

Review

Information analysis and geographic information system (GIS) exploitation in a grain silo

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Accepted 9 September, 2010

This paper presents on the one hand, the cereal activities in Tunisia and on the other hand, a systemic approach of analysis based on the objective oriented project planning (OOPP) method. The exploitation of the systemic approach enables us not only to analyze and to identify the information of the stock management in a grain silo but also to lead an efficient management of cereal transaction. In fact, the OOPP method constitutes a tool of a global systemic modelling enabling to analyze a complex situation by a hierarchically decomposition until reaching an elementary level of allowing an operational planning. This analysis enables us to identify the information needed for the deployment of a geographic information system (GIS) in Tunisia.

Key words: Cereal transaction, systemic analysis, objective oriented project planning method, geographic information system (GIS).

INTRODUCTION

The country alimentary security requires an efficient management of basic food resources that are necessary for the balance of its equilibrium socio-economic system. This management depends on the global environment constituted by the production, consumption and transformation system. Because of its geographic context, its climatic environment and its social tradition and culture, Tunisia with its alimentary tradition based particularly on the consumption of cereals, shows an important deficit of the national production and cereal consumption. In fact, the Office des Cereales represents the official organism of cereal commercialisation in Tunisia, it participate, with private co-operatives, at the harvest and the cereal storage. It possesses the monopoly in cereal importation that is intended to human consumption (Annabi, 1998).

The management of its cereal resources must be efficient and the transactions between the cereal purveyor (farmers producers, importation, stokers at a delivery) and the clients (farmers for seed, stokers at a conservation, millers, transformation industry must be excised by a coherent and objective process based on the cereal grading system. In fact, a performance of a production structure or a service depends particularly on the performance of its information system. A geographic information system (GIS) constitutes an essential element in a grain silo allowing an efficient management

of its stock. The object of this paper is to present in the one hand, the management of a stock in a grain silo exploiting a systemic approach based on a objective oriented project planning (OOPP) method (AGCD, 1991; Gu and Zhang, 1994) allowing to achieve a reliable information analysis and in the other hand we present the exploitation of a GIS in order to manage the activities of cereal transactions in Tunisia.

PRESENTATION OF SYSTEMIC ANALYSIS

In order to analyze the complex activities of a grain silo, particularly the management of the stock, we adopt a systemic logic that allowed the entity to be situated in its intern or exterior environment. In fact, the systemic analysis belongs to a scientific tendency that analysis the elements of a complex process as a component of a set where they are in a reciprocal dependence relation. Its study field is not limited to the mechanisation of the thought: the systemic analysis is a methodology that organise the knowledge in order to optimise an action (Lakhoua, 2009).

The main objective of the system-approach is to schematise all complex sets, leading to a modelling that enables it to be affected, after the comprehensiveness of its material configuration and its dynamic structure. The systemic analysis of a production system has a mission to define the general strategy of the modelling study to achieve (Landry and Banville, 2000). This strategy, with a precise making of the modelling limits, must enable its fixation by defining the frontiers of the system to model and specify the data that are

really exchanged between the different component of the production system and those that the modelling study will cover.

The different tools of the systemic analysis (AMS, Causal Analysis, SADT, and OOPP) adopt a hierarchic analysis approach and allowing answering to the pertinent questions in order to conduct a project: What? How? Why? When? Where? (Lakhoua, 2008).

According to the method and the used tool, other parameters can be defined like performance indicators. In order to offer a model of a management of a stock in a grain silo, we adopt the OOPP method. In fact, the OOPP method (AGCD, 1991; Peffers, 2005) constitutes a tool of a global systemic modelling that enables an analysis of a complex situation by a hierarchical decomposition until reaching an elementary level allowing an operational planning. This method, widely used in the planning of complex projects, involves many operators and partners.

In Tunisia, OOPP method was used in development projects financed by bilateral or multilateral co-operation mechanism (with Germany, Belgium, Canada, World bank), in upgrading of a different structures (Training and employment through MANFORME project, Organisation of the Tunis Mediterranean Games, 2001) and in restructuring private and public enterprises.

The two determining steps for the OOPP analysis are (Lakhoua et al., 2006):

1. The scheme of planning project (SPP) that consist in establishing a global diagnostic of a situation by elaborating a tree of problems using a causal logic and by transforming it to a tree of objectives.
2. The scheme of planning activity (SPA) that, according to a logic «Medium - Detailed» lead to an hierarchic analysis of the results to achieve.

In fact, these steps constitute a preliminary action for establishing a project that requires a global piloting and evaluation system (PES). The parameters defined of the SPA can be represented in a «Matrix of Activities» that comported: the number of the activity, the code of the activity, the designation of the activity, the responsible of the activity, the collaborators of the responsible, the objectively verifiable indicator (OVI), the verification source (VS), the necessary resources according to their categories: Infrastructure, human resources, equipment and consumables, logistic (energy, transport), informational resources.

RESULTS OF THE OOPP ANALYSIS

After an OOPP analysis, three specific objectives (SO) are identified corresponding to the activities of a grain silo (Program of the movement of the cereals established, movement of the cereals registered, reporting elaborated). The analysis of the SO lead to results (R), intermediary results (IR), activities (A), under-activity (UA) enabled to identify 291 activities (Table 1).

Analysis and deployment of a geographic information system (GIS)

Today, information at the moment has become a strategic weapon and its life has become very short. So, information system of an organisation must be reliable and quick, that is, it justifies the importance of an information tool (Ayari et al., 2001; Baazaoui et al., 2000; Bernhardsen, 1993). In fact, a GIS represents a group of information equipment, software and methodology for

keyboarding, storage and data exploitation, in which the majority is spatial referring, allowing a simulation of the process as a grain silo, a management and a decision help (Berry, 1993; Bolstad, 2005; Caloz and Collet, 1998; Chang, 2007). A GIS allows the representation and the analysis of all information with a geographic character. In that way, all the events are produced. As a matter of fact, it stores the world information like thematic leers that can be linked together with geography (Chesnais, 1998; Claramunt et al., 1997; CNT, 1998).

This concept, simple and powerful, shows the efficacy to solve many practical problems. The GIS exploit all the possibilities offered by data bases (request and static analysis) by a unique visualisation of them (Elangovan, 2006; Longley, 2005; Teoh, 2009; Tomlinson, 2005). We introduce the appropriate information of all the cereal storage centers. Figure 1 presents the process of cereals movement in Tunisia.

However, we classified information by entity of storage and indicated the identified entity;

1. Center: Center code (identified entity), city code, capacity, center type, substructure information, handling equipment information, weighing, thermometry and level measure equipment information, quantity stock information, quality stock information, spending information and personnel information,
2. Storage unity: Storage unity code (identified entity), center code, substructure information and stock information,
3. Storage cell: Storage cell code (identified entity), storage unity code, storage cell type, storage cell, ensiled produce and ensiled quantity,
4. Handling equipment: Handling equipment code (identified entity), center code, portico information (loading and unloading), weighing information and transport equipment information.

We represent with the GIS all the entities of a grain silo as a pendulum, a purifier, a hopper in bulk (wagon and truck), an electrical transformer post...

The list of data to the keyboard on the table of received cereal produces in a grain silo are: received share produce code, origin produce code, produce, origin produce, quantity produce, quality produce, storage cell code, date of reception and instant of reception.

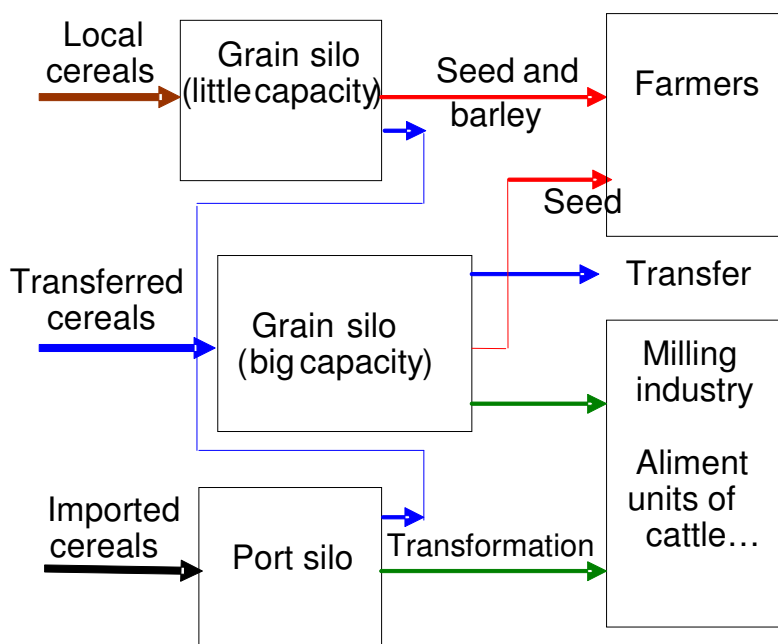
The list of data to keyboard on the table of expedited cereal produces of a grain silo are: expedited share produce code, produce, destination code, destination produce, quantity produce, quality produce, storage cell code, date of expedition and instant of expedition.

The execution of requests allows the search of a city capacity (Figure 2), substructure grain silo, cereal quality, cereal stock, cell stock (Figure 3) and length section during a cereal transfer from a center to another.

In order to represent with the GIS, the Office of des Céréales and the different road or railway sections permitting the determination of distances browsed by carriers

Table 1. Objective tree of a grain silo.

N°	Code	Activity
1	GO	Assurance of the stock management of a grain silo
2	SO1	Establishment of the program of the movement of the cereals
3	R1.1	Analysis of the program of the reception of cereals
4	R1.2	Analysis of the program of the expedition of the cereals
5	R1.3	Establishment of the program of the transfer of the cereals
6	R1.4	Determination of the operational program of the reception of the cereals
7	R1.5	Operational program of the expedition of the cereals determined
8	SO2	Movement of the cereals registered
9	R2.1	Registration of the information related to the reception of cereals
10	R2.2	Registration of the information related to the storage of cereals
11	R2.3	Registration of the information related to the expedition of cereals
12	SO3	Elaboration of the reporting
13	R3.1	Identification of the performance indicators
14	R3.2	Identification of the preventive objectives
15	R3.3	Identification of the objectives reached
16	R3.4	Assurance of the analysis of the gaps
17	R3.5	Assurance of the actions of improvement
18	R3.6	Edition of periodic activity documents

**Figure 1.** Diagram of cereal storage process.

carriers of cereals (trucks, wagons...) with the best precision, it is necessary to exploit the well stocked data by satellites (Figure 3).

We exploited the global positioning system (GPS) in the realization of the management project of cereal transfer activities. This is why we started precisely with

representing the different road sections and collected a maximum of data in different points. Then, we analysed the mass of information collected in order to determine costs of transfer of the cereals ton, notably.

We exploited the map info software to keyboard, manipulated and managed all cereal storage data, in

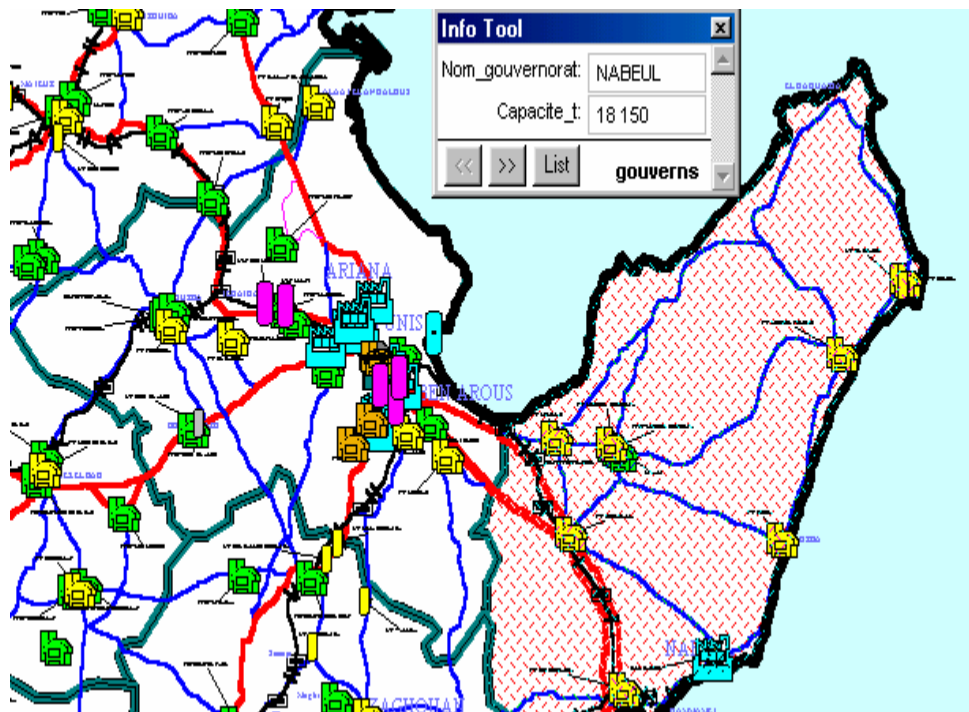


Figure 2. Using symbols with GIS.

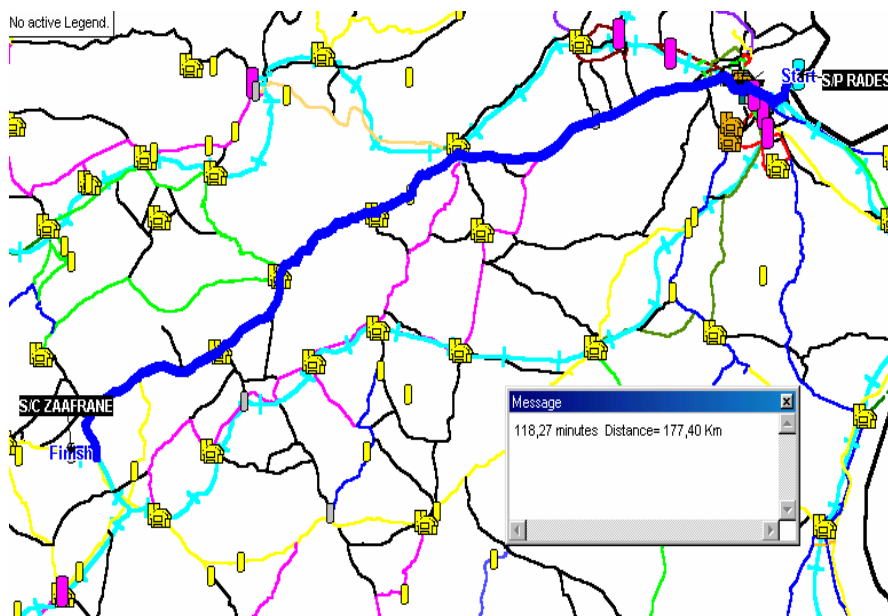


Figure 3. Example of cereal transfer.

order to conduct a query and analysis and display maps and graphs (Figure 4).

CONCLUSION

In this paper, we presented on the one hand, the cereal

storage system in Tunisia and on the other hand, an analysis of the management of a stock in a grain silo by exploiting the OOPP method.

The deployment of a GIS at the Office des Cereales in Tunisia enables the management of the cereals transactions. In fact, it enables the production of geographic maps, executes requests and geographic analysis and

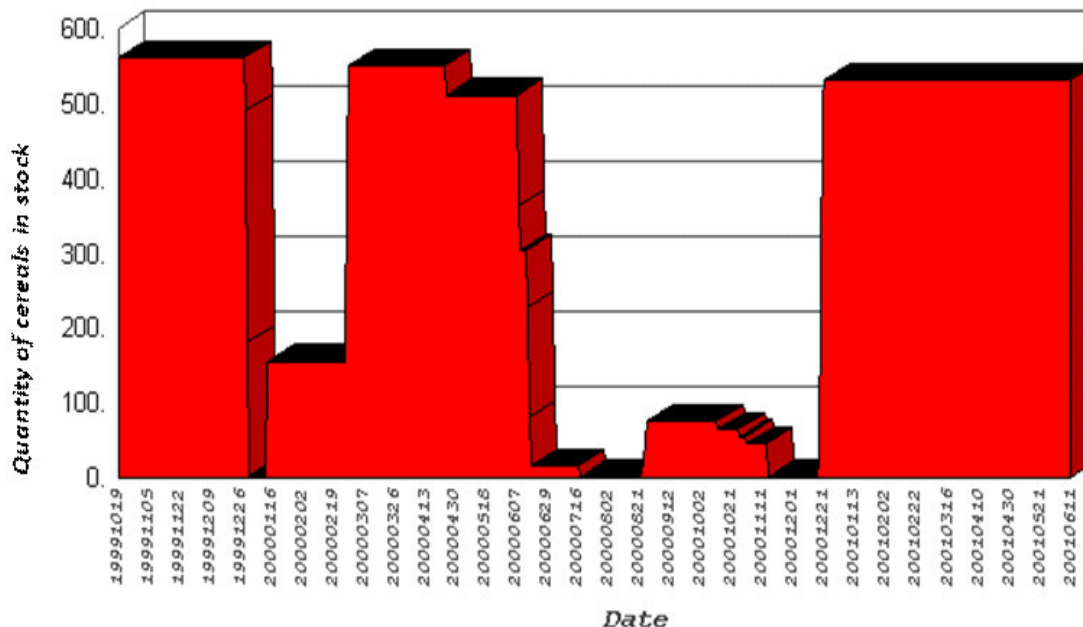


Figure 4. Evolution of the stock of cereals.

improves the organisation by tackling rapidly better decisions.

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