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Contributions concerning an inventory decision support system conception, design and implementation

- Summary -

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Abstract

In view of current developments in the economy, the issue of decision making quality decisions to ensure the successful conduct of business of an enterprise is becoming increasingly difficult. To ensure this success, managers must be able to manage and exploit the large amount of data, information and knowledge coming both from own organization, and especially from the outside market, potential customers, competitors. Collection, processing and analysis of this information has exceeded far beyond human capacity, and therefore, the need for an information system for organizing data, extracting useful information and thus to obtain new knowledge and relevant decision-making process is evident

Keywords

decision, decision-maker, decision-making process, DSS, GDSS, prototyping, modeling, simulation, Monte Carlo.

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Introduction

Motivation and objectives

The successful management of work involves studying the reports not including large volumes of data, detailed uncorrelated. In the current environment, where decision must be made quickly, an advanced information system must provide data directly, quickly, synthetically relevant, but also include facilities for analysis and forecasting

To better meet the requirements of the decision, it is necessary to implement the organization of decision support systems (DSS) to assist management by harnessing this large and diverse data. Thus, changes in DSS was helped by the emergence and development of new technologies in the storage, processing and analyzing data and obtaining information necessary for the decision. This appeared successively data warehouse concepts ("data warehouse"), OLAP applications ("On-Line Analytical Processing"), and “Data Mining" and artificial intelligence technologies (expert systems and intelligent agents)

In this context, and in inventory management, problem solving increasingly complex involves decisions to be made with as much data available and information on the application whether it is direct when talking about goods, whether it is indirect when mention of products or services produced by the organization. effective stock management concerns so as to ensure a better balance between limited resources and the need to achieve a minimum cost regular supplies and stocks of raw materials necessary for the production process, i.e. the stock of products in selling goods.

The objectives are the scientific work and developing a framework for achieving a SSD in inventory management.

Therefore, in this paper we propose:

- presentation of the theoretical foundations of decision and decision making
- description of the evolution, characteristics, classifications, DSS components
- present the main components of Business Intelligence
- presentation of the theoretical foundations of inventory management and modelling
- design a general framework for the development of a DSS's inventory management and validation in a case study.

Summary description of the chapters

Corresponding to the objectives listed above, the paper includes four chapters.

Chapter 1 summarizes some theoretical aspects related to decision-makers and DSS.

Thus, in Section 1.1, we made an overview of the concepts of decision makers and decision making at both the individual and group as well as decision models. Also related to our topic, we emphasized the role of modelling in decision making, in the context of increasing environmental dynamicity.

In section 1.2, we highlighted the theoretical and practical context that led to the emergence and development that DSS needs, the role of these systems in the decision making process of an organization, architecture and the technologies behind them.

In section 1.3, I made a summary of the concepts of business intelligence and information technology (data warehouse, OLAP and "Data Mining"). We also describe how these technologies can be integrated into the SSD for improving the quality of decision making in our work.

In section 1.4, we presented the most known and used methodologies, models and techniques for designing, designing and implementing decision support systems highlighting the features, advantages and disadvantages of their use for the development of DSS's.

In Chapter 2, we presented the theoretical elements of inventory management and some ways of modelling future demand and hence the establishment of programs more efficient and effective supply.

In Chapter 3, we have designed and developed a framework for designing, modelling, design and implementation of DSS for stock management, based on the methodology "Unified Process", language UML modelling and prototyping techniques.

In Chapter 4, we developed a prototype of a DSS based on OLAP and Monte Carlo simulation to analyze sales and supply establishment of scenarios to a company that has as main activity is selling auto parts.

Chapter 5 presents the conclusions of this work, contributions, and concerns embodied in intermediate research works and development prospects in this direction.

1. Some aspects of decision support systems

1.1. Decision makers and decision making

1.1.1. Preliminary issues

The term can have several meanings decision:

- in a single reaction to economic decisions
- the basic mental acts to complex processes of deliberation and choice
- from individual work to that of collective (group decision).

Decisions require a rational choice among several options, they form part of our everyday life. There are two major categories of decisions:

- related personal existential needs for continuous improvement etc
- economic: the asking price for a product, an investment fund etc.

Henceforth, the term "decision" we refer to the economic decisions.

1.1.2. Defining of the decision

The decision is the choice of courses of action to achieve goals, the application of which has an impact on the actions and behaviour of at least one other person.

Managerial decision has two forms: [NIVE99]

- decision document (predominates in the organization) that has reduced complexity, repetitive or variable is known
- decision making, specific decisions more complex and consists of all stages which prepare, adopt, implement and evaluate managerial decision, this process is a long one.

In our opinion, the decision must be made through the defining characteristics that it have:

- must be the result of a rational process, be justified either scientific or logical
- making a decision to a choice between several possibilities
- choice should be the result of a conscious act, deliberately
- decision to assume the existence of a measurable objective and precisely determined.
- decision to be interpreted as when moving from creative thinking to action.

In any decision even if we do not realize this, there are three elements:

- *statement*
- *alternatives*
- *criterias*

1.1.3. Models of decision making process

The decision is all the phases through which prepare, adopt, implement and evaluate managerial decision.

The first phase of structuring the decision process belongs to Condorcet and appears in a work in 1793 and includes three stages:

- expressing opinions on the principles that should underpin the decision and the possible consequences of adopting each alternative
- harmonize these views, yielding a much smaller number of alternatives
- the choice between these alternatives. [HANS05]

The modern approach to decision making but belongs to John Dewey who, in "How we think" (1910), specifies five stages of solving a problem:

- resentment of a problem
- defining the nature of the problem
- suggesting possible solutions
- evaluating solutions
- further observations and experiments that can lead to accepting or rejecting of solutions.

Based on models of Condorcet and Dewey, Simon introduced in 1960 a model that originally had three phases (1960), and later being added a fourth phase (1977). [SIMO77], [TURB07]

- intelligence (intelligence) - identification and formulation of the problem or opportunity
- design (design) - is seeking and considering alternative solutions
- choice (choice) - is evaluated and then selects one of the alternatives
- implementation (Implementation) in the chosen solution is implemented

In each of the previous phases, a well-designed DSS can help:

- in the stage of intelligence, to identify symptoms that will report the problem and to collect and process large volumes of data and information
- in the design stage, to generate possible alternatives and their evaluation
- in the stage of choice to reduce effects of the cognitive or perceptual
- in the implementation and evaluation stage, with the implementation of the decision [TURB07]

1.1.4. Components of decision-making process

In the [HAND04] we meet a decision model that has four components:

- the organizational component
- the component process
- the cultural component
- the component decider.

1.1.5. Models of decision-making process

In the literature there are two broad categories of models: rational and non-rational models.

Rational models considered classics fall into two categories:

- normative models - believes that the decision maker is a rational, non-contradictory, when deciding which knows all possibilities and selects the optimum

- descriptive models - suggests that obtaining information and processing limitations complicate decision-making: satisfaction, "trash" incremental political. [BECK98]

Due to the economic environment more dynamic and unstable, the growing volume of information environment requiring quick decisions even under conditions of uncertainty, risk, etc., we believe that strict rationalist approach is no longer sufficient. There is a need to balance the logical and analytical thinking through another form of intuitive judgment, especially when there are several viable alternative decisions, difficult to differentiate in other ways. [SAGE00], For example, in [DOBR09], we drew attention to the impact it may have emotional issues, non-cognitive entities contained in multimedia (text, sound, images, films) on the state of the decision maker and hence the way they make decisions. It is also suggestive experiment conducted by Wheeler and Arunachalam ([WHEE09]) it is highlighted the influence of the type of communication and cognitive aspects of decision making through multimedia.

1.1.6. Modelling as a tool in decision-making

According to [TURB07], the model is a simplified representation or abstraction of reality.

According to [RATI03], a model is isomorphic representation of reality, which provides an intuitive, yet rigorous, for the purposes of the logical structure of the studied phenomenon, and enable discovery of links and laws difficult to determine by other means.

We appreciate that the use of models is increasingly necessary as conducting experiments on real system leads both to high consumption of material resources and time and the consequences that cannot be remedied. The models can be classified according to several criteria.

Depending on the degree of abstraction can be [TURB01]:

- *iconic models*
- *analogy models*
- *mental model*
- *quantitative models (mathematical).*

Depending on the nature of the variables we have: [LUBA04]

- *deterministic models*
- *probabilistic models (stochastic)*.

Every model has four basic components [TURB01]:

- *decision variables*
- *uncontrollable parameters or variables*
- *outcome variables*
- *intermediate variables - bind variables and parameters of decision variables result*.

In Chapter 2 we achieve a customization models for inventory management.

1.1.7. Decisions' classification

In 1973, Mintzberg considers decision criteria for classifying activities:

- entrepreneur activities
- adjustment activities
- planning activities. [MARA99]

Each of the categories mentioned above are found in the inventory management.

Following classifications have a particular importance as they make the transition to DSSs. Thus, the degree of structure in 1960 Simon develop a scale issues to fully structured to fully unstructured and Keen and Morton (1978) classify them in decisions structured, semi-structured and unstructured [MARA03].

Another criterion is the purpose and is based on the Anthony (1965):

- strategic
- tactic
- operational.

Even if there is no overall correlation, we appreciate that operational decisions are structured as the strategic decisions tend to be unstructured.

1.1.8. Final aspects of the decision and decision-making process

Decision making process is now becoming more complex and difficult because of the amount of information increase and fluctuations of the economic environment.

For this reason, decision makers need technical assistance to help them make quality decisions in a short time, this assistance is provided by using a DSS.

Therefore, in our opinion, an important aspect of the relationship between DSS, decision-makers and decision-maker is the way DSS use in decision making. In this regard, since 1983, Pritsker and Sigal makers characterized by how decision making using a DSS: [POWE00]

- „DSS hands-off "using only the reports they provide DSS
- „requester" is an intermediary, an DSS analyst who asks questions to whom and who gets results which they then interpret as a basis for decisions
- „hands-on DSS" that directly access the DSS and use that information obtained through the use of direct to decisions
- „renaissance" can build their own models and even simple DSS's.

Regarding our subject, given the large amount of resource assets, to ensure the best possible management of them in developing a DSS on inventory management, pay attention to decision makers, their decision-making style and how the resulting decision making within the organization aspects that we take into account in Chapter 3.

1.2. Description, classification, components of the DSS

1.2.1. Preliminary issues

With an increasingly complex economic environment, we consider that the organization should become increasingly more: reactive, adaptive, proactive and even predictive.

In our assessment, the field of study, the pressures can come from different directions:

- market - increasing competition, electronic commerce, innovative marketing methods
- customer demand - the diversity, quality and speed of delivery, low loyalty
- technology - products and services, increasingly rapid obsolescence
- society - laws, regulations, increasingly diversified workforce.

Semi-structured and unstructured problem solving are used SSDs. These systems try to bring a greater degree of structurability in these types of problems. [BRAN07]

In our opinion, the degree of structurability depends on other factors:

- how subjective the decision maker sees the problem - the less experienced it will consider a number of issues as unstructured
- the hierarchical level at which it is placed decider - the hierarchical level increases, the less structurability decisions they have taken.

1.2.2. The DSS concept

The first definition was given by Little DSS in 1970. He defined DSS as "a model based on a set of mathematical procedures for data processing to assist a manager in decision making. A DSS needs to be simple, robust, adaptive, and easy to communicate with him so. "These attributes made by Little apply today.

DSS are a class of systems with features anthropocentric, adaptive and evolving, integrating information and communication technologies in general use and specific and interacts with other parts of the global system of organization. [FILI07]

Analyzing the DSS definitions, we see that they have the specific elements:

- are informatics systems
- are used primarily for semi-structured or unstructured decisions
- are used to support the human factor and not to replace him completely
- incorporating databases of different types or sizes
- containing models for decision making support.

Since DSS's definitions are not unitary, we tried their individualization based on features and functions they must satisfy.

In [HOLS96] authors highlight five characteristics of a DSS:

- contains a body of knowledge that describes some aspects of the world maker
- has the ability to acquire and manage descriptive knowledge, procedures, rules

- this knowledge has the ability to form ad-hoc and regular reports
- has the ability to select any desired subset of knowledge to be viewed or get other knowledge we needed decision making
- can interact directly and flexible decision-maker.

In [FILI07] have indicated the following characteristics of a DSS:

- providing decision support but are not substitute human judgment
- solving some complex problems
- providing support in as many stages of decision-making (possibly all)
- use by managers at different levels, a decision maker or group
- no matter amount and sources of data and information, communication messages with DSS decision maker must be simple and friendly interface is achieved by.

In the area of inventory management, we consider that a DSS should include tools to analyze the level and structure of sales, supplies and facilities prior modelling future applications. Also, the supply chain having a very important role, as we shall see in Chapter 3, DSS should provide at least access to data provided by the other components of its.

The principles of developing a DSS

According to Sprague ([SPRA96]), four main principles are:

- DDM paradigm (dialog - data - modelling)
- the technology
- iterative design
- organizational environment.

DSS classification

Donovan and Madnick [DONO77] meet a classification by the recursion of the issue:

- *the institutional DSSs*
- *DSSs ad-hoc*.

Hackathorn and Keen propose [HACK81] a classification by type SSD decision maker:

- individual DSS
- DSS for group
- DSS organizational.

Filip [FILI07] proposed the following scheme of classification by type of support SSD:

- DSS passive assistance - used to "increase productivity”
- Traditional assisted DSS - provides answers to questions such „What if…?”
- DSS regulatory support - used as a "computerized adviser”
- DSS support in cooperation
- DSS support extended.

Power proposes a classification of the DSS as the targeting. [POWE00]

- DSS-aimed at data(Data-Driven DSS)
- DSS aimed at models (Model-driven DSS)
- DSS aimed at knowledge (Knowledge-driven DSS)
- DSS aimed at document (Document-driven DSS)
- DSS aimed at communicatian (Communication-driven DSS).

The following three categories of SSD are considered by the author as being derived:

- DSS interorganizational / intraorganization: SCM (Supply Chain Management), SRM (Suppliers Relationships Management), CRM (Customer Relationships Management)
- specialized DSS- Examples: budget planning, marketing, flights etc.
- Web based DSS (Web-based DSS).

May it be noted, however, that, for all above Mentioned DSSs:

- makers and DSS were two separate entities
- the development of a solid state was determined, in particular, the technology
- decision-maker was regarded only as a DSS user

A new trend that we find in the literature is that of decision support systems based on knowledge (Cognitive driven - DSS) in which the decision maker is an integral part of the system, they communicate through natural language. [NIUL09]

In our study, we develop a hybrid DSS, as it will be an OLAP system that allows complex analysis of the sales data according to several criteria (suppliers, regions, period), which will be combined with modelling facilities, mainly related to the development of scenarios for future supplies.

1.2.3. The role of DSS in computer systems

Precursors DSSs

Classification of informatics systems and thus highlighting the DSS's place in computer systems is based on the role they play in the management processes and have information-decision as the axis relationship.

DSSs for group decision

In the '80s have other two components of group decision support systems (GDSS) and expert systems (ES), which, due to the vast coverage and will have an impact on all systems.

The benefits of GDSS in group decision making are:

- GDSS supports parallelism (parallel processing of information and generated ideas)
- GDSS provides quick access to external informations
- GDSS supports collaboration both on the use of data and in making reports
- GDSS enables parallel discussions

- GDSS allows participants to see overall situation concerning a problem
- GDSS could allow the participant anonymity
- GDSS allows registering the information used in a meeting. [TURB07]

Expert systems and artificial intelligence

Artificial intelligence is a branch of computer science that focuses on two elements:

- studying the processes of thought, reasoning, human learning
- duplication of these processes through machine (computers, robots etc).

Based on artificial intelligence expert systems are built.

Expert systems and their relationship with DSS:

There are situations where management decisions, particularly qualitative, cannot be taken only on the basis of data or mathematical models, but requires knowledge of the experts.

Experts are people who have specialized knowledge, power of judgment, experience, which advise or solve complex problems.

The term expert systems can be defined as a computer application that uses a set of rules based on human knowledge to solve problems that would otherwise require human expertise. [MARA03]

Intelligent software agents

The term refers to a human agent who interacts with others aimed at fulfilling a predefined task. This deadline was extended to information systems where we could find the term software agent or intelligent agent.

Over time were set many definitions of intelligent agents:

- intelligent agents are the software that performs a certain set of operations [NOOR10]
- agent is a computer system that is placed in an environment which is capable of autonomous action in order to achieve the objectives [WOOL02]
- agent is independent entity acting on behalf of a third party. Example: stockbrokers, real estate agents, viruses or software agents used browsers.

We appreciate that, as a possible component of a DSS inventory management, intelligent agents can perform multiple roles:

- monitoring data - e.g. monitoring and reporting price changes
- data collection - e.g. reports the discovery suppliers with the best prices modelling - e.g. maintain optimal price policy and resources.

A new trend, linked to our topic of study is the use of intelligent agents in DSSs integrated throughout the supply chain. In their development, but there are barriers related to data access partners, of time for development and validation of such an DSS, the implementation of rules and algorithms functioning of agents uniformly accepted by partners.[HILL12][DOBR05]

1.2.4. DSS components

DSS architecture

In general, architecture of a computer system shows how the components (hard and soft) are connected, what tasks are allocated to each component and how the components interact with each other and with external environment.

Architecture components of an DSS

To highlight the most important aspects of components DSSs authors have considered approach Turban and Aronson [TURB07].

Thus, a decision support system includes:

- Data Management Subsystem (MDS). This subsystem includes a database containing relevant data for decision-making situation and is managed by a software called Database Management System (DBMS)
- Management subsystem models (SMM). includes a software package with financial models, statistical or other quantitative models that provide analytic capabilities system, and modelling languages that allow the construction of particular models
- User interface subsystem. User and control through its DSS, becoming part of the system

1.2.5. Platforms for using DSS

This term means a combination hardware/operating system running DSS. We can have:

- DSS on a centralized
- DSS and client / server architecture
- DSS and web - intranet, extranet, VPN
- DSS and data warehouses.

1.2.6. DSS hardware infrastructure

The equipments forming the DSS structure are:

- computers of all kinds, servers, workstations, personal computers
- DSS distributed more calls and mobile devices such as laptops, PDAs
- other equipment: printers, scanners, routers, switches, multimedia.

We appreciate that the correct hardware infrastructure required is obtained by trying to answer some questions.

They may refer to:

- What is the dispersed user community?
- Users use the same application, different versions of the application or applications?
- If you use the same application, do independent or coordinated?
- From here will become apparent in the need for a server or not.

- Users already have a system installed. If so, how difficult is this system to be put in touch with the new DSS?
- There are users who are already familiar with DSS or certain parts?
- If you already have a centralized system, the new DSS can retrieve data from it? If so, is only allowed reading and writing or in this database?
- What storage capacity is needed?
- Users are able to conduct system administration and operations and possibly installing new software or data backup?

1.3. Business Intelligence

1.3.1. Preliminary issues

With the increasing complexity of the economic environment, organizations have understood the importance of rapidly obtaining and transmitting the information required by the decision-makers, business partners and other interested parties. This has led in the mid 90s, to the concept of business intelligence (BI), although some components are older. The goal of BI is to improve the quality and efficiency of information on various aspects like:

- market position against competitors
- actions of competitors
- changing customers or suppliers' behaviour
- market conditions and future trends
- demographic information
- the social, legal and political changes
- the potential of the organization in carrying out a decision.

1.3.2. Definition and characterization of BI

„BI is an umbrella term that combines architectures, databases, analysis tools, applications, methodologies".

We can say that a BI system has several important advantages:

- is focused on accessing and distributing economic information to decision makers
- provides access to all necessary information resources to make decisions, not just the data in data warehouses
- provides a number of predefined solutions for different areas of activity
- being considered an umbrella, it will constantly use the latest and advanced technologies, continuously perfecting.

1.3.3. BI components

BI includes two areas:

- *the data warehouse or data mart*
- *the analysis.*

In our case study, based on operational data, we build a data mart that will implement and query tools to extract information which will then be used in the simulation scenarios.

Regarding the relationship data warehouse - data mart have been elaborated two models:

- Inmon model [TDWI08] - is first developed data warehouse then data mart are created (top-down approach)

- Kimball model [TDWI08] - first to be built data marts by department subject oriented, and further will subsequently be integrated to achieve a data warehouse (bottom-up approach).

Variant of our case study is the first (Inmon), whereas another application builds data warehouse and for our study, we built a data mart focuses on the specifics of this area.

OLAP concept

Since the OLTP proved its limits when processing large volumes of data, the question of the development of new tools to allow rapid processing of an increasing volume of data became necessary. This limitation led to the OLAP technology.

OLAP basic elements

- hypercube
- dimension
- hierarchy
- cell
- the variable and the measure
- collection of facts, facts

Data mining

Only the information storage in a data warehouse does not always bring the expected benefits to the organization. To put into value of a data warehouse, it is necessary to extract the knowledge hidden behind the data. As the amount and complexity of data grows, it becomes increasingly difficult if not impossible for analysts to identify trends and relationships between data using only simple queries and reports. The existence of this growing volume of data raised the issue of transition from retrospective to a prospective data mining process. [GIUD09]

According to Han ([HANJ06]), knowledge discovery process involves the following steps:

- data cleaning
- data integration
- data selection
- data transformation
- data mining
- pattern evaluation
- knowledge presentation.

Also, in our study, on the use of data mining can be applied both in finding connections between different categories sale of spare parts as well as customer loyalty, since as noted in [RUPN10] effort, even and financially in bringing new customers is greater than the effort to preserve the existing customers.

Other components of BI

According to Turban ([TURB07]), BI includes also the following components:

- BPM (business performance management)
- user interface
- intelligent systems.

1.3.4. The role of BI in inventory management

The interdependence between the inventory management and sales, either directly (goods) or indirectly (raw materials), making necessary to use BI elements in the DSS inventory management as we mentioned in the previous paragraphs. We can illustrate this sales analysis on different dimensions (region, storage, time, supplier, etc.), mining on these dimensions, but also trying to forecast sales.

1.4. Development of DSS

1.4.1. Preliminary issues

We consider that the aspects of the methodology for are quite sensitive because:

- in generally, DSS is made through the programmer and not by the user
- being generally an expensive operation, should be considered several options
- DSS should help people with different personalities, knowledge, skills, and functions.

The determining factors in the development of DSS

In the development of a DSS we should consider two categories of factors:

- participants (DSS constructors) users, analysts and software developers
- the current situation, the desired changes in the organization, the technologies used.

1.4.2. Strategies for developing a DSS

Further to the development of the feasibility study, the organization will decide on the two possible strategies to follow:

- Design and development of DSS in the organization (developing "in house")
- Purchase a specialized DSS which then to adjust in the organization.

On the other hand, the strategy of development "in house" can focus on:

- developing specific DSS through programming languages
- development through DSS generators.

1.4.3. DSS's development process

Phases of a general process include:

- definition of the problem
- identification of DSS objectives and resources
- system analysis
- system design
- building the system
- implementation of the system
- incremental adaptation.

1.4.4. Classical methodologies to achieve DSS-based systems lifecycle (SDLC)

- waterfall
- development method in parallel
- functional category analysis.

1.4.5. Rapid methodologies for achieving DSS

- RAD methodology
- prototyping

Prototyping methodology has two variants:

- evolutionary prototype methodology
- throwaway prototype.

1.4.6. Agile methodologies

These principles specify that:

- the main priority is to provide early and required software constantly
- changes in the user requirements are used by agile processes to create a competitive advantage
- delivering software the user is typically from a few weeks to several months, trying to shorten the time
- managers and developers must work together day by day on the project
- in the project development have trained and motivated each participant
- the most effective method of conveying information to and within the team is face to face conversation
- functional software is the first indicator of progress
- agile processes are ongoing processes of development, their implementation efforts involving the sponsors, developers and users
- continuous attention to technical excellence and quality design enhances agility
- simplicity, the requirement of maximizing the work performed is essential
- best architecture and design requirements arise independently organized teams
- from time to time, examine how teams can become more efficient and adjusts its behaviour accordingly.

Some of these methods are:

- Dynamic Systems Development Method (DSDM)
- Scrum
- eXtreme Programming (XP)

1.4.7. Unified process methodology (UP)

Unified process definition

With the increasing complexity of decisions taken and thus the need for more performance SSDs, the question of building them as fast, and there is support in the strong development of computing technologies, the Internet, etc.[JACO99]

Unified Process is based on three axioms ([ARLO02]):

- is based on use cases and risk assessment
- is focused on architecture
- is iterative and incremental.

UP structure

For solving complex problems more easily and therefore a development of complex SSD is required, according to UP, the approach of "life cycle" where division is done in phases (design, development, construction, transition) and the phases in iterations.

Each iteration is divided into five core workflows:

- requirements - determining what the system should do
- analysis - refining and structuring requirements
- design - transposition system architecture requirements
- implementation - developing software
- testing - checking how the implemented system meets the requirements.

Unified Modelling Language UML

UML is a modelling language and not a methodology for systems analysis and design, making it available to system designers a vocabulary and a set of rules for communication and conceptual and physical modelling of the systems.

UML operates with a series of diagrams and symbols to represent the system model.[1]

UML diagrams in version 2.2, can be classified into three categories:

- structure diagram
- behaviour diagram
- interaction diagram - a subset of behaviour diagrams to emphasize the interactions between objects.

We consider that the use of UML in the conception, design and implementation of a DSS in inventory management leads to:

- a more rigorous requirements determination decision related the sales and the supply
- a more rigorous determination of the interactions between decision makers, the external environment, existing computer applications and other elements in the decision making process
- an easier and faster communication of DSS functionalities.

The methodology used by us in the design of new SSD is unified process methodology (UP).

[1] http://www.omg.org/spec/UML/2.2/Superstructure/PDF/

1.5. Conclusions regarding the need for a DSS in inventory management

In this chapter we have synthesized some elements on decision-making and decision support systems that provide the best possible decisions.

Thus, we realized a synthesis of decision, decision-makers and decision-making concepts at both the individual and the group level, and the role of modelling in decision-making at both the general and related to inventory management, which becomes more important as witnessing a growth environment dynamicity operating organization.

We put out the context that led to the appearance and development of DSS, the role of these systems in the decision making process of an organization, the architecture and the technologies behind them, emphasizing the role of Business Intelligence, OLAP and data mining technologies. In the final part of chapter we have presented the most known and used methodologies, models and techniques for designing and implementing decision support systems emphasizing the features, advantages and disadvantages of their use for the development of DSS.

Finally, we emphasize several advantages of using DSS in inventory management:

- improving the quality and the number of decisions taken by managers especially when there is a cognitive, temporal or economic limitation
- improving decision makers' productivity
- facilitating interpersonal communication in group decision-making by using a common language
- communication and thus cooperation between customers and suppliers along the supply chain to ensure that the most efficient mix of 4P (Production Decision, Decision pricing, promotion Decision, like Decision) ([UNHE10])
- improve the control of the organization by monitoring by the top management of how DSS users make decisions. This should be treated with care since, on the one hand, may cause users to take decisions only "safe" but that is not always the best for the organization, and on the other hand, may affect privacy of DSS user, subsequently leading to decreased productivity and quality of decisions taken by him.

From the user perspective will have other advantages of using a DSS in the studied domain:

- the generation of better alternatives, related to the suppliers, for example
- a promptly response given to a situation related to competition policy
- generating new points of view, including brainstorming solutions
- more analysis of the sales by period, zones, groups
- analyzing multiple facets of decision.

In the development of a DSS will appear limitations such as:

- DSSs cannot replicate human skills such as creativity, imagination, intuition

- because of the hardware and software cost considerations, SSD should be developed for a specific category of operations
- if the DSS will be integrated into the organization's existing information system (hence takes its data) may experience problems of compatibility between the two systems
- could generate a block of thought, a dependency of the decision maker on the DSS, because of the human tendency to accept solutions "because the computer says so.”

In order to achieve a good DSS, BI tools can be integrated into it like:

- on the levels of complexity, depending on the requirements and resources of the organization
- once implemented, creating the premises of efficient and effective decision making process.

But ultimately, the managers, by the decisions taken, are the ones that make the organization to develop, exploiting the potential of these tools.

2. Inventories. Classification and modelling.

2.1. Preliminary issues

Inventories represent the amount of resources, materials or products (finished or in any stage of manufacture) accumulated in the storage organization in a given volume and structure, and for a period of time, for their later use or sale. We can appreciate that the dynamics of the inventory within the organization has a dual aspect:

- as a manufacturer - it is concerned with reducing inventory levels
- as a beneficiary of its work - should reduce the risk of stock outs.

These two aspects being contradictory, we consider it necessary to establish a balance between them, the target inventory management activity being looking for this balance.

2.2. Inventories in the production process

The need to build inventories of production is justified by the existence of several factors that determines the level the function and the purpose of their creation[2]:

- the contradiction between the specialized nature of production and non-specialized nature of demand
- the spatial gap between production and consumption
- seasonality of production or consumption
- periodicity of production, consumption, transport
- the need for conditioning of materials prior to their entry into consumer
- disturbances in the supply-transport.

2.2.1. Types of production inventories

In the literature we find several classical criteria for classification. [RUSH10]

From the point of view of the production stock may have:

- the raw materials
- finished products for delivery to customers
- interoperable, designed to ensure the continued operation of production lines.

From the point of view of the economic role inventories are:

- the role of regulator
- the strategic role
- speculative.

In terms of the formation of them, inventories may be:

- Current Stock
- Safety Stock

[2] http://www.asecib.ase.ro/Mitrut%20Dorin/Curs/bazeCO/pdf/53Gest-stoc.pdf

- Stock preparatory or conditioning
- Internal transport stock
- Winter stock.

2.2.2. The constitutive elements of storage processes

The specific elements of storage processes and thus determines the quantity and value of inventory that we encounter in literature are: [RUSH10]

Demand for selling products made

- request for sale
- costs
- quantity supplied
- lot
- processing stage of inventory
- controllable variables (quantities entering, frequency and timing of acquisitions, the degree of processing) and uncontrollable (costs, demand, period of replenishment, quantity supplied).

2.3. Inventories in the selling process

The concept of starting more efficient management of supplies and goods is the added value. Added value is the difference between the amount the customer is disposed to pay for a product or service and the cost to the manufacturer for supplying the product or service.

In our case study, as distributors, we must establish the price based on two elements of oligopoly:

- providers - are a few major suppliers of parts that must be negotiated by delivery and payment conditions as favourable
- several other distributors on the market, which can offer better prices because of lower costs (lower purchase prices, lower quality of goods) or lower profit margins.

Price policy

In our case study, the best price policy is differentiated strategy (providing discount) depending on the amount of goods purchased over a period of time, the specific client (service or store) etc. The assessment of the client is usually three months.

2.4. Collaborative inventories

Given that the organization's resources immobilized in inventories may have a fairly large share and by the desire of the organization to achieve a better coverage of its customers demand, the issue of transition beyond a simple business relationship established with suppliers and customers, namely the realization of collaboration to achieve including a better management of inventory [DOBR10]

One of the ways businesses has been booming lately which influence the way of realization of inventory management is the supply chain.

The supply chain, from the point of view of its components, may have two variations:

- organization is one of the components chain
- the organization itself has its own distribution chain.

2.4.1. Organization - part of the supply chain

In paragraph 2.3 we have analyzed some aspects of the actual distribution of the products. We will insist on the idea of collaboration in the supply chain, both as a dealer and as an intermediary in product realization.

In this situation, the supply chain is seen as a set of organizations involved in the implementation phases of a product or service: design, design, development, promotion, distribution to the end user. [DOBR07]

Collaboration, in this case, refers the activities between partners related to customer satisfaction in the best conditions in terms of cost and time of development of the phases mentioned above. [DOBR08]

The need for collaboration between the components of a supply chain is justified from several points of view:

- customers requesting a large variety of products, lower costs and "agility" from suppliers
- reducing life cycle period and the time a product reaches the design phase to delivery market
- elements mentioned above are all sources of uncertainty manifested along the supply chain phases developed. [ZHAN11]

2.4.2. Supply chain from inside the organization

In this situation, the organization not only operates in a single location, it has a supply chain. The organization will therefore have two components: a central management and multiple locations, each of these locations being a selling point of the same assortment of products to customers. [YUSO04]

We still use the concepts of supply chain (SC), supply chain management (head office (HO)), point of sale (POS) supply chain management (SCM), and decision support system of supply chain (DSS-SC).

2.5. Modelling and simulation of inventories

2.5.1. General issues

Decisions have increasingly uncertainty as the argument in paragraph 1.1.6. Therefore, with the development of computer technology and its capabilities, the question of prospective thinking on decisions can be done through modelling and simulation methods. In our opinion, the decision maker by making impact analysis using modelling and simulation, and even if he cannot act on chance, can better understand the decision-making problems, to improve your chances of getting a desired result or be prepared for developments unfavourable beyond his control.

The starting point for need to use stock models is to make forecasts, projections being an essential element in developing long-term strategies.

There are many definitions of simulation [LUBA05] but all are composed of several essential aspects:

- can construct a logical-mathematical model of the analyzed system
- undertake experiments with this model, creating an artificial history
- attempting to obtain "something" about the possible future evolution of the real system.

According to the same author, realization of simulation involves the following steps:

- establish the problem to be solved and development of a conceptual model
- implementation of the conceptual model into a computer model called simulation model
- determining the number and manner of implementation of simulation experiments
- analysis of the results, development of conclusions and recommendations.

It must however to specify that the simulation is not a substitute of the manager or the decision maker.

In our case study, developed in Chapter 4, for the stocks of spare parts, where demand has once again sporadic need to be used the simulation as a tool helpful. In addition, have considered a wider range of issues and transport, storage, people involved chain. [SOUZ11]

2.5.2. Models of inventories

The theory of modelling inventory levels has to answer questions like:

- how much should be ordered?
- at what intervals should place an order for replenishment, needed to restock to meet manufacturing or commercial requirements so that costs are minimized?

As detailed inventory management requires the allocation of time and resources, it is important that it be directed where to obtain higher efficiency. Thus it is essential to Pareto analysis, (ABC analysis).

The inventory management using two types of storage models:

- *the deterministic models* - where we have complete certainty on the application, time and delivery costs
- *the stochastic models* - some or all factors are uncertain but may be evaluated with a certain probability.

To determine which version of the model to be applied is started, according to Rusu, [RUSU01] from the analysis of previous demands evaluated at n points in time...

We assume that the demands were: $N_1, N_2, \ldots, N_n$. Calculate the mean and variance, standard deviation and coefficient of variation.

$$\overline{N} = \frac{1}{n}\sum_{i=1}^{n} N_i \,, \quad \sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(N_i - \overline{N})^2 \,, \quad \sigma = \sqrt{\sigma^2} \,, \quad C_v = \frac{\sigma}{\overline{N}} \,.$$

It may possibly use the Bessel correction for dispersion: $\sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}(N_i - \overline{N})^2$.

If requests N_i are equal then $C_v=0$.

If they are not equal, but $C_v < 0.2$, i.e. have a low scattering values, methods to be used are the deterministic, since demand is sufficiently close to average.

If $C_v > 0.2$, scattering values demand is quite high, the average is not a good characteristic of the application and then type stochastic methods are applied.

2.5.3. The deterministic models

1. *Storage model, instant supply, at no shortage of stock (Wilson)*
2. *Storage model, instant supply, instantaneous delivery time, at no shortage of stock*
3. *Storage model, instant supply, when admitted shortage of stock*
4. *Storage model, gradual supply, when admitted shortage of stock*
5. *Storage model, gradual supply, at no shortage of stock*
6. *Storage model, instant supply, at no shortage of stock ((Wilson), variable acquisition cost* [RUSU01]

2.5.4. The stochastic models

Monte Carlo Modelling

The Monte Carlo method generates random values of random variables by using:

- a generator of random numbers uniformly distributed in the interval *[0, 1]* and
- cumulative probability distribution of the random variable associated with that. [DUNN12]

Therefore the question is, in general, in Monte Carlo simulations, the number of procedures to be of the order of 10^3.

The quality of the sample obtained by simulation can be assessed by tests of concordance (Kolmogorov, Smirnov and Pearson or $\chi2$) which measures the closeness of the theoretical distribution specified for a random variable and the simulated distribution.

2.6. Conclusions

Achieving an optimal inventory management has emerged as a result of the need to ensure an effective supply, on the one hand with the raw materials needed to run the best conditions of the productive process, and on the other hand in selling the goods.

Given the limited resources available to the organization, it will have an interest in developing simulation models for future demands and programs supply. Therefore, in this chapter, we presented several deterministic and the stochastic mathematical models, each of these models, as well as any other models having strengths and weaknesses. Each model can be applied according to the specific products and their sale, the economic environment in which the organization operates, etc. The favourable or unfavourable situations may arise that could not be anticipated and can change quantities and terms of supply.

Taking into account that the studied in detail, the demand is fluctuating, it is necessary to use a stochastic model to try a better anticipation of demand. In this model we use Monte Carlo method to develop scenarios located around the average supply sales, so the inventory to cover future demand as well. The quality of the simulation, however, will be confirmed only by how these future customer requirements will be covered, something that will be seen in the future sales and the number of new customers attracted.

3. General framework of development of a decision support system for inventory management

3.1. Preliminary issues

Starting from those presented in subchapter 1.4, the creation of a DSS in inventory management, we considered the following three aspects:

- methodology
- modelling
- implementation.

3.2. Stages of DSS for inventories

3.2.1. Initiating and designing DSS

This stage includes the following activities:

- identifying and shaping decision-making requirements
- identifying risks in decision making
- the feasibility of the project design, development and implementation of DSS
- elaboration of the action plan
- working prototype model's DSS.

Identifying and shaping decision-making requirements

In this activity was taken into account:

- developing requirements decision model
- developing decision-making context model
- determining and describing decision models
- developing collaborations in the system model
- developing general use cases of the decision-making process
- design the reports.

Identifying risks in decision making

As shown in the paragraphs 1.1.4.2. and 1.1.7, requires decisions involve a degree of risk related to the uncertainty of some of the variables involved in decision making.

In this model will be considered:

- presentation of instruments used to determine the risk
- identify and describe the uncontrollable variables in the system
- presentation decisions are taken under uncertainty.

The feasibility of the project design, development and implementation of DSS

Following the determining potential user requirements and the conditions for and implementation (the investment, personnel, etc...), aspects to which we have referred in more detail in paragraph 1.4.1.3, it is necessary to analyze the feasibility of this project.

Through this model we follow:

- to present the tools used to analyze the feasibility
- to present supporting documents of the feasibility of DSS.

Elaboration of the action plan

The project plan, which set out tasks, resources and terms to achieve it, (subchapter 1.4.3.), becomes a tool for verifying the practical way in which the project complies with the initial requirements relating to:

- the tasks and their duration
- the allocation of human and material resources in the project tasks
- the reference points ("milestones") on the evaluation and control of the project.

The working prototype

Working prototype (paragraph 1.4.5.2.) is used for the rapid determination of the system functions so that it covers as well the user requirements.

Through this model we aim:

- establishing prerequisites and development of working prototype
- updating the prototype with the changes required by the users.

3.2.2. Design and construction of decision support system

After the phase of initiation and design, the team can proceed to develop the structure and behaviour patterns and after that the system construction and the completion the basic executable version.

The activities of this phase are:

- development of the model classes and objects of DSS
- elaboration of data model
- development of the model components and packages of DSS
- model development location - hardware and software infrastructure.

Modelling the behaviour of DSS

In this phase we aim:

- development of the uses’ and activities’ model
- development of the interaction’s and communication’s model between DSS components.

Developing an executable DSS basic version

In this phase developed iteratively the executable versions of DSS. Each version goes through an iterative flow, the aim being to get as close versions of the user requirements. A special role in this phase plays DSS alpha testing.

Elaboration instruction manuals

After the first version was completed and alpha tested proceeded to draw up the system instruction manuals. This phase may begin in parallel with the development and the system construction and continue until after its transition in the organization.

Beta testing

At this stage iterative testing the executable versions of the same data but with the decision to be implemented DSS. Therefore these tests are in direct collaboration with system users.

Completion of the basic version

This stage marks the completion beta testing, user manuals and obtaining basic the executable version will go through a transition phase in the organizational the system.

3.2.3. The transition of the system

The stage of DSS transition includes:

- the preparation of organization's information system for installing DSS
- elaboration of user training model
- location development of the model and system integration
- development of the model and maintenance plan.

At this stage the focus is on implementation (installation and integration software) and testing (the latest updates of the basic version).

3.3. Conclusions

The conceptual framework for achieving SSDs in inventory I thought to be a support to design, produce and implement an SSD in this area that involves the use of financial resources of the organization.

Obviously this framework can be improved, taking into account the specific problems that arise in applying it in practice, problems that could not be anticipated now. Examples of such problems are outlined in the case study presented in Chapter 4.

4. Analysis and simulation of supply scenarios using DSS.

4.1. DSS testing for aftermarket inventories type

Based on the theoretical aspects of inventory management, discussed extensively in Chapter 2, in this chapter we will try to customize, referring to freight stock management in a specialized field, namely that of auto spare parts, called aftermarket.

Auto spare parts are characterized by an advanced technicity, they must respond to precise and standardized rules imposed by manufacturer’s original components (OE). As a result, the market for such goods is heavily customized for each component of the product categories with specific default and distribution channels. [DOBR06]

4.1.1. Specific elements of management stock automotive spare parts

The first element is the distribution on the way that the product reaches the final consumer. The problem of distribution as part of the sales process was discussed in detail in Section 2.3. We highlighted specific circuit layout both for the market and evolving with time, circuits that have disappeared or reduced their importance over the years.DOBR13a], [DOBR13b]

The second element relates to the way in which the need for inventory is applied to the specific case:

- fluctuations in demand
- fluctuations in supply
- anticipation
- transportation
- protection against the risk of stock
- batch size.

The third element concerns the data to be taken into account in determining the level of the stock of spare parts. These are:

- planning stock structure
- establishing the budget
- accuracy of records
- prompt feedback
- corrective action.

4.1.2. Specific elements of company that is achieved DSS

In this section we highlight some specific elements of society that is implemented DSS:

- organizational chart of society
- IT system used

- the company works for the supply of large manufacturers or wholesalers mainly from Germany, providers who in general impose conditions relating to the way in which it delivers. For this cause shall have made a harmonization between the values resulting from OLAP analysis and simulation procedures with budget data supply and the conditions they impose on them (the minimum order value, delivery, discounts, etc.)
- in the simulation will not consider special orders usually high value, as they will be treated specially, as these exceptional circumstances, aiming in particular, to increase customer confidence and to attract new customers.

4.2. DSS elements

Users of this system can be grouped into two categories:

- those who will access both multidimensional OLAP component and the simulation
- those who only access multidimensional OLAP reporting component.

Presentation of DSS is treated in detail in the thesis.

5. Conclusions and perspectives.

5.1. General conclusions

Given, on the one hand, the increasing complexity of competitive economic environment in which the firm evolves, and on the other hand, the limited resources it has at its disposal, the business decision becomes a key element.

Making good decisions requires, however, a large volume of data and information handling which cannot be done without a decision support system. Since the emergence of the DSS concept (Gorry and Scott Morton 1971), it has experienced a continuous evolution, both in terms of architecture and technology of its design. Technological advances made in terms of extraction, storage, processing, reporting, emergence and development of Internet and Web technologies have expanded the possibilities.

Regarding the technologies was assimilated into decision support systems, thus expanding the possibilities, we can mention:

- database technology increased storage capacities and analysis
- client / server technology has expanded the potential of SSDs by enabling the use of data throughout the organization and the possibility of developing a collaborative environment
- Internet has expanded SSD potential by developing communication and access to information
- process technologies business intelligence ("BI") by data warehouses, OLAP applications and "Mining" techniques led to the expansion of functions on DSS storage, analysis and forecasting
- artificial intelligence technology has increased the performance modelling and simulation of decision-making, expert systems and intelligent agents taking over the tasks of decision makers.

Regarding design DSSs in inventory, we believe that it should leave both the requirements of the decision-making process and technological and operational data of the organization. The way in which the storage, processing, retrieval and communication of information and data and system architecture influence the way must be designed and implemented DSS. Therefore we proposed to use modelling using UML to define requirements and context decision-making information so that a script can be created as full of what you need to cover DSS. We also use the design stage, through prototyping technique to allow direct communication between the user, the system and its designer. We believe that good documentation as close to what is desired in future DSS, realized early design phase, ensures successful development, implementation and use of the system. Also recommend SSD design a client / server architecture, as more important data and information for decision making are dispersed in several applications throughout the organization. The decision makers can be distributed in different locations and can access the system at different times.

We recommend approach design and implementation DSS by iterative unified process flow, which will cause the basic executable version to be more stable and better cover the user requirements.

5.2. Author contributions in this thesis

Personal contributions resulting from this research can be summarized as:

I emphasized some elements of decision, decision maker and style to individual decision makers' roles in the group and group elements that help us better at fixing the concept of business decision and how it should be. Given the complexity of the economic environment, we concluded that it is necessary to use a DSS and that one of the most important tools to be integrated into the DSS is the simulation.

I made a summary of the methodologies, methods and techniques of design and implementation of decision support systems highlighting the importance of each in the development of the current decision support systems. For this, we started to define DSSs, continuing with the principles to be taken into account when building a DSS, DSS with the classifications and the place it occupies in information systems from the precursor to the elements artificial intelligence and intelligent software agents.

I made a summary of the main technologies in the process of business intelligence ("BI") and have shown how they can be integrated with decision support systems. For this, we started to define BI and also we highlighted components: data warehouse, OLAP, data mining, BPM.

We synthesized methodology of DSSs realization, from classics (cascading, parallel) to the fastest (RAD, prototyping) and to the agile (XP). We presented the methodology and UML unified process, this methodology and basis for standing framework for SSD.

We analyzed several elements of inventory theory and storage process, starting from the classical elements (types of inventories, components, logistics, distribution, pricing policy) to newer elements (inventories collaborative supply chain, modelling mathematics).

We have developed a framework for the design and implementation of SSDs in stocks, using a simplified form of the methodology "Unified Process" technique using UML and prototyping, thereby harnessing the theoretical elements presented in the first chapters.

We have tested this framework by developing a DSS prototype based on OLAP, on making sales situations and a supply scenario for particular goods, namely the automotive aftermarket. The particularity comes from the fact that the demand is variable, which makes the simulation model to be a stochastic type. So here we have used Monte Carlo simulation where the interval between two supplies was given by the supplier, we being able to control only the supply level.

5.3. Dissemination of the results

Research and analyzes in this paper are the result of concerns in recent years, concerns that have resulted in works of which we mention:

Dobrican O., An informal system of stocks at a spare parts depot, în volumul Simpozionului *The central and east european conference in business information systems*, Cluj-Napoca, 20 – 22 mai 2004, cod ISBN 973-656-648-X

Dobrican O., An example of collaborative system, în volumul *The proceedings of the international workshop on Collaborative support systems in Business and Education*, Cluj-Napoca, 28 – 29 october 2005, cod ISBN 973-651-008-9

Dobrican O., Collaborative information systems in the global economy – *Research papers* Editura Universității de Vest, Timişoara 2005, Cod ISBN – 973-7608-54-2

Dobrican O., An example of collaborative activity in automotive industry în volumul *The 3rd International Workshop IE & SI*, Timişoara, 26-27 mai 2006. ISBN (10) 973-661-870-6; ISBN (13) 978-973-661-870-3

Dobrican O., Planning like a collaborative activity in a supply chain în volumul *Annals of the Tiberiu Popoviciu Seminar - Suplement International Workshop in Collaborative Systems*, Cluj-Napoca, 26-28 octombrie 2006; ISSN 1584-4536

Dobrican O., Transparency and collaborative supply chain in the automotive industry în volumul *The Proceedings of the International Conference on Competitiveness and European Integration, Business Information Systems & Colaborative support Systems in Business*, Cluj-Napoca, 26-27 octombrie 2007; ISBN 978-973-751-597-1

Dobrican O., Some aspects of E-Collaboration and supply chain integration, conferința internațională *Economy and transformation management*, Timişoara, 9-10 mai 2008

Dobrican O., Agent collaboration in supply chains în *Annals of the Tiberiu Popoviciu Seminar Supplement International Workshop in Collaborative Systems*, Cluj-Napoca, 10-11 octombrie 2008; ISSN 1584-4536

Dobrican O., Some Aspects of Collaborative Project Management, *Conference: Education, Research & Business Technology, The Proceedings of the the 9th International Conference on Informatics in Economy*, 7-8 May 2009, ASE Printing House, ISBN 978-606-505-172-2, p.38-43

Dobrican O., Multimedia and Decision-Making Process, *Informatica Economică*, vol. 13, no. 3/2009, ISSN 1453-1305, EISSN 1842-8088, pg 36-48

Dobrican O., Knowledge management issues in supply chain domain, *Intelligent Systems for the Economic Decision Support*, 10-11th of September, 2010, Cluj-Napoca, Romania
Dobrican O., E-integration in the supply chain domain. The ELM example în volumul *The 11th International Conference on Informatics in Economy, Education, Research & Business Technologies*, ASE Bucureşti, Romania, 10-11 mai 2012, ISSN 2247-1480, indexat ISI Thomson Reuters
Dobrican O., Some aspects of automotive aftermarket inventories în volumul *The 12th International Conference on Informatics in Economy, Education, Research & Business Technologies*, ASE Bucureşti, Romania, 25-28 aprilie 2013, ISSN 2247-1480
Dobrican O., Forecasting Demand for Automotive Aftermarket Inventories, *Informatica Economică* vol. 17, no. 2/2013, ISSN 1453-1305, EISSN 1842-8088, pg 119-129

5.4. Future development

Based on the research results of this paper, we intend in the future to continue in the following directions:

- the development of the work proposed in Chapter 3 by applying it in several projects for design and implementation of DSSs in inventory management
- developing practical model of DSS for managing inventory based on OLAP and simulation by implementing new algorithms and simulation functions for future supplies
- developing practical model for managing inventory DSS by integrating data mining system
- the implementation of functions that allow the calculation of performance indicators
- the implementation of simulation facilities supply budgets required in future periods.

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