

APPLICATION OF SYSTEM ANALYSIS IN ORDER TO MONITOR GRAIN SILOS

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Abstract: After a presentation of the management of grain silos, we present the necessity of the system analysis and the identification of information in grain silos based on the OOPP method (Objectives Oriented Project Planning). This kind of analysis enables an efficient management and monitoring of the activities of grain silos. In fact, the OOPP method constitutes a tool of a global system modeling that allows us to analyze a difficult situation by a hierarchically decomposition until attainment a basic level allowing to an operational planning. Then, the aim of this paper is the application of the OOPP method to the analysis of grain silos which enables us to contribute to the development and deployment of an Information System and monitoring of grain storage.

Keywords: System analysis, monitoring, information system, grain silos.

1. INTRODUCTION

Agriculture has been one of the main occupations of man since early civilizations and even today manual interventions in farming and storing grains are assured. In most countries' grains are among the most important staple foods.

In fact, grain storage facilities acquire many forms depending on the quantity of grain to be stored, the use of storage, and the place of the store. The grain storage chain is an important element for incrementing the agricultural production and to preserve them in ideal technical condition [1, 2].

Grain storage occupies a very important role in the economies of developed and developing countries. Indeed, a country alimentary security needs an efficient management of basic food resources that are essential for the balance of its equilibrium socio-economic system [3]. This management depends on the global environment constituted by the production, consumption and transformation system [4].

The management of grain resources in a country must be efficient and the transactions between grain purveyor (farmers producers, importation, stokers at a delivery) and clients (farmers for seed, stokers at a conservation, millers, transformation industry must be excised by a coherent and objective process based on the grain grading system [5, 6].

The object of this paper is to present an application of the OOPP method (Objectives Oriented Project Planning) to the management activities of grain silos in order to contribute to the development and deployment of an Information System and the monitoring of grain storage.

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2. METHODOLOGICAL APPROACH

In order to analyze the complex activities of a grain silo, particularly the activities of the stock management we adopt a system approach allowing situating the entity in its intern or exterior environment. Then, we implement a codification for all centers in order to identify the different actors on the cereal storage system, private co-operatives, customers and millers [7, 8].

2.1. Presentation of systemic analysis

The systemic analysis belongs to a scientific trend that analysis the elements of a difficult process as a part of a set where they are in a mutual dependence relation. Its study field is not limited to the mechanization of the thought: the systemic analysis is a methodology that organizes the information in order to optimize an action [9].

The major objective of the system approach is to schematize all complex sets, lead to a modeling that allows to have a result on it, after the comprehensiveness of its materiel configuration and its dynamic organization [10].

The systemic analysis of a production system has an assignment to describe the global strategy of the modeling study to realize. This strategy must enables to fix with a precise making the limits of the modeling by defining the frontiers of the system to model and to specify between the data that are really exchanged between the different component of the production system and those that the modeling study will cover [11, 12].

The diverse tools of the systemic analysis assume a hierarchic analysis approach and allow answering to the pertinent questions in order to manage a Project: What? How? Why? When? Where?

According to the method and the used tool, other parameters are defined like performance indicators.

Several diverse approaches are in use to describe the strategic objectives some of the more well know ones are OOPP (Figure 1) [13, 14].

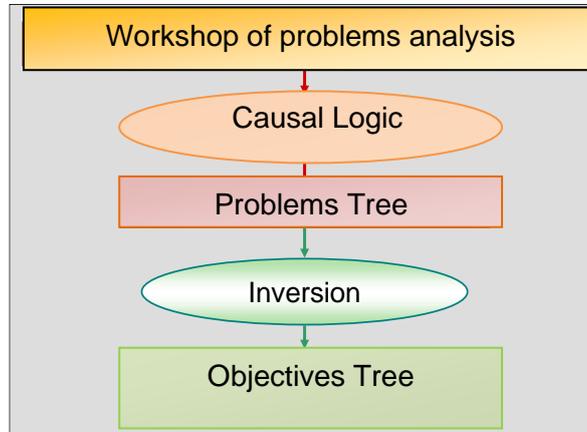


Fig. 1. OOPP method.

The LFA (Logical Framework Approach) is referred to OOPP in German, ZOPP (Ziel Orientierte Projek Planung) and in Word Bank as Team Up [15, 16]. This approach is a structured meeting process. This approach seeks to recognize the major current problems using cause-effect analysis and search for the best strategy to alleviate those identified problems [17, 18].

2.2. SCADA and PLC

The grain storage technique is of great importance in Tunisia. In this part, we present a proposal of an automated system for the controlling and monitoring of the grain storage using Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) [19, 20]. In fact, the main parameter that is essential for proper storage of grains is temperature which is taken as input parameter to be controlled using PLC and is measured using a temperature sensor. The SCADA system acquires the necessary data and monitors the overall process. Then, all operational functions (various grain handling equipment of conveying, cleaning, weighing, ventilating...) are carried out by SCADA user's operation and monitoring configuration interface [21, 22].

A Programmable Logic Controller (PLC) is a digital computer which performs the control logic, sequencing, timing, arithmetic data manipulation and counting functions. The PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. CPU is the brain of the PLC, it consists of microprocessor for implementing the logic and for controlling the communication among the modules. Memory unit is used for storing results of logical operations performed by the processor. IO section consists of input modules and output modules. This system forms the interface by which field devices are connected to the controller [23, 24]. The programming device enters the desired program into the memory of the processor. The power supply supplies DC power to the modules. Ladder logic is the programming language that is primarily used to develop software for PLCs. It represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware [25, 28].

The term SCADA (Supervisory Control and Data Acquisition) usually refers to centralized systems which monitor and control entire sites, or complexes of systems spread out over large areas. A human machine interface or HMI is the apparatus which presents process data to a human operator, and through which the human operator controls the process [29]. An HMI is usually linked to the SCADA system's databases and software programs, to provide trending, diagnostic data, and management information such as scheduled maintenance procedures, logistic information, detailed schematics for a particular sensor or machine, and expert-system troubleshooting guides (Figure 1) [30].

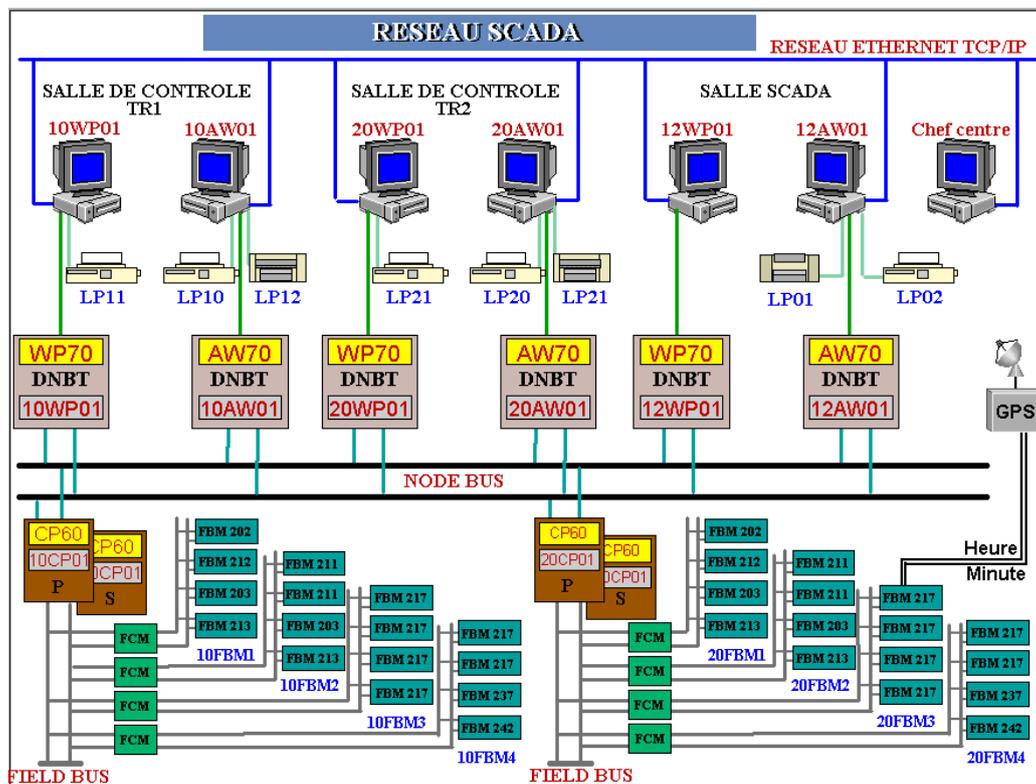


Fig. 2. SCADA network.

3. RESULTS OF SYSTEM ANALYSIS AND DISCUSSION

In this part, the results of the application of system analysis and discussion based on the OOPP analysis are presented.

Table1 presents the details of application of the OOPP method in order to contribute to the development and deployment of an Information System in a grain silo and the monitoring of grain storage.

Tables 2 and 3 present the details of the information relative to grains at the reception and the expedition. This analysis enables us to monitor the grain silo at the reception and the expedition.

Table 1. OOPP analysis of a grain silo.

N°	Code	Activity
1	GO	Application of system approach in order to implant an Information System in a grain silo and the monitoring of grain storage
2	OS1	Analysis of systems posts harvests of grains assured
3	R1.1	Analysis of the food security of grains assured
4	R1.2	Analysis of the sector of grains assured
5	R1.3	Analysis of the production and of the utilization of the grains assured
6	R1.4	Analysis of imports of grains assured
7	R1.5	Analysis of the merchandising of the grains assured
8	R1.6	Analysis of the system of grains assured
9	OS2	Upgrading of a grain silo assured
10	R2.1	General context of the project of upgrading defined
11	R2.2	Methodological gait of the project of upgrading of a grain silo adopted
12	R2.3	Results of the systemic analysis of a grain silo identified
13	R2.4	Matrix of ties between functions of a silo of storage elaborated
14	OS3	Analysis of the valuation system of the quality of the grains assured
15	R3.1	Analysis of valuation systems of the quality in producers' countries assured
16	R3.2	Analysis of the valuation of the quality of cereals in Tunisia assured
17	R3.3	Analysis of the system of valuation of the quality of cereals in Tunisia assured
18	OS4	Proposal of a new system of valuation of quality of grains assured
19	R4.1	Modelling of the imprecision of the variable of grading system
20	R4.2	Systemic analysis of the grading system of grains assured
21	R4.3	Application of fuzzy logic techniques to the system of grain grading assured
22	R4.4	Correspondence between the different systems of quality valuation assured
23	OS5	Information System of a grain silo exploited
24	R5.1	Executive Logic of the Information System defined
25	R5.2	General methodology of the Information System adopted
26	R5.3	Specification of the Information System

Table 2. Identification of information in a grain silo at the reception.

N°	Code	Activity
1	R2.1	Registration of the information relative to grains at the reception
2	A2.1.1	To register the nature of the grains at the reception
3	A2.1.2	To register the origin of the grains at the reception
4	A2.1.3	To register the lot of the grains at the reception
5	A2.1.4	To register the N° of the order of the transfer of grains at the reception
6	A2.1.5	To affect the N° of the lot of grains at the reception
7	A2.1.6	To register the date of the reception of grains
8	A2.1.7	To register the quantity of the cereals at the reception of grains
9	A2.1.8	To register the mode of the reception of grains
10	A2.1.9	To register the N° of the voyage of lot of the cereals at the reception
11	A2.1.10	To register the quality of the cereals at the reception of grains
12	A2.1.11	To register the eventual anomalies detected and the corrective actions
13	A2.1.12	To register the reclamation at the reception of grains
14	A2.1.13	To establish the documents at the reception of grains

Table 3. Identification of information in a grain silo at the expedition.

N°	Code	Activity
1	R2.1	Registration of the information relative to grains at the expedition
2	A2.1.1	To register the nature of the grains at the expedition
3	A2.1.2	To register the origin of the grains at the expedition
4	A2.1.3	To register the lot of the grains at the expedition
5	A2.1.4	To register the N° of the order of the transfer of grains at the expedition
6	A2.1.5	To affect the N° of the lot of grains at the expedition
7	A2.1.6	To register the date of the expedition of grains
8	A2.1.7	To register the quantity of the cereals at the expedition of grains
9	A2.1.8	To register the mode of the expedition of grains
10	A2.1.9	To register the N° of the voyage of lot of the cereals at the expedition
11	A2.1.10	To register the quality of the cereals at the expedition of grains
12	A2.1.11	To register the eventual anomalies detected and the corrective actions
13	A2.1.12	To register the reclamation at the expedition of grains
14	A2.1.13	To establish the documents at the expedition of grains

4. DISCUSSION

The system analysis presented in this work enabled to the management and monitoring of grain silos. In fact, the global production of application of a systemic logic enabled to answer clearly to the questions « what ? » and « who ? », and allowed the establishment of the record post and the elaboration of the chart of a grain silo notably the specification of the responsible of the activities and their collaborators, and the answer to the question « how ? » led to the elaboration of the work procedures but the answer to the question « when ? » enabled to establish the planning of the actions and finally by answering to the question « where ? » we enabled to determine the frontiers post. The most important function that exists in the new structure, compared to that is in the application is the TQM function and IS.

Following the OOPP analysis, three Specific Objectives are recognized consequent to the activities of management of grain silo (Program of the movement of cereals established, Movement of the cereals registered, Reporting elaborated). This kind of analysis enables an efficient management and monitoring of the activities of the grain silo.

5. CONCLUSION

We presented in this paper the management, the control and the monitoring of grain silos while exploiting a system approach based on the Objectives Oriented Project Planning method. This approach allows us to analyze a complex situation and the identification of the information.

The result of this analysis allows us to contribute to the development and deployment of an Information System in the one hand and the monitoring and control of the grain storage on Programmable Logic Controller and Supervisory Control and Data Acquisition, on the other hand based.

Starting from this study of the methodology of analysis and monitoring of grain silos presented in this paper, we will extend strategy for system analysis and modeling of various physical parameters of grain silos.

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