Decision Support System and Customer Relationship Management as Components of the Cybernetic System Enterprise

Ruxandra MISDOLEA
DEVOTEAM Consulting France, Paris
rmisdolea@aol.com

This study analyzes the role played by the information system and its component, the software system, in a larger system - the Enterprise. In this context, the paper focuses on the structure of Decision Support System and Customer Relationship Management and their benefits in the functioning of the global system, by examining the conditions of implementation of these tools in the organization. We will show that used independently these tools offer reduced services, but when interconnected, they become a very powerful tool for command and control. Viability, evolution and autonomy requested by users for their information system are obtained more easily by a systemic-cybernetic approach to the Enterprise.
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1 Introduction

Last few years the business of information technology has changed both in the sense of development of technology and in the vision of designing application architecture and platform, which represent the elements of a larger concept – Enterprise Architecture. It is possible to approach this subject from several perspectives. In this study we try to integrate it in a systemic vision of the organization.

A *system* can be defined as any collection of objects or processes between static and dynamic connections, used to achieve one or more objectives. In a systemic approach, the enterprise is a cybernetic system interacting with its environment.

The science of cybernetics, which emerged in 1948, following the publication by the American scientist Norbert Wiener of his study *Cybernetics, or control and communication in the animal and in the machine* [1], became a scientific discipline as well as a way of thinking and acting, an emblematic science of the twentieth century. Cyberneticians interested in economic development, have taken the concepts of system, status, command, regulatory mechanism, control mechanism and laws of evolution, and have applied them to the study of economic phenomena.

Systemic approach consists in working out models able to describe or simulate overall or partially the behavior of the studied systems. The concepts of system and model are closely related; according to J.-L. Le Moigne [3], "Modeling is a way of knowledge" and “can establish a correspondence between an object identified and a general system”.

The cybernetic system is one of the possible models for real systems. In this sense an Enterprise can be perceived as a cybernetic system at micro-economic level.

The concept of cybernetic system [2], as a model for the concept of real system, is defined by the following principles:

1. Principle of requisite variety [8]: In a system the variety of Output items can be modified only by an adequate amount of Input elements.
2. Principle of feedback [1]: A cybernetic system contains at least one closed circuit of reverse connections among its constitutive elements. This self-regulation mechanism allows the system to ensure its own survival and perpetuation in its operating environment.
3. Principle of synergy [7]: In a cybernetic system the effect obtained by the concomitant and interrelated functioning of system components is greater than the global effect of each component working separately.
4. Principle of the external complementarily: Any cybernetic system represents a constituent element (subsystem) of at least one feedback loop in a cybernetic superior system. In other words, any cybernetic system is a subsystem of a superior system.
5. Principle of the relationship between the entropy and the syntropy: In the cybernetic

system the informational syntropy[1] increases while the informational entropy[2] decreases. This phenomenon is due to the self-regulation and to the self-organization[3] [6] of the cybernetic system; those two processes make possible to maintain the degree of organization of the cybernetic system, as it accumulates and uses existing information.

According to the fourth principle, the principle of the external complementarily, any cybernetic system Enterprise is a subsystem of the economic cybernetic system of a country or of an area. As to the information system, it is a subsystem of the cybernetic system Enterprise. As a constituent element of the self-regulation feedback, the information system processes the data necessary to the host system to maintain its identity.

Running a business today is more competitive than ever. The Enterprise is confronted with complex problems and must have a very good knowledge of the environment in which it usually evolves. To solve all these problems, it is necessary to obtain technical, legal, tax, political or commercial information, which are specific to this environment. The Company must then be able to effectively use great quantities of information, in accordance with the first principle, the law of the requisite variety.

J.-L. Le Moigne, in his study about general system theory [3], defines the information system as "the connection system between the decision system (Système de Pilotage) and the operative system (Système Operant)" (see figure 1).

The *operative system* is the system where the transformations are carried out on technological flows which cross the company in order to generate value. It exchanges material and services flows with the system's external environment.

The *information system* and its component, the software system, represent the mechanism of the self-regulation and the self-organization of the cybernetic system Enterprise. It makes it possible to maintain the degree of organization on a certain level by the use of existing information at a given time, in accordance with the fifth principle, the principle of the relationship between the entropy and the syntropy.

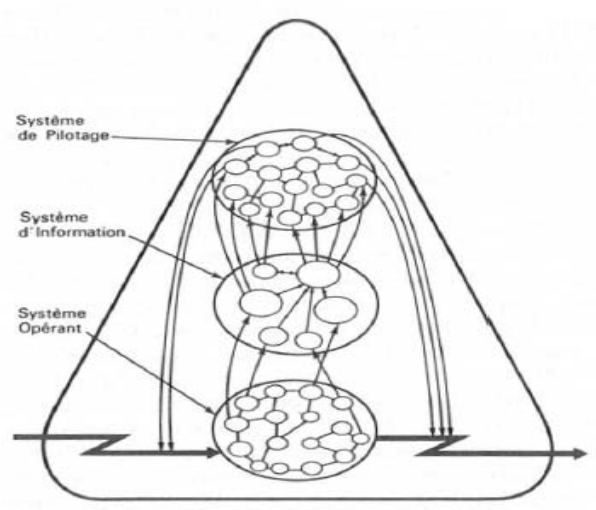

Fig. 1. The emergence of the processes coordination by the informational network, within the General System [3]

The *operative system* draws its objectives from the *decision system*; the decision system takes the decisions, assigns the needed resources to the *operative system*, carries out the necessary controls and imposes (or not) corrections (see figure 2). The *Inputs* contains all resources necessaries to operative system to work; the *Outputs* represent the goods and services created by the operative system.

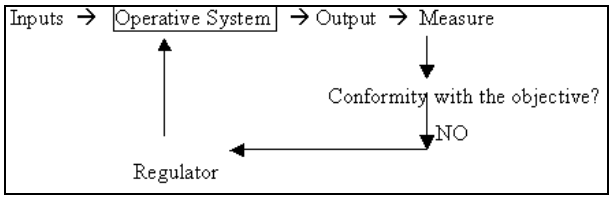

Fig. 2. The self-regulation mechanism of the Operative System

We can notice that when J.-L. Le Moigne studies the interaction between the information system and its environment, he studies in fact the second cybernetic principle, the principle of feedback.

In the vision of the Enterprise as a cybernetic system, the concepts *Decision Support System* (DSS) and *Customer Relationship Management* (CRM) take a central place in enterprise's mechanism of self-regulation. Data warehouses can work in conjunction with and, hence, enhance the value of operational business applications, notably customer relationship management systems.

DSS and CRM software are, technically, independents, but in practice these two concepts are dependent one to another and the

[1] The syntropy represents the tendency towards the order and the organization.

[2] The entropy represents the tendency towards the increase of the disorder degree

[3] Self-organization means that a system achieves its spatial structure and functions without specific interference from agents outside the system.

implementation of these specific tools is made at the same time; indeed they reflect different types of analysis of the company's knowledge and they are complementary.
These tools treat, in a pragmatic way, all the characteristics of information system, which are:

- Access to knowledge;
- Communication of knowledge;
- Use of knowledge;
- Representation of knowledge on all the organizational levels.

They belong to the *information system* and, from a functional point of view; they are the principal factor of feedback of the cybernetic system, as we will see now in the analysis of each of them.

2 Decision Support System

With the appearance and the development of new economic phenomena like diversification and globalization of world markets, the companies move in a more and more challenging environment. The result is that the strategic or political decision-making is increasingly complex (increase in the number of parameters to be taken into account). At the same time, the Enterprise must act quickly in order to maintain the lead position in its field.
New information technologies make possible to conceive particularly powerful and innovative information systems. All the users can reach strategic information by using the Info-centers and theirs tools. This enables the company to be more reactive; however this brings new issues like confidentiality or need of skills for analysis.
The Info-centers of the Eighties, which worked directly with operational data bases, had reached their limits in volume and quality of data processed, in the reduced capability of information analysis and the difficulty of usage for the decision-makers.
The Decision Support System (DSS) is a class of information systems (including but not limited to computerized systems) that support business and organizational decision-making activities. A combination of functional procedures and techniques allows the transformation of the operational data into information for end-users. This information can be explored, analyzed and put into reports which will help professionals to identify and solve problems and make decisions.
All those functions are performed through different types of DSS software:

- Data warehouse – repository of an organization's electronically stored data; historical, modified and aggregated data which represent the basic support of the DSS.
- Datamart – store of data targeted on one or more business subjects
- Datacube – three dimensional cubes of presentation of data
- Data mining – techniques to analyze the data in order to obtain "knowledge" models for the business user
- Datawebhouse or Dataweb – warehouse of data collected on the Web

These types of DDS software fit in the chain of the data implementation, according to its four fundamental functions: collection, integration, publication and presentation. A specific data model is created for each layer : integration model, publication model and presentation model.
The *collection* represents the provisioning of the DSS with the flow of data from operational data base system, to denormalized tables; often the DBMS[iv] systems, operational and decisional, are different (e.g., Sybase IQ, a DBMS dedicated to fast exploring of voluminous data base). In the "denormalization" approach, the data in the data warehouse are stored following, to a certain degree, database normalization rules. Tables are grouped together by subject areas that reflect general data categories (e.g., data on customers, products, finance, etc.). The main advantage of this approach is that it is straightforward to add information into the database. Specific tools allow to extract, to transform and to load data into the Datawarehouse. The most well-known Extraction, Transformation & Loading tools (ETLs) are Informatica, SunOpsis or Ascential.
A disadvantage of this data collection is that, because of the number of tables involved, it can be difficult for users both to:

- join data from different sources into meaningful information and then
- access the information without a precise understanding of the sources of data and of the data structure of the data warehouse.

That's why, in the second step, the *integration* makes it possible to build understandable information, at least on a captured data, for a specific business domain activity, and its provision in a single point (Datamart). The inputs files are the *collected* files and the outputs ones are the *integrated* files. The data are transformed by aggregation, conversion, standardization and addition of identifiers and are stored following an *integration model*.
The *publication* represents the data loading from

the centralized repository and deployed by line of business; the publication data model joins specifically information views, which are hold in a data following the *integration data model.* Usually it is a *star* or *snowflake* data model which generates the “facts", which are generally numeric transaction data, and the "dimensions", which are the reference information that gives context to the facts. The facts data base tables connected to multiple dimensions tables generate Datacubes (some OLAP[v] multidimensional database that use dimensional data marts as a data source). For example, a sales transaction can be broken up into facts such as the number of products ordered and the price paid for the products, and into dimensions such as order date, customer name, product number, order ship-to and bill-to locations, and salesperson responsible for receiving the order.

The engines OLAP of the Microsoft’s SQL Server, NCR, Oracle or Sybase are the most used tools today to generate Datacubes.

The *presentation* data model is a mask which covers the publication data, in order to facilitate the access to information for the end-users. It holds the catalogue and the queries to access data or usual reports. Some of the most used tools for reporting and analyzing data are Cognos (Impromptu and Power Play), Business Objects or Hyperion Solution.

This top-down design, in four layers (collection, integration, publication and presentation), has also proven to build a robust structure against business changes. The three data models don’t need changes when the structure of the operational data bases changes. Generating new dimensional data marts against the data stored in the data warehouse is a relatively simple task.

Some of the benefits that a DSS software provides are as follows:

- A data warehouse provides a common data model for all data of interest regardless of the data's source. This makes it easier to report and analyze information than it would be if multiple data models were used to retrieve information such as sales invoices, order receipts, general ledger charges, etc.
- Prior to loading data into the data warehouse, inconsistencies are identified and resolved. This greatly simplifies reporting and analysis.
- Information in the data warehouse is under the control of data warehouse users so that, even if the source system data is purged over time, the information in the warehouse can be stored safely for extended periods of time.
- Because they are separate from operational systems, data warehouses provide retrieval of data without slowing down operational systems.
- Data warehouses facilitate decision support system applications such as trend reports (e.g., the items with the most sales in a particular area within the last two years), exception reports, and reports that show actual performance versus goals.

In this global context, how the decision-making is organized in the company?

Since 1997, the expenditure in the field of the decision-making aid has increased approximately for 40%. Largely higher than that of the data-processing expenses, this progress illustrates, according to “Pierre Ardoin Consultants”[vi][4] (CAP), the increasing maturity of the companies in this sector. It succeeds their hesitations in the Eighties, whereas offers of info-centers were available. According to this adviser, this change has multiple reasons: more information to analyze in order to control the company, new technologies for data mining, query tools, data manipulation and extraction and powerful solutions for the data storage.

We should not forget the Internet, which makes the access to decisional application easier and makes possible the connection of thousands of users. Approximately 10% of queries on the data warehouses and others data marts are done using Internet.

The companies need to invest in infrastructure now. According to CAP, more than half of investments were on infrastructure. The rest went to tools (data feed, data extract, search engines) and software.

This last segment should enjoy the most interesting progression, with an average annual growth for 48%. This can call into question the classification of the editors, and the first places of specialists like Business Objects or Cognos.

The data warehouse helps the decision maker to work in an informational, homogenous and historical environment. Using data warehouse will avoid issues due to the heterogeneity of the software systems and due to the heterogeneity of the data business definitions resulting from the history of the organization.

Then the decisional applications will extract from the Data warehouse a partial knowledge of the company activity according to the criterion

[4] Pierre Ardoin Consultants is a French consultancy, of a certain notoriety, specialized in economic surveys.

selected by the decision maker, at a given time.
A major change is due to Internet. A concept that merges the Data warehouse and the Web is known as the *Dataweb*. The Dataweb contains the idea of an access to an universal data base whatever the platform of login, its location or the data format are. It is essential today to have access to internal data of the company, but also to the external data coming, for example, from the Internet. The Dataweb is accessible from an application available on all the machines, like an Internet navigator. The objective is to increase the quality of the decisions by improving the quality of basic information.
Moreover, the access to the Dataweb is possible from anywhere in the world; with his laptop, the user will be able to work anywhere like it does in his own office.

3 Customer Relationship Management

The enterprise's goal is to sell goods or services to its customers with the view to generate higher and higher profits. The Customer Relationship Management (CRM) involves this dynamic of growing the corporate profits, by selling more and better or by saving money in the wake of a better organization of the selling process. When an implementation is effective, people, processes and technology work in synergy to develop and strengthen relationships, to increase profitability and to reduce operational costs.
Once simply a label for a category of software tools, Customer Relationship Management has matured and broadened as a concept over the years; today, it generally denotes a company-wide business strategy embracing all customer-facing departments and even beyond. The CRM strategy helps companies to improve their relationships with customers, by capturing and analyzing customer information. This allows users to identify customers' purchasing behaviors and preferences in order to better serve their needs. The CRM software is constantly evolving along with newly defined CRM processes, providing greater insight into how to attract and retain customers.
Generally, the CRM uses the information lodged by Data warehouse. Everything concerning the relationship between the organization and its customers (phone call, visit, mail) will be memorized in the data base, so that the information becomes available for all users and is better employed.
From this computerization the possibility will rise, for all employees, to reach information, even in the absence of the customers/ sales prospects administrator (cases of holidays, disease, etc.). Consequently any person in the company will be able to find (according to his or her specific access rights!) the date of the next commercial agent's visit, even if the latter is not present in the company when the customer phones. Or, on the contrary, the assistant will be able to fix an appointment with a customer who wishes to see his sales representative, even in his absence. Moreover, the information of this follow-up makes it possible to generate statistics in a very short time (a few minutes for the most complex statistics).
CRM tools are characterized by common modules and the possibility, for the majority of them, of opening to the specific parameter setting with the intention of adapting to the company's trade. Consequently, an adequate CRM solution can be found for each company.
The common modules to the majority of CRM software are:

- Sales prospects & Customers file
- Diary of the sales engineers
- Daily report to management
- Commercial offer and estimation
- Mailing or E-Mailing modules
- Data base to duplicate for nomad user (sales representative)
- Various statistics on the data base (the number and quality differ according to the software solution)

The CRM software shares its architecture between the functionalities of "front office", which are visible by the users, and the functionalities of "back office" which carry out the calculation processing on the data stored in the data bases [9].
The "front office" activities involve:

- The sales force automation, for contacts, agenda and commercial activities managing. The system provides an array of capabilities to streamline all phases of the sales process, minimizing the time that the commercial agents need to spend on manual data entry and administration. The information can be available on mobile embedded devices (laptop, PDA, phones); it will be synchronized with the central data base information when salesman is back to the office. Newly-emerged priorities are modules for Web 2.0 e-commerce and pricing management.
- The marketing automation, which helps the enterprise to identify and target its best

customers and generate qualified leads for the sales team. This is possible thanks to the automation of marketing multichannel campaigns, including email, SMS, search, social media, and direct mail (commercial booklet distribution). Metrics monitored include clicks, responses, leads, deals, and revenue. These tools use customer information registered in the CRM's data base; they record the result and calculate the return of investment of each campaign. As marketing departments are increasingly obliged to demonstrate revenue impact, today's systems typically include performance management features for measuring the return of investment of campaigns.

- Customer service and support, or Call Center, which became possible with the development of intelligent call routing, Computer Telephone Integration (CTI). This offer has expanded considerably with new services distance selling products and services. Recognizing that customer service is an important differentiator, organizations are increasingly turning to technology platforms to help them improve their customers' experience while increasing efficiency and keeping a lid on costs.
- The Web site : more recently, the customer interaction has become personalized according to user profile (detected during the connection) in order to provide only the useful information. The tools memorize also the behavior of the customer and use it to fit better with his or her expectations. E-service capabilities, Web self-service, knowledge management, email response management, Web chat, collaborative browsing and virtual assistants are gaining in importance.

The "back office" activities are ensured by the analytical CRM, which concerns the strategic command and control of the company's activity.

Relevant analytics capabilities are often interwoven into applications for sales, marketing, and customer service. These features can be complemented and augmented with links to separate, purpose-built applications for analytics and business intelligence.

Sales analytics let companies monitor and understand customer actions and preferences, through sales forecasting, data quality management, and dashboards that graphically display Key Performance Indicators (KPIs).

They are based either on the analysis of historical Data warehouse data (which are supplied by the operational data) or on CRM own operational data bases, updated continuously by the commercial activity. It is the case of the operational indicators of the control provided at the direction's request. Finally, through data mining technologies, the companies can target better the commercial efforts, improve the quality of the services, satisfy and develop loyalty of their customers.

Web analytics have evolved significantly from their starting point of merely tracking mouse clicks on Web sites. By evaluating customer "buy signals," marketers can see which prospects are most likely to transact and also identify those who are bogged down in a sales process and need assistance. Marketing and finance personnel also use analytics to assess the value of multi-faceted programs as a whole.

Customer service analytics are increasing in popularity as companies demand greater visibility into the performance of call centers and other support channels, in order to correct problems before they affect customer satisfaction levels. Support-focused applications typically include dashboards similar to those for sales, plus capabilities to measure and analyze response times, service quality, agent performance, and the frequency of various customer issues.

Some of the most usual CRM software are Siebel, Selligent, Novacial. Actually the tendency is to include their functionalities into operational tools (ERP), e.g. Oracle or SAP market policy.

4 Interactions

The CRM is a tool associated with the DSS, but also with the Web and the Workflow[5]. Used independently these tools offer reduced services and even can generate faults and functioning problems. But when interconnected, they become a very powerful tool for command and control (according to the third cybernetic principle, the principle of synergy). An example is the order booking via Internet, without connection with the information about data warehouse's stock status. If the product is not available, the corporate could be discredited and it will lose customers. On the other hand, when Web is connected not only with the DSS but also with the CRM's information about the customer or prospect, about his past contacts with the corporate and his interests about

[5] Workflow: Company's computing system for work flows management which implies a limited number of people having to achieve tasks in a limited time, which are articulated around a definite procedure and having a total objective [5].

a line of products, the Internet agency will be able to propose some other articles. In this way it will sell more and better and it will attract and retain its customers.

It results that the DSS and the CRM are tools acting on all the levels of the company and bringing an added value to the strategic problems, as well as to the information management.

Many decisions concerning the improvement of the future company's activity are based on the customer's behavior, which is evaluated by the CRM functionalities; all analyses and reporting are based on historical data of Data warehouse; the forecast for goods production, purchasing and selling uses DSS information.

S. Brown [4] uses a metaphor to describe the interactions between the Data warehouse, the Web and the Workflow:

- The Data warehouse is the brain and the central nervous system.
- The Web is the eyes, the ears and the mouth.
- The Workflow is the arms and the legs.

This metaphor points out the triad "Decision - Information - Operation" based on the hierarchy of the three systems established by J.-L. Le Moigne [3]:

- At the top, the decision system: decision-making body (the Data warehouse).
- In the middle, the information system: body of knowledge (the Web).
- At the bottom, the operating system: body of production (the Workflow).

5 Conclusions

The understanding of the role played by the information system and its component, the software system, in a larger system – the Enterprise, as well as the understanding of the phenomena of the information system evolution, leads towards a new approach of the information systems design. The *Decision Support System* and *Customer Relationship Management*, by their dynamics and flexibility, constitute the main part of the Enterprise's communication and self-regulation system. They allow a very good knowledge of the environment in which the company evolves and run its business and, therefore, the best reactivity.

Today the users want their information system to be viable, evolutionary and autonomous. All these requirements are implemented more easily by systemic-cybernetic approach to the Enterprise.

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Ruxandra MISDOLEA has graduated the Faculty of Cybernetics, Statistics and Economic Informatics from the Bucharest Academy of Economic Studies. She obtained her Master degree in 'Information & Knowledge Systems' at the Business Management Institute – University Paris 1 Panthéon – Sorbonne. Since 1981 she has worked in software engineering for major Rumanian and French companies. Currently she is IT Architect to Devoteam Consulting. Her competencies and fields of interest are the Enterprise Architecture methods and frameworks, Information Systems modeling, Requirements Engineering and Enterprise Knowledge Development.