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SEARCH FOR QUALITY IN BIOSYSTEM ENGINEERING

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Abstract: *Today, engineering has become a disciplined field. The demand in food products caused the agricultural engineers to consider the matter in a different way. This consideration led the engineer to resolve the biological issues together with electronic and information disciplines and also advanced control, advanced technological materials and developed sensor systems. The subject has persuaded them to design solutions for problems related with living things and their environment. Bio-system engineering which has been developed for this purpose has become the application of technical knowledge aiming to fulfill the human requirements. The pursuit of bio-system engineering discipline are automation, new developed technologies, information technologies and human interaction, sensitive agriculture techniques, power and work machines, product technologies after harvest, structures and relation with environment, animal production technology, soil and water sources, rural development and planning. Bio-system engineering which covers such a wide area should reach the solution by using its system engineering feature first and then determine the process parameters of the subjects that it resolves. Therefore it has to attribute the reason – result relation in every stage to quality parameters. Therefore, in this announcement, the quality issues necessary for explaining the subjects dealt in bio-system engineering basis are examined one by one and solution models are created depending on these issues.*

Keywords: *Quality, biosystem, engineering*

1. INTRODUCTION

Bio-system engineering is the in-depth application of engineering and science to biological systems and processes. Within the fields of application, there are agriculture, environment, cultivation, food and health related industries. An engineering field covering such a wide scope has to take quality realities into consideration in order to be successful in its applications. Generally below subjects are the area of interest of bio-system engineering.

1. *Automation and developing technologies* (intelligent machines, automatic control conveying systems, location positioning, image analysis, image processing, biosensors, sensor connection and engineering in biotechnology)
2. *IT and Human Interaction* (communication and data protocols, ergonomic geography information systems (CBS), operational research, bio-system modeling and decision support, machinery industry, risk and environmental effect assessment, operator health and security, work science)
3. *Precision Farming Techniques* (agricultural meteorology, food, fiber and feed plant production, bio-production under satellite surveillance, product, foreign grass and soil mapping, geographical positioning systems (GPS), input decreasing, total struggling management)
4. *Power and Work Machines* (soil processing tools and machines, construction machines, planting, maintenance harvesting and plant protection machines, tractors and other agricultural tools, dynamic, vibration and noise, forest engineering (machines), hydraulic and turbo machines, cleaning technology)

5. *Product After Harvest Technologies* (properties of biomaterials, product drying, processing and storing technologies, optoelectronic classification, maturity and quality determination systems, damage and disease diagnosis depending on optical reflection, nuclear magnetic resonance (NMR) and tomography with x-ray, food packaging and processing technologies, integrity of food chain and foreign object sensing)
6. *Structures and Environmental Relations* (building design and surrounding control, animal shelters, dust and odor surveillance, product storages, vegetative production green houses, assessment of organic fertilizers and wastes)
7. *Animal Production Technology* (the health of farm animals and ethnology, imaging, robot usage in milking, slaughtering, etc.. operations, feed conveying, animal weight force, integrated species management, weighing, conveying and meat processing technologies)
8. *Soil and Water Sources* (properties and structure of soil, soil dynamic in soil processing, weight force and pressure, soil erosion control, water needs of plants, infiltration and carrying operations, irrigation and drainage, hydrology management of water sources, agriculture without soil) [1].

Engineering is the application of the technical knowledge for the purpose of fulfilling the human needs more properly. Therefore testing all applications to be made for quality will affect the system efficiency positively.

In this paper, bio-system subject has been explained by describing its main subtitles such as automation, information technologies and sensitive agriculture, the parameters required in means of quality and the processes made for achieving them.

2. QUALITY AND SOLUTIONS OF AUTOMATION APPLICATIONS IN BIO-SYSTEM STRUCTURES

Today, industrial applications appear with new requirements day by day. Processes that have become more complex and increasing application needs to reflect to industrial automation applications and direct companies to develop new solutions. A few years ago production responsible was interested in means of producing the product while today subjects appeared such as quality, traceability and production within standards. The production process becoming faster and more standard has also appeared as another requirement. Flexible processes are also a matter of demand in order to produce different products with the same machinery park. As a result, search has been initiated to find a solution for using the existing infrastructure more efficiently and without extra costs. The main subjects in these searches can be listed as follows:

- Gathering of quality control, traceability and process measurement data
- Short and long term reporting of production costs and analysis opportunities
- Short and long term reporting of energy consumption and analysis opportunities
- Better usage of production capacity by dynamic planning opportunities (production plan directing according to the results of stops in various points of production lines.)
- Easy access to all reports by the related staff working in bio-system structures

It is important to keep in mind that using standard and configurable components are basic issues for the persistence of the established system. In order to achieve this, layered software (Figure 1) like the one in the figure below can be developed in order to increase the chance of success in the automation applications of bio-system structures.

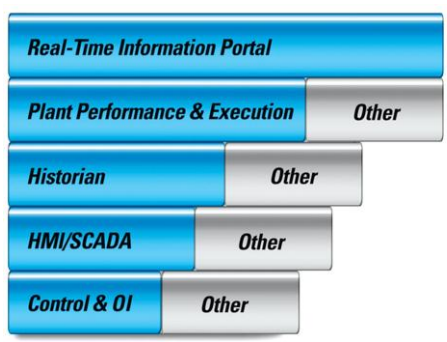

Figure 1: A layered software structure

In order to create an intelligent production plant, the data coming from different sources

should be gathered and be interpreted within a discipline such as efficiency, quality and production monitoring. The basic matter here is to be able to collect high amount of data coming from various sources into central data storage (historian) for long time intervals and be directed from there. This concept can be named as plant wide historian. These data may come from lab systems, machine controllers, process control systems, SCADA, DCS, analysis systems or various databases or may be entered by operators manually in certain stages.

While developing production application system software suitable to bio-system structures, the historian module can be used as plant data storage and a scaleable process database can be obtained according to the size of the data to be stored. Thanks to the internal time labeled storing, special filtering and zipping techniques, its performance is 10-100 times more than the relational databases. Historian can transfer the gathered and stored data to different application modules for converting into information, to portal software for display on the web, to ERP or to various information systems in the plant.

On the other hand, bio-system structure responsible persons know the real efficiency percentage of the production plant. Even if they know this value, they do not have enough information about the details of the factors causing efficiency losses. The value measuring the efficiency of the production is OEE (Overall Equipment Efficiency). OEE concept first came out in Japan semi-conductor industry in 1960's. Since then, OEE has been accepted by various industries in the world and has become a basic criterion for the melioration of the equipment usage. Using the correct OEE system provides rapid financial feedbacks [7].

Stop event analysis is the basis for OEE assessment and for the precautions to be taken for melioration. Production application system efficiency module, allows the user to monitor the stops instantly and historically, to examine the details of the stops, to find the reasons of malfunctions and to take meliorating precautions depending on these analyzes. Efficiency module also allows analyzes to be made such as equipment, staff, shift efficiency, shift MTBF and MTTR, product – machine relation.

Together with the regulation 178/2002 EC, the food production processes were taken under control in Europe starting from 01.01.2005. This control traceability is described as below and obliges the application: "Traceability should be achieved for all stages of production and distribution of food and food raw material containing animal product [2].

It is relatively easy to achieve the traceability of the product produced in single line. In systems where raw material or semi-product converts into final product after certain stages, traceability becomes more complex. In order to achieve a complete traceability, all data in these stages should be recorded and correlated professionally. These data are parameters such as temperature, pressure, weight, alarm information, values entered by the operators, analysis values entered by the laboratorians, automatic data coming from quality systems. Besides, serial/lot nr, recipe information, equipment information are also in the traceability system.

As the result, all final products are correlated with all the data starting from the first stage, alarm information and quality parameters and the final product can be matched with a report containing all these information. Traceability is used to reach the source, process and arrival information of a product after it is produced. Processes generally consist of consecutive stages. Data related with the product in all stages are recorded. The raw material used in a final product can be determined this way.

3. IT IN BIO-SYSTEM STRUCTURES AND QUALITY AND SOLUTIONS IN HUMAN INTERACTIONS

IT is described as production, processing, storing of the information, tools used for transferring it and the decision process of these tolls in the organization and its effect on other processes. It is foreseen that organizations must manage technology as well as employees having a certain working life quality in order to maintain their existences.

The relation between these two concepts and how it is going to be emphasized for an organization, is closely related with the management approach and understanding of the

organization. The quality and level of the IT in an organization shape the working style and management environment in the organization. Therefore, the effect of IT on working life quality occurs through various management elements. Quality of working life (QWL) is described as the quality of the relation between the work and the worker including the technical, economical and human dimensions [6].

When the researches made about the effect of IT on the organization and workers are examined, it can be seen that starting from 1980's, the effect of IT on efficiency is especially examined. Another change related with the organization is re-designing the work processes and relevantly increasing work satisfaction together with the decreasing work load and stress. A more detailed model can be created from these basic approaches. (Figure 2).

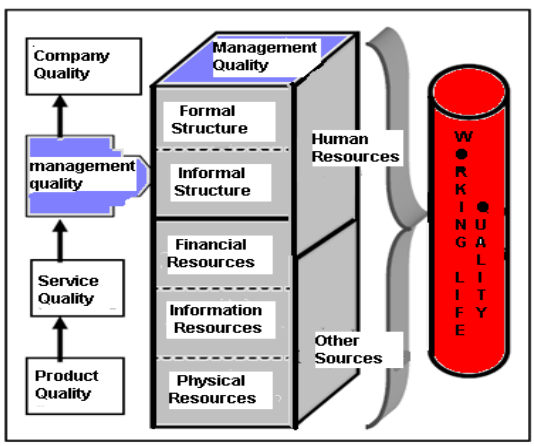

Figure 2: Passing from management quality to life quality

By the model created under the scope of analytical hierarchic process, it is possible to research the effect of IT on working life quality through the sources and elements that are mentioned by the management. Decision makers can first think about the effect of IT on the various dimensions of management quality parameters and then the working life parameters. Generally the results depending on this model in bio-system structures suggest that the working life quality of every individual in the production facility is affected by IT. Moreover, there is no similarity between production plants selecting similar working life quality parameter. However, generally looking in all plants, among the working life quality dimensions affected by IT, only social integration to organization is related with the product type and quantity in the plants [5].

4. QUALITY AND SOLUTIONS IN SENSITIVE AGRICULTURE TECHNIQUES

Although agriculture stayed out of IT sector in many countries for long, in developed countries it is facing a serious evolution allowing quality and efficiency increase in production which is sensitive towards human, plant, animal and environment.

Precision Farming which is considered as the continuity of the transition process in agricultural production from human power to animal power and then to tractor power, expresses the usage of developing technologies of information era, in production activities integrated with economy and environment. Although producers know that they will have different amount of product from different parts of their farms or they have different masses of soils in their farms, they are fully aware that it is not practically and economically possible to behave according to this information. Therefore, the aim is to distribute the required fertilizer and medicines to the farm homogenously no matter how big the farm is. However, in the last 15-20 years, the sustainable farming concept which came out according to the protection of environment and natural resources emphasizes that these inputs should be used in smaller amounts and more carefully. It can be said that precision farming will be able to fulfill these necessities in agricultural production. In recent years, economical and legal obligations and increasing public sensitivity against environmental pollution are factors persuading the input usage to be decreased in agricultural production (Figure 3) [3].

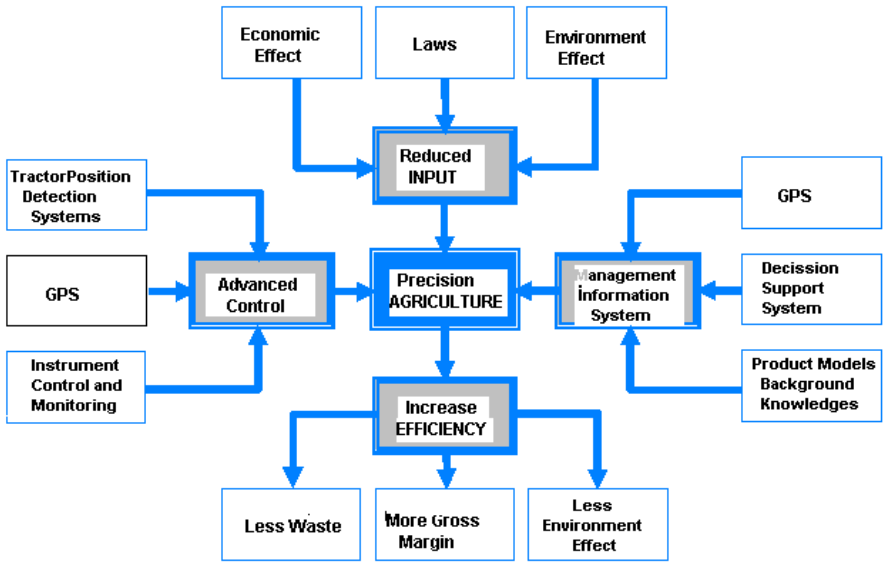

Figure 3: Elements and interactions forming precision farming

Thanks to the satellite technology which was initially used for military purposes but later started serving to civilian sectors, important developments took place in controlling of mechanical systems (vehicle position determination, geographic information systems and automatic control and tracking of vehicles) which led their usage in bio-system structures as well. These systems will be used in all areas where economical and environmental concerns are present in agricultural production. Together with the usage of IT in this area, soil mapping, yield mapping, tractors having agricultural bus systems, GPS based measurement systems and etc. application technologies will be used much more in bio-system structures [4].

5. CONCLUSION

Bio-system engineering, basis of which depends on fulfilling the human needs, has started to concentrate on other dimensions today, together with the support of technology. As a natural result of this, the quality parameters of the obtained products are meliorating. This situation is for the good of humanity. However, it is our wish that technological applications do not threaten natural environment. Therefore the used technology should be controllable. Bio-system engineering is believed to make important contributions to the benefit of humanity by the new systems coming out depending on the quality and efficiency parameters [8].

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