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MAINTENANCE MANAGEMENT INFORMATICS

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ABSTRACT
General concepts of info systems in maintenance management are presented departing from basic modelling of systems such as an economic enterprise, business or integral assets. It is shown how an industrial system can be modelled to map a hierarchy of its vital components. Maintenance informatics media critically affect interactions between planning, evidence & control and actual performance (maintenance actions such as repair operations, store keeping and shutdown maintenance). Appreciation of multidisciplinary structure of industrial systems enables understanding why Maintenance Management needs infos components such as planning, control, communication and documentation.

1. INTRO

Man-made systems cannot operate sustainably without being maintained. Maintenance is ensuring and controlling the reliability and availability of a system [1]. Reliability is satisfactory performance (according to specification) when used. Availability is presence of a reliable item at the given time & location, ready to be, or being used for a specified purpose.

Business firms, (and other socioeconomic organisations) rely on info systems to manage their operations, supply services, comply to the standards, maintain and improve their functions. Most business corporations rely on computerised info systems to run and maintain their operations, to process financial accounts and to manage human resources [2,3].

Informatics, also termed Info Science (or conservatively "Information Science") is the study of data and information, including how to interpret, collate, record, analyse, store and retrieve it. Informatics includes processing and distributing info related to a system (in our case, the maintenance system) in order to document, control and improve it. This involves planning, protecting, deciding and publishing information. Recorded info (info media, documentation) are means that enable managing, complying and acting in accordance to orders, communication, evidence and other functions both within and beyond the system. An industrial system is not an isolated island: in fact its relations with ambient are its most important denominators.

Further disciplines addressing adjacent domains of knowledge are System Engineering, System Science and Cybernetics. Applications of info systems in maintenance management may be better understood by becoming acquainted with these differing viewpoints.

System Engineering (also Systems Engineering) involves design, management, control and optimisation of a total system. The system engineering process is a structured, disciplined, and documented effort through which system products and processes are simultaneously defined and developed. Most effective system engineering utilises multidisciplinary teamwork to implement holistic strategy to integrated product and process development. Examples of engaged disciplines include electr(onic)ical engineering, communications theory, cybernetics, and computer theory.

System Science is applied to the analysis of all aspects of all systems, both manmade and non-manmade. One example is a lake with incoming and out coming flow including its flora an fauna. Another example would be a complex electrical network with feedback loops, in which the effects of a process cause changes in the source of the process. System Engineering applies that knowledge in order to organise, improve, control and govern actual man-made systems.

System engineering applies knowledge from other branches and disciplines in effective combination to solve multifaceted engineering problems. It is related to operations research but differs from it in that it is more a planning and design function, frequently involving innovative solutions. Probably the most important feature of system engineering is multidisciplinary application and development of new technological possibilities with the specific objective of putting them to use as rapidly as economic, technical and other social considerations permit [4].

Cybernetics is communication, control and processing information related to governing (regulating) a system. While informatics focuses on information, cybernetics comprises of informatics plus other relations affecting the significant (predefined) processes within a system.

System is a set of relations. Actual number of these relations is infinite, and the complete set cannot be understood within the real timeframe. However it is possible to identify some of significant relations and to define algorithms for their control and management, by assuming that the remaining factors are individually insignificant and in total random (but statistically regular).

2. MAPPING THE HIERARCHY OF MAINTENANCE INFORMATICS

Maintenance management system must be able to function and interact together with company systems such as technology development, financial system and production management system. Some functions, e.g. stock control and purchasing present "overlapping" fields. Efficient collaboration requires transparent communication and recording information; info media (documentation) are means that enable managing, communication, evidence and other function of the whole system such as complying and acting in accordance to orders and standards. Information should be shared by many separate areas of an organisation (company, industrial system); however a care should be taken to avoid information overflow ("info noise").

One way of mapping a system is to show pertinent subsystems in form of a Venn diagram indicating mutual interferences. Another way of mapping the whole system is to follow the flow of material, energy and information (Figure 1). Management (hierarchically the highest category) may be analysed as shown in Table 1.

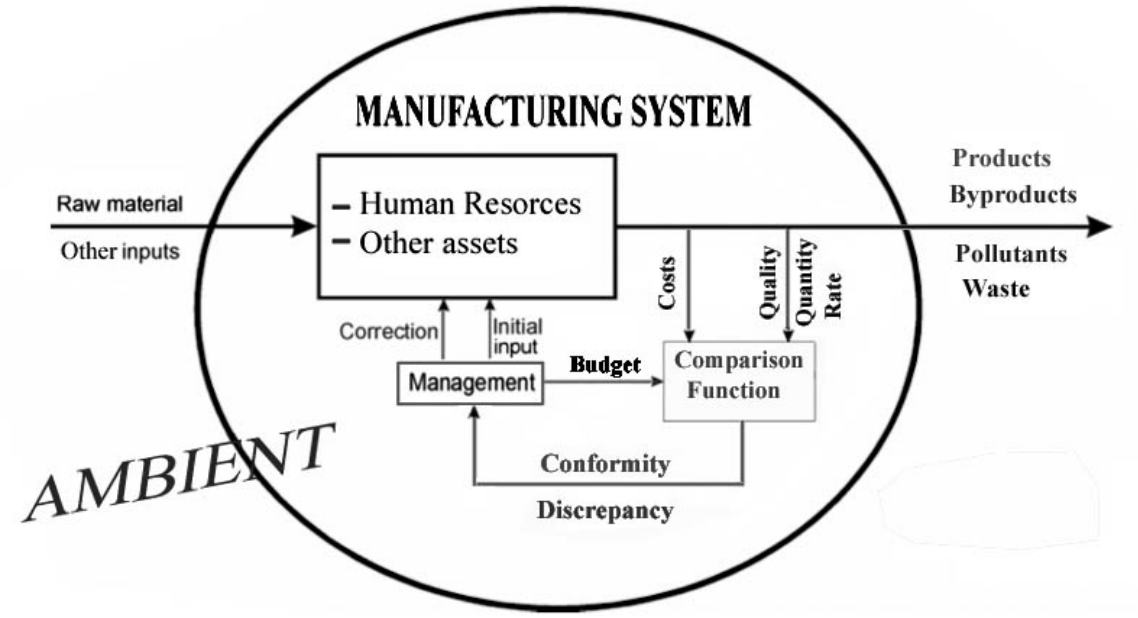

Figure 1. A Simplified Model of an Industrial System [2].

Table 1: Components of an Industrial Info System

MANAGEMENT	Human Resource Management	Info (Documentation)	Examples of info (documentation) in Maintenance Management
Human Resources	Recruitment	List of employees	Equipment failure report
Planning	Training	Company mission statement	Maintenance work order & report
Production	Health, Safety and Security	Instruction manuals re safety, health, security and other procedures	Work sampling observation record
Maintenance	Etc.	Company budget	Tool/material acquisition
Finances		Specification of assets	Maintenance planning sheet
Etc.		Production process manuals	Maintenance budget and cost reports
		CAD documentation (Plant layouts, electrical, mechanical, civil and other schemes and drawings)	Gantt charts
		Inventory lists (asset data base)	Maintenance manuals
		Product catalogues	Illustrated part catalogues
		Standards and internal specifications	Technical drawings (CAD)
		Etc.	Etc.

Yet another approach is to map the hierarchy of functions. Two distinct levels of functions are:
1) Executive: Concerned with activities such as marketing, production, maintenance, transport
2) Managing: Concerned with business, controlling, planning, developing, publishing, personnel

The "systems hierarchy approach " is useful for modelling a company, the environment in which it operates, company sub-systems and their interaction.

The hierarchy of systems is one of the key concepts of 'general systems theory' and its applied branch — system engineering. A general hierarchy of socioeconomic systems is shown in Figure 2. Another key concept is holism — the system itself is best explained as a totality [5].

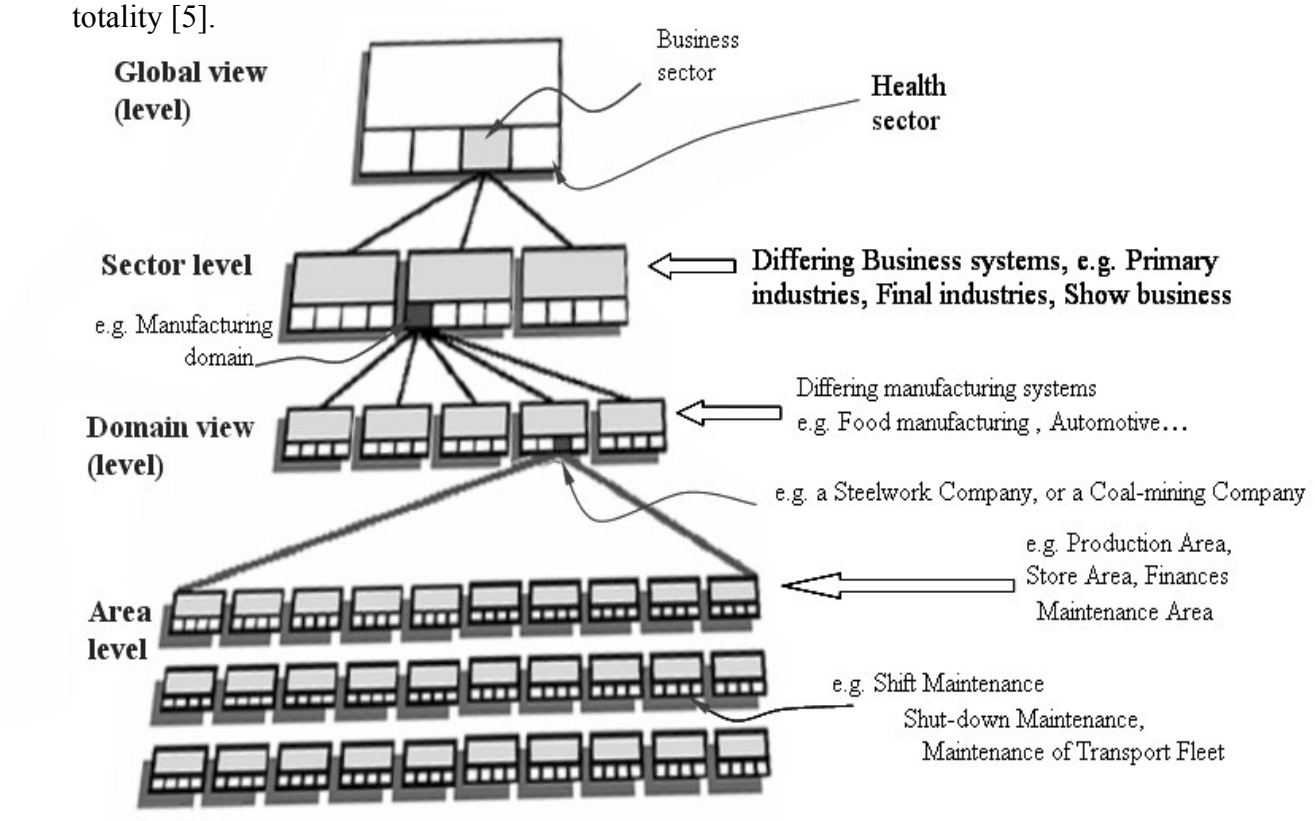

Figure 2. Hierarchy of Socioeconomic Establishments.

One way of explaining the system hierarchy is so-called top-down approach. The top-down method generates core processes from the strategic business fields. These processes, on the highest level of abstraction, are successively refined in the course of modelling. This is substantially the process of deduction (reasoning and drawing notions starting from general level towards the 'lower' particular levels). The advantage of this method is that the developed business processes are well aligned with strategic viewpoints. Figure 3 presents hierarchy of information applicable to a manufacturing system [7].

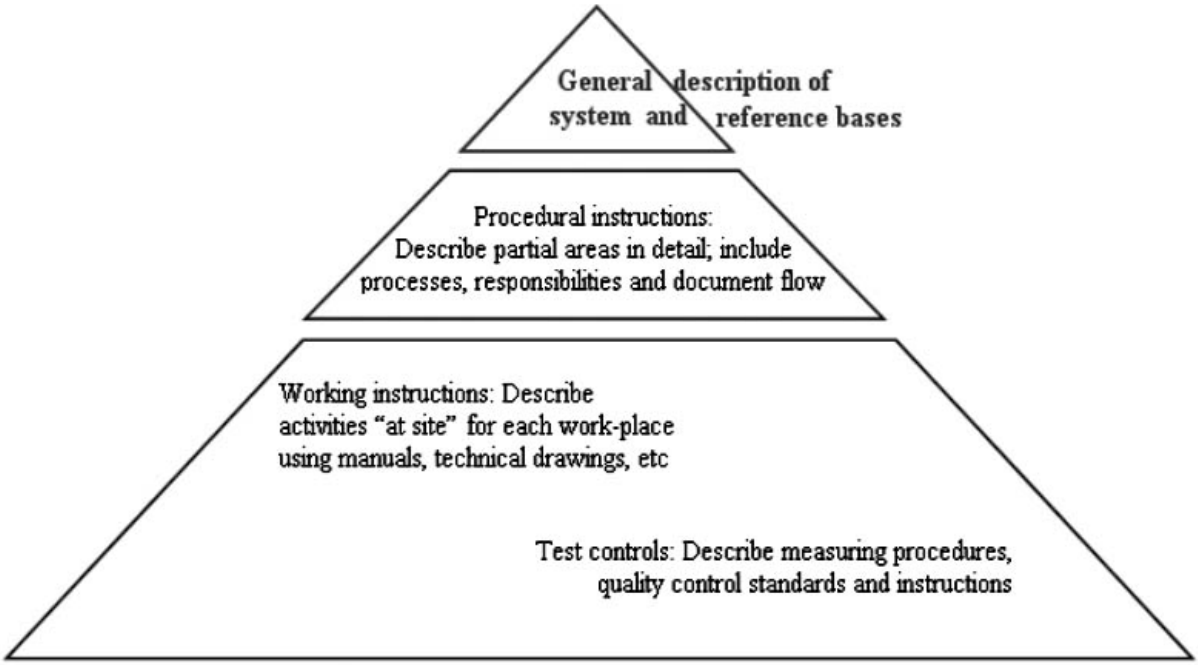

Figure 3. Hierarchy of Information Applicable to a Manufacturing System.

Maintenance Management System as a part of the company's information system is shown in Figure 4.

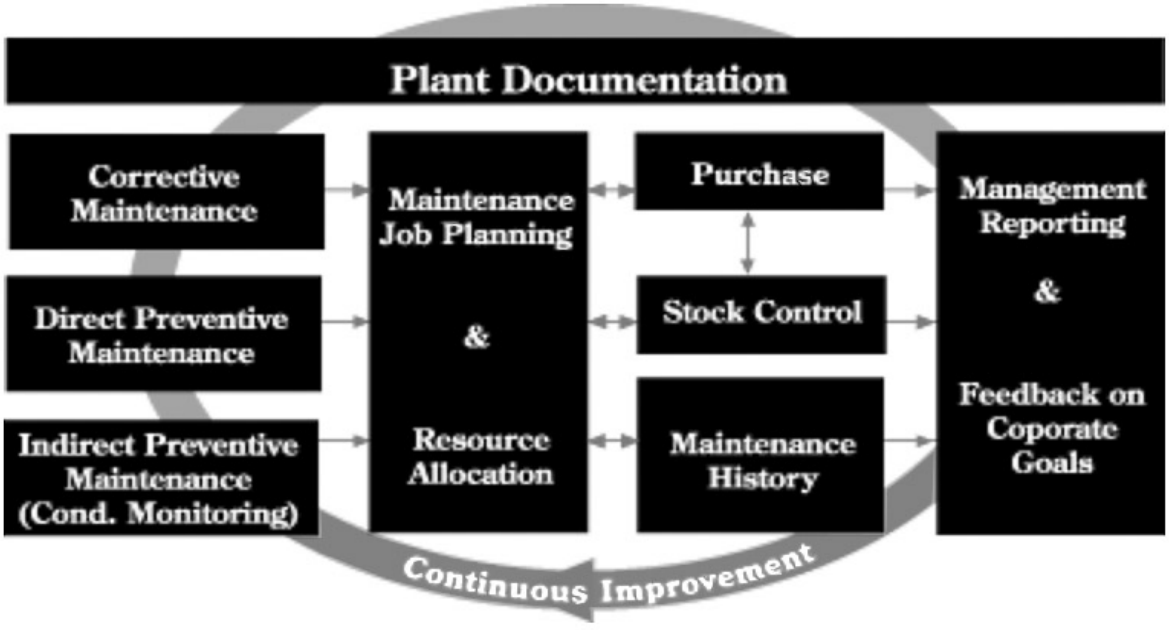

Figure 4: An Example of Integrated Scheme of the Maintenance Informatics [6].

Figures 1 to 4 are designed and intended to enable understanding of maintenance informatics and other maintenance systems. Although a conscious attempt was made to present a holistic, integral and logistic features of introduced systems, it should be noted that each of above

schematics could be designed using another set of lines, colours and geometric features. In other words, differing intellectual approaches can be used and we cannot state that one method is better than the other since the criteria for ranking these differing figures are by no means formally defined. However, more formal graphic (diagrammatic) presentations of systems do exist indeed, such as Critical Path Diagrams, Gantt Charts and Flow Charts.

3. SUMMARY OF INTERACTION BETWEEN MAINTENANCE AND INFO SYSTEM

Figures 4-6 illustrate interactions between the components of maintenance informatics and other components of the maintenance system such as planning, stock (inventory) control, drawing & alphanumerical database, shutdown operations, inspection, shift maintenance crew etc).

Maintenance info records may be classified as follows:
♠ Maintenance planning evidence
♠ Maintenance budgetary control evidence
♠ Maintenance performance and plant reliability measurement and control
♠ Inventory control and evidence
♠ Maintenance work realisation, documentation and info distribution.

These subsystems can be organised to function within real-frame levels, for example as follows:
♣ First line maintenance that is performed on-site by the shift crew, without delays; this type of maintenance is remedy for smaller failures or malfunctions.
♣ Second line maintenance performed during week-ends, or in the case of continuous operations, during the dedicated, but short delays in production; this maintenance can be preformed on passive segments of the operation lines, while other segments of operations are active.
♣ Third line maintenance includes major overhauls and repairs planned within periodic planned shut-downs in production; this systematic maintenance often includes preventive actions and can be scheduled once or several times per year.

Info (documentation) flow that accompanies the flow of maintenance services and physical product is considered to be the key factor for successful maintenance management. The typical number of documents for maintenance work ranges from 3 to 7, but the number can climb to more than 20. Documentation is a form of control necessary to ensure that goods are not shipped without regard to their being paid for. Electronic data interchange is often used in place of paper for the documentation process. Info systems enable organisations implement their strategy to decrease downtime and increase the utilisation of their maintenance resources, and can be viewed as a communication tool to help make better decisions. Maintenance personnel need to access information and work orders in a number of ways — depending on both the category of maintenance-subsystem and on the real time application that needs to be performed.

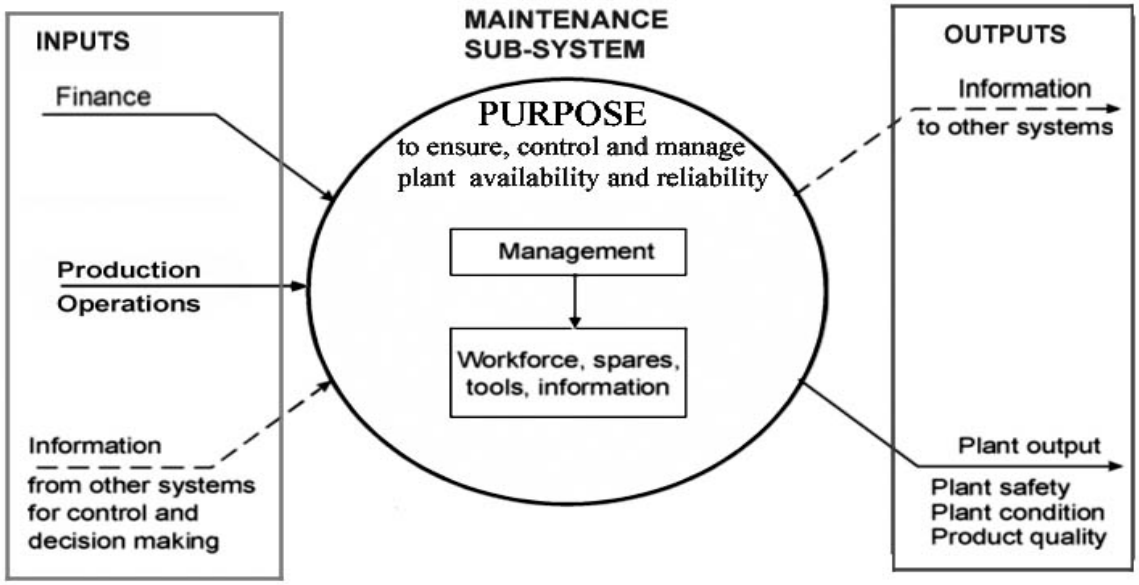

Figure 5. A Model of the Maintenance Sub-Systems Interactions [2].

Maintenance system would collapse without functions, regulations, measurements and evidence such as planning, control and documentation. Bearing in mind that an industrial system is a premeditated enterprise conducted with aspirations to optimise its function, its maintenance cannot be consigned to chaotic judgments or purely reactive sustenance and repair. What you cannot not measure and record you cannot control.

Info systems are essential to enterprise asset management and reliability strategies irrespective of plant size. Maintenance info systems can be organised on various platforms (e.g. using mainframe, client/server, single client, or browser-based applications). Smaller, stand-alone systems can be run on a personal computer or local area networks. Because of nowadays rapid development of artificial intelligence aids, some powerful computerised info systems can run on a single personal computer or on networked computers without the central server; the dividing line between small and large systems has blurred.

In summary, Maintenance Management info system is needed to provide detailed statistics on maintenance activities in order to accomplish the following:

♠ Provide data on work load and cost of maintenance activities to support budgeting and planning efforts
♠ Provide data and tools for analysing maintenance activities so that all operational functions can be performed and improved
♠ Document the maintenance work accomplished in order to support the maintenance control
♠ Maintain the evidence and communicate data and inferences to disseminate vital information.

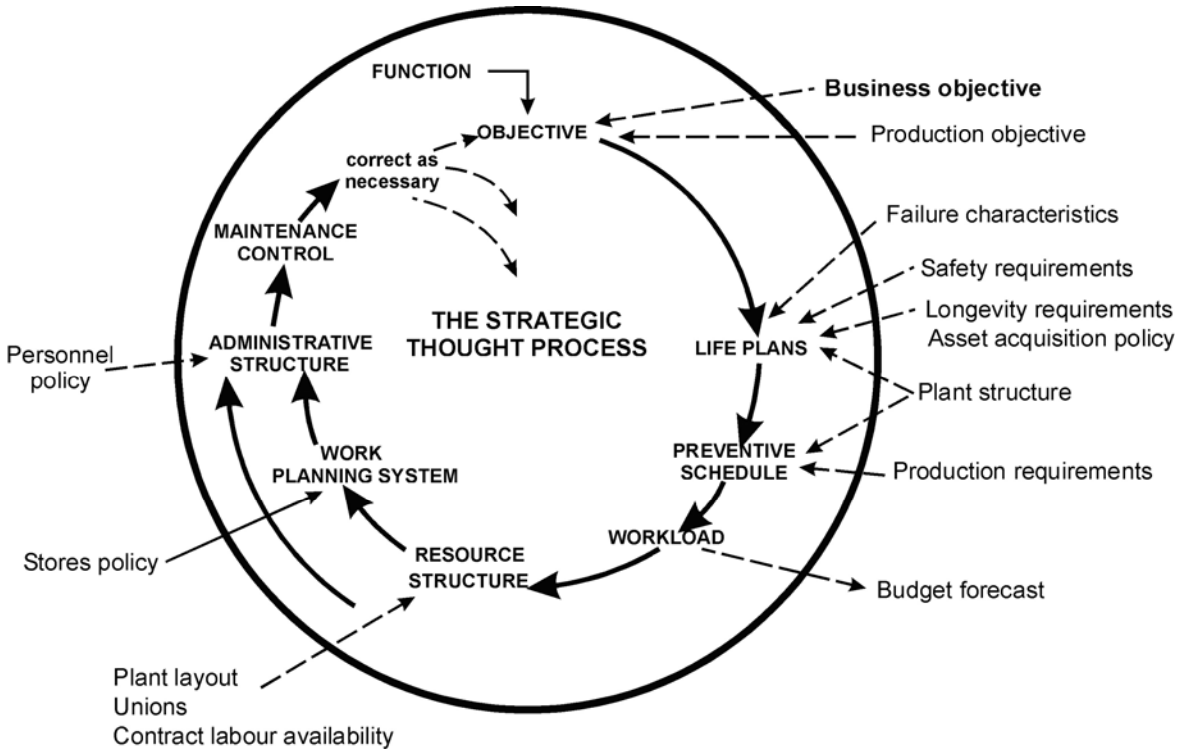

Figure 6. Scheme of Interaction of Maintenance Functions and Informatics [1].

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