

CONSIDERATIONS ON THE IMPACT OF THE ROMANIAN ELECTRICITY SECTOR RESTRUCTURING ON THE MAINTENANCE AND THE ASSET MANAGEMENT

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INTRODUCTION

Against the background of sustainable development, asset management is a set of methods and procedures contributing to increased profitability, competitiveness of services provided by such assets and their uninterrupted operation at a high quality level.

Asset management is a manner to optimise the use of assets by acquiring and processing the relevant data obtained from maintenance, upgrading, investment decisions and performance monitoring.

Risk management also helps supervising and controlling risk levels in the operation of assets, in accordance with the Company's objectives of service quality, operational safety and installations security.

The de-regulated business environment makes the decision-making process for asset management to be based on a balance between risk assessment and future performance evaluation.

In these terms, fixed assets management within Transelectrica SA represents an evolved concept applied to the activity starting from the operation and maintenance of existing installations, with a view to minimise costs and maximise performance, up to activity management with a view to increase the mid- and long-term profitability, also providing quality service at highest standards, under acceptable risk conditions.

Therefore the optimum balance among **performance, cost and risk** is aimed at, by means of installations utilisation at highest level.

Mention should be made that Transelectrica's subsidiaries play a very important part as well, they being considered strategic partners that however do not prevent competition in other areas.

Asset management is an **iterative and evolving** process, as shown in Figure 1.

Between 2000 and 2005, the restructuring of the whole Romanian energy sector was carried out under the condition of the power market liberalization, when Transelectrica assured the NPS (National Power System) operation under safe and reliable conditions.

Transelectrica restructuring included efficiency increase actions, going through the corporative reshaping stages when subsidiaries have been set up – commercial entities operating based on the trading principles.

In terms of power transmission and system operator and for meeting the requirements in the energy sector strategy and the UCTE ones as well, Transelectrica evolved a development and modernizing program which had been technically and economically justified based on the strategic documents such as the Prospect Development Plan on the National Power Grid 2004-2006 and as a guideline until 2014; Business Plan 2004-2013.

The investment efforts have been focused on two main directions:

- Modernizing/development of the NPS control system simultaneously with the enhancement of the power market infrastructure;
- Modernisation of the transmission grid vital substations. Interconnection substations have been included in the first class of priority.

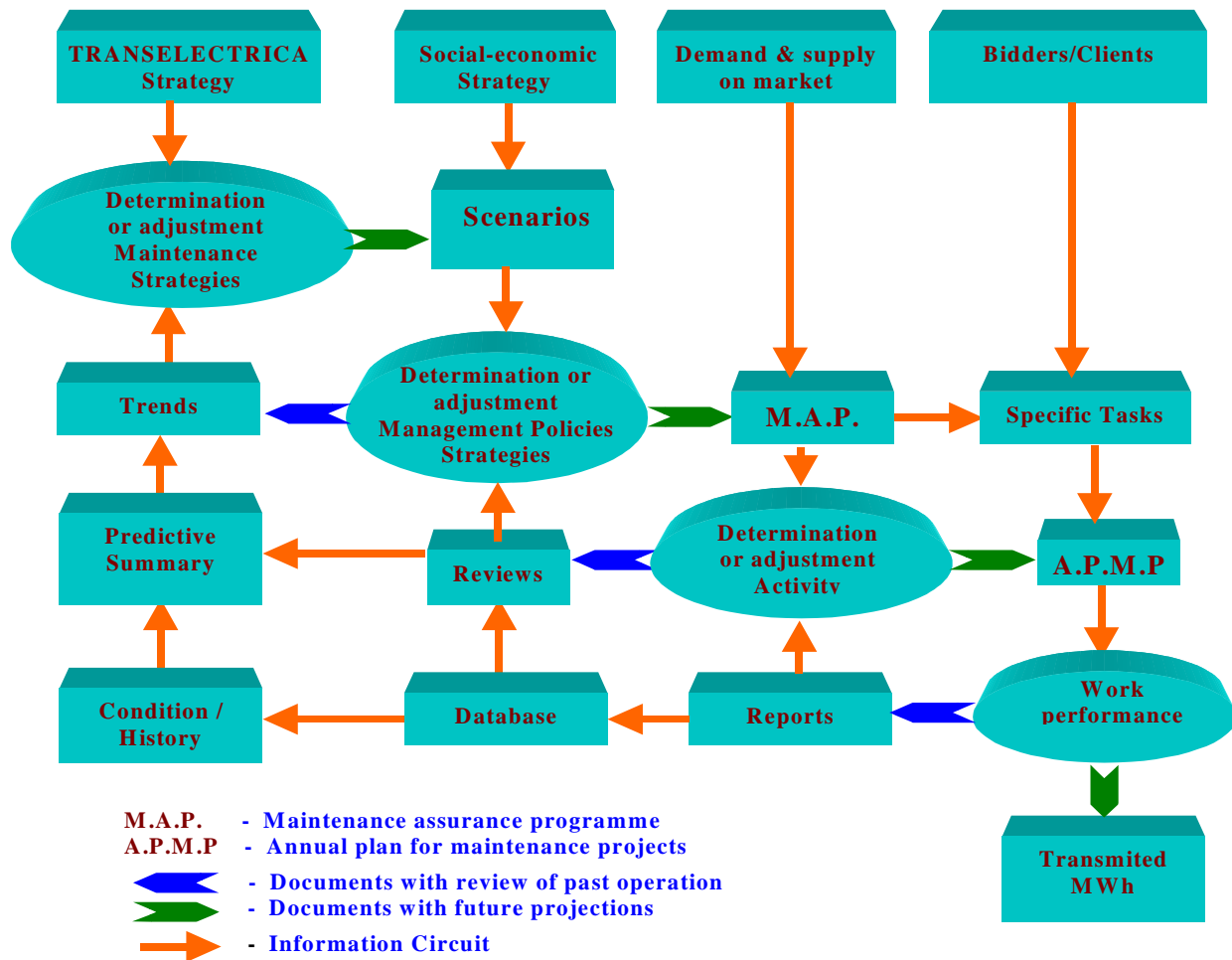


Fig.1 The asset management process

CN Transelectrica SA is implementing a risk management plan which actually covers the company-wide risks and which makes possible to be used some appropriate options resulting in effective costs, risk mitigation and transfer.

CN Transelectrica SA performs the fixed asset management (substations, electric lines) for their being maximally utilised by a balance between the maximal performance (operation), minimal costs (maintenance, rehabilitation, modernizing) and efficient risk management (ageing, failure, criticality, impact). To reach its goals, Transelectrica promotes the state-of-the-art technologies, attracts domestic and foreign funds and undertakes activities based on projects.

The operation CN Transelectrica SA at the European standards meant a strong argument for Romanian accession in the European Union and for the institutional harmonization with the community aquis. During the negotiations on Chapter 14 – Energy, it was appreciated that Romania had met the requirement of developing the power market, the power transmission and NPS operation, being therefore created an independent, neutral and reliable operator.

2. ASSET MANAGEMENT

2.1. Objectives and functions of the asset management

The **objectives** of the asset management can be summarised as follows:

- Safe operation of existing installations;
- Minimising costs and increasing the performance under efficiency conditions;
- Increasing the business mid- and long-term profitability;
- Efficient risk management;

- Optimising the trading activity by applying market competitive mechanisms;
- Promoting a long-term investment programme;
- Correlating the maintenance and the investment programmes;
- Complying with the legislation in the areas- quality, environment, installations safety, labour safety and fire prevention, users' rights.

The basic function of asset management can be described as a continuous iterative decision-making process regarding all activities that take place within and in relation to the network.

Decisions refer both to investment planning and to maintenance.

Therefore by applying a sound asset management one can achieve- adapting to institutional changes, maximum availability of transmission network, justifying the upgrading decisions, providing equipment reliability and increased operational safety, extending the life cycle of fixed assets within the network and optimising the information flows.

The main **functions** of asset management refer to:

- Maintenance strategy;
- Upgrading / replacement decisions;
- Risk management;
- Implementation of new technologies;
- Maintenance management;
- Relations to users (customers);
- Network planning;
- Cost control;
- Legislative conformity- environment, safety, fire prevention, labour protection;
- Management of regulations.

The stages of the **asset management process** evolve in a spiral from the existing situation to the proposed target (spiral „Plan – Do – Check – Action“). Such stages are:

- Determining and adjusting the vision and the objectives

This is related to the Company's objectives; here the business plans are drawn up and are periodically reviewed, taking into account the needs and the evaluation of its own performance.

- Determining and adjusting the strategy and policy

The regulation and environmental scenarios are used here, and the required asset management aspects as well as the activities constituting policies are defined (e.g. investment in the network, introducing a certain type of equipment).

- Planning

It generally consists of an annual business plan, which involves a long-term planning (in general for 5-10 years). The plans aim at keeping the network functionality. Various solutions are defined- maintenance, investment, studies for the long run. The options retained make the base of a long-term plan that is annually reviewed, with terms and costs.

- Achievement

Service providers carry out the plan on behalf of the asset manager. The latter uses the results obtained as basis for the future also integrating them in the long-term planning process.

Within Transelectrica SA activities are organised by projects /programmes, with beneficial outcomes for the technical and procedural approach, the best capitalisation of financial resources, specialists, communication to suppliers, operators, operational personnel etc.

In the context of the sustainable development, the asset management is a set of methods and procedures contributing to profitability increase, service competitiveness carried out with these assets under continuous and quality conditions.

Asset management is a modality of optimizing the assets use through collecting and processing the relevant data resulted from maintenance and rehabilitation work, from the decisions on investments and from monitoring the assets highly efficient use.

At the same time, the risk management is meant to monitor and control the assets operation risk levels as per the Company's goals referring to the service quality and equipment operation reliability and safety.

Considering the assets management, the deregulated business environment makes that the decision made should be based on a balance between the risk assessment and the future performance expectation.

Following the restructuring of the energy sector, the integrated Company of energy generation, transmission and distribution was split into individual companies which deal with these activities based on licenses issued by the National Energy Regulatory Authority (ANRE).

The restructuring process impact upon the fixed asset management is shown by:

- Strengthening the responsibility of the Company's departments for judiciously planning the overhauls and modernizing work fully synchronized with the other economic agents (power distributors, generators, consumers), on the contractual basis;
- Observing the contractual obligations stipulated for the maintenance activity with the view of avoiding the additional costs for the Company in case of the delay of some activities planned or because of some accidental non-availabilities of Transelectrica facilities;
- Enhancing the economic efficiency by separately pointing out the maintenance expenses and also as a requirement of the *License for electricity transmission and system service providing*;
- Impact upon the power transmission tariffs in case the annual maintenance program and investments are not carried out.

The asset management in Transelectrica is a developed concept applied to the activity starting from the operation and maintenance of the existing facilities (with the view of cutting down costs and maximizing efficiency) up to the activity management (for increasing profitability on medium and long term), assuring the service quality at the highest standards under acceptable risk conditions.

3. MAINTENANCE ACTIVITY – A COMPONENT OF THE ASSET MANAGEMENT

3.1. Maintenance objectives:

- Providing a **safe operation**;
- Providing **high asset availability** by means of:
 - Reducing the number and duration of failures;
 - Reducing the number of planned maintenance operations;
 - Reducing the period of planned maintenance operations;
- Increasing the operational **flexibility** by means of:
 - Solutions for deviations from the disconnection schedule;
 - Modern solutions;
- **Optimising costs** with respect to:
 - preventive maintenance;
 - corrective maintenance;
 - reducing the maintenance-induced failures

3.2. Maintenance Assurance Programme

In SC Transelectrica SA the maintenance activity is developed based on its own Maintenance Assurance Programme (MAP) drawn up based on ANRE provisions.

MAP envisages the following goals:

- Observing ANRE requirements on carrying out maintenance activities;
- Determining the strategy and goals on medium and long term, the responsibilities, requirements and the manner to meet them in order to assure the development of maintenance activity in CN Transelectrica SA;
- Setting the strategy, the medium and long term objectives, responsibilities, requirements and the way to meet them for ensuring the maintenance activity development within Transelectrica;
- Featuring the performance maintenance criteria and costs identification;
- Collecting all the necessary data and information to meet the requirements of reporting;
- Drawing up, issuance and updating the regulations, procedures, instructions, programs, technological sheets specific to some activities and/or to some areas related to the maintenance work;
- Setting the specific conditions which have to be included in the contracts concluded with the maintenance service providers.

MAP is thus based in prescriptions, recommendations, procedures, technological sheets etc. to ensure that the maintenance policies are determined and understood within and outside CN Transelectrica SA -to the maintenance service providers-, implemented and kept on country - wide. The activities stipulated in MAP are procedure-shaped. The procedures have requirements including roles and responsibilities,

personnel qualification, change management. MAP consists in and preserves (by ensuring the framework for elaboration, review, update the documentation on maintenance, if the case) all the documentation referring to the maintenance activity. This documentation justifies in an efficient manner the implementation and functioning of each stage of MAP and makes the key results of this process as well as the decisions made to be traceable and applicable. MAP is applied to all the components of the maintenance activity (technical, economical, financial, relational, and organizational) undertaken at all the fixed assets within the network.

The new approach of the maintenance activity accounted for some principles within a sophisticated strategy targeting the strategic goals of this activity as a support for meeting the goals of the Company:

- providing the service of quality and in the amount required by the contracts concluded with the purchaser;
- ensuring the operational safety of the NPS and electricity quality as per the quality standards stipulated in the Technical Code of the Power Grid;
- providing access to the power grid for all the players on the power market under transparent, fair and indiscriminate conditions;
- achieving the auxiliary services in a competitive manner (where it is possible) and at an effective cost;
- interconnected operation synchronous with UCTE;
- limiting the impact of own power facilities upon the environment;
- using qualified and motivated personnel under secure and health conditions.

3.3. Maintenance strategy

The maintenance strategy defines the objectives of the Company needed to carry out this activity.

In order to organize, plan, schedule and conduct the maintenance activity, general and specific objectives are determined through the provisions in MAP which should be reached for increasing the performance.

The maintenance strategy is meant for planning and scheduling the long term activities, organizing the activities on clearly stated bases, purchasing maintenance services based on contracts from specialised entities (economic agents), from outside CN Transelectrica SA and by observing the performance criteria. Organising the activity ensures the needed interfaces (relations, communication, coordination) between the departments on CN Transelectrica SA and Contractors, work execution survey, work acceptance tests.

Analysing the evolution of the incidents in-between 2000-2004, a decreasing trend may be noticed for the incidents number in time, following the measures taken (replacing the insulation of OHLs, replacing the measurement, current and voltage transformers, replacing the bus bar insulation, replacing the transformers and autotransformers with new units and wholly rehabilitated and, in a smaller part, acquisition of reliable parts for the hydraulic mechanisms).

Considering that at present our Company has initiated a comprehensive investment plan for the rehabilitation/modernizing the existing facilities, the maintenance expenses shall be decreased up to 18-20 % of the operation expenses.

When the investment and major maintenance work reach a technical uniformity of the facilities, the maintenance expenses will stabilise to a certain level for the following period of time.

For these expenses, annual decreases have been estimated by 4 % until 2010.

3.4. Coordination of the maintenance work

The schedules of the preventive maintenance are correlated with the investment programs (transforming substations rehabilitation programs constructed on scientific bases, on ranking criteria which lead to making ranking decisions on performing the maintenance work or investments).

Based on the annual maintenance and investment plans the annual plan on equipment and facilities deenergising is constructed. The annual deenergising plan includes the total deenergising work for the whole year of equipment and facilities requiring maintenance and investment activities which have been decided upon by CN Transelectrica SA.

The maintenance plans are constructed in such terms that all activities to be performed at an equipment or facility of the NPG should be executed within a single deenergising period.

At the same time, the work at OHLs should be correlated with the work at the end bays, the work at transformers, autotransformers, shunt reactors will be correlated with the work at the related bays, the work at the primary equipment with the work at the secondary one or between various equipment managers etc. including neighboring power systems partners.

3.5. Information feedback used to improve the maintenance strategies

In order to justify the decisions on enhancing the reliability and maintenance activity based on the information feedback, the following issues have to be considered: analysis of the failure occurrence frequency and analysis of the equipment operation features evolution to state the technical condition; analysis of the equipment importance within the NPS; cost analysis.

All the aforementioned are included in the general philosophy of Reliability- Centred Maintenance (RCM), a systematic decision making process and a process of standardized approach of the maintenance activity currently applied within the NPG. The RCM is capitalizing the classical theory of reliability which directs the maintenance actions towards the vulnerable spots in the installations and where these activities are justified by the economic efficiency. Therefore it was progressively change from the time-based maintenance activity to the condition-based maintenance work, namely the reliability-based maintenance activity

The main maintenance philosophy objectives based on reliability are as follows: maintenance undertaking at the optimum time and in the optimum amount; cutting down the maintenance costs; diminishing the decommissioning periods of time; providing the requirements on the investment work promotion; correlating the maintenance and rehabilitation programs.

Priority of the preventive maintenance work is set function of the technical condition of equipment/facilities quantified based on statistically processing the information on the operational behavior: frequency and duration of the accidental failures, evolution of parameters and operational features, maintenance history, costs and considering their importance for the NPS.

Integrating the results related to the technical conditions of all functional equipment/facilities owned by each transmission branch and the importance of facilities for NPG, it results the program on annual maintenance activities required at the level of each functional category unit, split by the four levels stipulated in MAP as well as suggestions for the rehabilitation/investment plan.

The final maintenance program, followed by the one on deenergising activity is the result of an annual iterative process as per the specific operational procedures.

Managing the maintenance activities (work controls, identification of the facility to undergo the maintenance work, other facilities deenergized as a measure of the labour protection norm, date, period of time, action type and scope, costs, conversion costs, parts and material utilised, transport of tools, invoices for services and products etc.) is made by using all the dedicated data.

The information application allows the acquaintance with and storage of the maintenance activities history which had been performed at each functional unit, work orders issuing and forwarding.

Primary information on the power grid facilities operation is capitalized by its being processed and by issuing reports based on the data collected from monitoring the facilities behaviour in operation.

In an operative system of observation, recording, information on the accidental events (incidents, technical failures) occurring at the power grid facilities, regulated through the Technical Norm "Regulation on accidental events record and analysis on heat and power transmission and distribution facilities". Based on the specific application instructions and on the specific procedures, the corrective maintenance actions are initiated to remedy the defects and restore the facilities to operate at the designed parameters.

Monitoring of the facilities operational behaviour is systematically made at the power transmission branches and consists of collection, recording, validation, storage, taking over and forwarding the information on operation, maintenance and repair of power grid facilities, equipment and their component parts when of the communication between equipment supplier and purchaser is of utmost importance.

The system of checking the maintenance results consists in monitoring the operational behaviour of facilities, before and after carrying out the maintenance work, respectively. The history of the maintenance work and of the operation behaviour points out the equipment operational trends, weaknesses, improvement needs.

The contracts concluded with maintenance services suppliers include provisions on their observing the MAP applied by CN Transelectrica SA.

Since there is an obvious need to have a **single and transparent flow of data and information** regarding the maintenance activity [1,2], which should provide all available data and control facilities for their quality, a specific **database** was set up for maintenance. An **IT system** was established as well in order to manage, optimise and coordinate all maintenance activities, with also the possibility to have an interface with the other IT systems- GIS, MIS etc. (Figure 2), as used within the specialised IT system.

The efficiency of maintenance can be assessed using the following [1÷2]:

- Technical criteria of maintenance efficiency;

- Economic criteria of maintenance efficiency;
- Criteria of service quality;
- Statistical indicators.

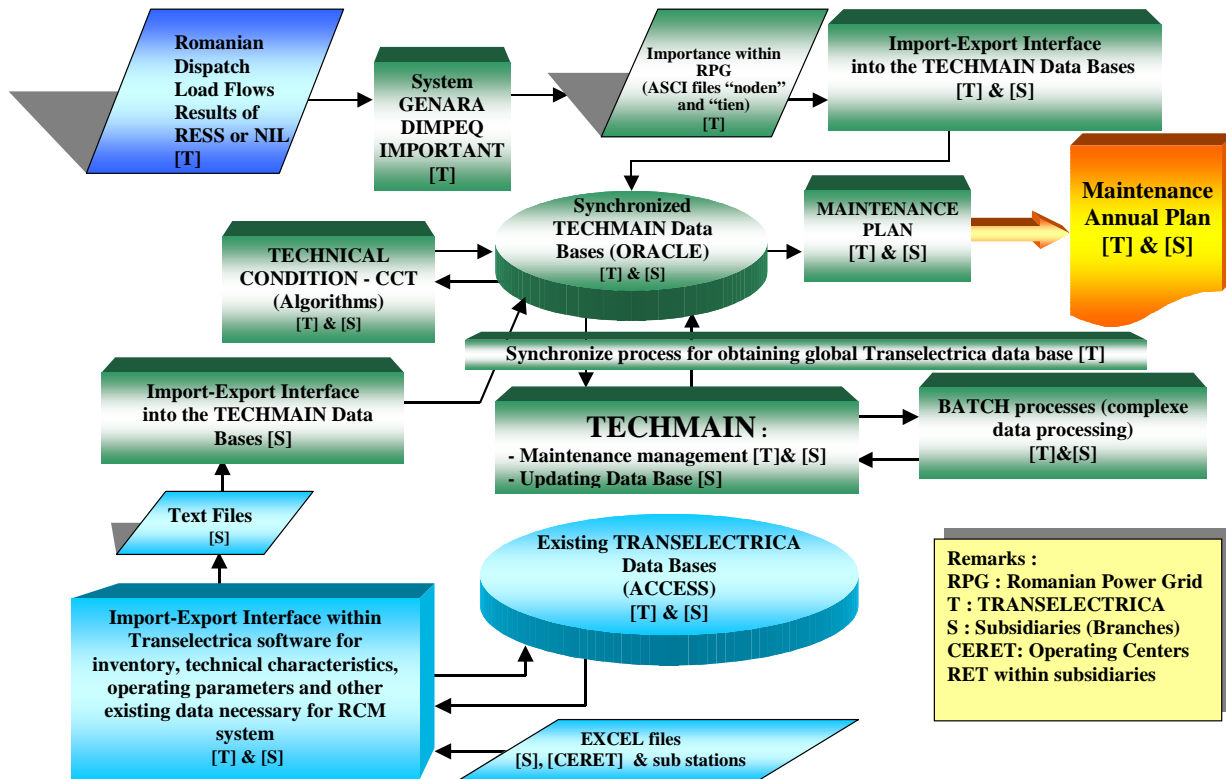


Fig. 2. Reliability centered maintenance informational system

4. DECISION-MAKING PROCESS IN ASSET MANAGEMENT

Asset management requires assistance for decision-making in order to allow selecting the best solution between several possible options.

The **decision-making** process involves [3]:

- evaluating the condition and the risks;
- decision-making algorithm.

Decision-making can be considered as a continuous process based on technical, economic and sociological data.

Technical data refer to the condition of equipment. Financial data combine economic and technical details on assets, being especially oriented to reliability. The social data combine the company's information with sociological data in order to take decisions on risks.

Such data categories are:

- **technical** data: stocks, characteristics, operational parameters;
- **economic** data: assessing costs for the entire life cycle (investment, operation, maintenance, taking out of operation), costs of failure results;
- **sociological** data: social and environmental aspects (impact of hazards, criticality: number and period of hazards), thus the social impact being obtained: the image for the public and the feeling of 'security'.

The decision-making algorithm develops by hierarchical levels:

Level 1: component (asset)

It consists of assessing the equipment condition based on the technical data and information. Many scenarios can be found to influence the assets performance in terms of **reliability and availability**.

Level 2: network

When technical information is combined to the economic and network ones, costs are quantified. These are also expressed in terms of reliability, consequences of events, risks.

It is during this stage of the decision-making process that modern methods of (RCM) maintenance evaluation and planning are applied.

Level 3: corporation (Company)

The costs and advantages of various scenarios are combined with the risks of each one in order to take the best decision.

The permanence of the decision-making process requires **the best information in due time.**

Quality, coherence and validity of data and information have to be ensured in the decision-making process.

Basic data refer to **historical** information obtained from supervising the operational behaviour.

A good **feed-back** process is needed.

Two types of information are required:

- behavioural performance of fixed assets;
- acceptable risk / availability levels;

There is need for a transparent **single flow** of data and information, as it has been shown previously.

CONCLUSION

The fixed assets management process, with all its complex aspects, is meant to maintain the safe functionality of NPG and of the NPS as a whole.

The goals to be achieved in a system concept are:

- adapting to institutional changes,
- maximising the availability of the network,
- grounding the maintenance and / or retrofitting decisions,
- determining the strategy, objectives, responsibilities, requirements and their mode of achievement in view of the maintenance activity,
- providing reliability of equipment and increased operational safety,
- extending the life cycle of fixed assets,
- setting up a coherent strategy to identify, assess, review and manage risks; providing the specific data and information needed to implement the risk management,
- setting up and optimising the information flows needed for the activity and providing a proper feed-back; providing interfaces between different entities,
- identification, control and optimisation of costs,
- documenting the activities,
- determining, assessing and supervising the performance criteria; determining efficient measures to improve performance.

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