition of a management tool capable of guaranteeing "total availability" of the plants.

1.1. State of the art

Research was carried out on the state of the art of the maintenance service field through the analysis of the main tools physically available and through literature on measuring the quality of services, and in particular by focusing on the extension of these approaches to quality management in the field of maintenance services, specifically in the case where these services are outsourced through result-based contracts.

Unlike what occurred in the field of industrial products, where a series of statistical methods based on the evaluation of tangible elements for the quality control of the processes have been devised, no such universally accepted reference outline is available for the service sector.

This deficiency is linked to the particular characteristics of the services category compared to that of the product category.

The models present in literature concerning the measurement of quality of services basically take three aspects of the service itself into consideration: the expectations of the contract provider with regards a given characteristic of the service; the importance given to this characteristic; the evaluation of the actual performance of the service.

The most well known existing tool is ServQual [3], which measures quality, using statistical methods, as the difference between performance and expectations.

Another interesting study is the American "Service level agreement framework for business service" [4], where the author states that the measurement of customer satisfaction must be connected to what are considered, according to several other studies, two key elements for the evaluation of the results of a Global Service agreement: the SLA and the reporting system.

The CEN draft standard "Maintenance performance and indicators" [5] provides an incomplete list of maintenance indices as well as a useful guide to choosing and processing a set of indicators suitable for representing the performance of maintenance activities in an objective and precise manner, by controlling the achievement of the objectives and comparing with other similar realities.

The preliminary analysis of the entire research activity carried out highlighted the lack of an actual model for the comprehensive evaluation of the management and maintenance contracts. At the same time the research showed the usage, by result-based contract providers, of a combination of various indicators to evaluate and control the quality level of the service given by the supplier, which most times cannot be measured.

[1]Paper on "Analysis and definition of models for the comprehensive evaluation of management and maintenance of contracts", Università degli Studi di Roma "La Sapienza", Lorenzo Fedele, 2005.