# The Actual Functionality Requirements for Business Decision Support Systems

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# THE ACTUAL FUNCTIONALITY REQUIREMENTS FOR BUSINESS DECISION SUPPORT SYSTEMS

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Abstract— The specialty studies have sought to emphasize the importance of IT tools in human reasoning emulation, in developing methods and techniques in order to extract knowledge based on text, or in developing methods in order to improve decision-making process. This paper tries to present the functionalities required by decision support systems in order to sustain the business processes.
Keywords- knowledge, decision support systems, knowledge

## I. INTRODUCTION

Certainly the methods, techniques and tools for data analysis and knowledge extraction are from many areas of research (artificial intelligence, mathematics and statistics, psychology and cognotics). The application field is important. Researchers' concerns are oriented towards the unification of these methods; therefore the subject of any research in this area of computer-based modeling is interdisciplinary.

Better decisions means improving information provided. We tried in this paper to outline knowledge of acting from decision models must be implemented to improve information, to actually provide better information to the user. Using decision models for problem-solving task proved to be a failure in the past. It concluded in very static models, non-adaptive ones, with no utility for user because they captured a kind of model that impose performing an action in the form of transferring knowledge from the model to human being.

IT implementations resulted in a systemic approach to decision-making process so that solutions are hybrid forms of technology to solve functions, not necessarily decisions. Modeling decision-making requires integration of technologies and logical resources.

Technologically speaking, the IT solution is represented by decision support systems (Decision Support Systems) combined or not with intelligent technologies. Such systems offer users flexible tools to analyze important data sets. A system to assist decision should be simple, robust, easy to control, adaptive, comprehensive, and easy to communicate with.[4] Queries needed to assist decision making explore current and historical data, identify trends and create aggregate useful data to assist decision making. On-Line Analytical Processing (OLAP) [2] and data mining [3] are tools to assist decision-making ad hoc queries. Reasoning was identified as a critical issue in relation to decision making.

## II. METHODS OF RESEARCH

During the 2010 spring we conduct a study that had the main objective identification of principal requirements addressed by business decision-support systems.

The number of respondents was 214. Answers to principal addressed question: what are the functionalities that you want to have your decision-support system the main majority stayed for: best practices management (34%), case models (27%), e-mail and on-line meeting (97%), data integration and interoperability (100%), analyses (100%), the possibility to edit their own decision rules (85%), text-based narration functions (90%).

Therefore this paper presents our view undertaken by this survey study and analyze. We derived two main hypotheses from the research model.

H1: applying knowledge in the decision-making moment has a positive impact on user satisfaction with the Decision Support System
H2: information integration has a positive impact on user satisfaction with Decision Support System.
We derived eight research questions from the research model.
Q1: In decision-making processes there is a need of information that comes from multiple sources?
Q2: Do you use digitalized information in decision-making?
Q3: On a scale of 1 to 10 please estimate how much is digitized the information needed in decision-making processes
Q4: Do you use a Decision Support system?
Q5: Which are its main functionalities? (Multiple response -12 possible functionalities)
Q6: How much do you consider that your Decision Support System is helping you in decision-making processes?
Q7: In case you don't use a Decision Support System how much do you consider that your information system is helping you in decision-making processes?
Q8: What are the main functionalities that your Decision Support System should possess? (Multiple response -12 possible functionalities)
The 12 possible functionalities are: best practices, case models database, predictions, online analyzes of data (OLAP, data cube, data warehouses), groupware functionalities (e-mail, online conferences, online meetings), data integration from multiple sources, planning, financial analysis, budgeting, calculus, the possibility of editing their own decision-rules, narration functionality.

## III. REQUIREMENTS IMPOSED BY HUMAN DECISION MAKING PROCESS

Individuals differ in ability to understand complex ideas, to adapt to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles. Although differences can be substantial, they are never entirely consistent: a person's intellectual performance may vary in different situations in different areas according to different criteria. Definition of intelligence seeks to clarify and organize complex set of phenomena characterizing. Rather it is the ability to understand what is happening around.[13] Organizations differ in ability to understand the environment to adapt to the environment and innovation.

Researchers have tried to convince the public that we can build intelligent machines, smart or intelligent artifacts. Although many definitions were given, they may not be uniform as long as so far no any invented artifacts are so clever to overcome human being. Creating such artifact would mean a computer system adaptive and intelligent enough to learn, to adapt to new circumstances, to anticipate and evaluate possible actions. Due to parallel processing, Deep Blue is able to evaluate a large number of moves in the chess game and to remove "unsuccessful" moves. In 2001, an intelligent financial training simulation application defeated people.[14]

An intelligent system must be able to adapt to new information and learn from changes. The concepts of "adaptive" and "intelligent" would have to be redundant.[11] Many Internet search engines are not adaptive and thus not fully intelligent - because they cannot change their database according the required statements. An adaptive intelligent agent is able to learn, to reason and to prevent such absurdities as people recognize the contradictions.

People create knowledge over time due to complex cognitive processes that characterize them and because of ongoing communication taking place between them. If at the time of solving a decision, the decision-maker knows the solution accepted as true, the only cognitive process that is triggered is the search. Whole knowledge that an individual possesses at a given time is the result of experiments and theories, axioms, laws learned in life.

If decision-maker doesn't know the solution to a decision problem he will try to query it. Based on theories, axioms and previous experience he will try to reason (limited) using deduction and induction. Specifically, he will try to process data by making use of knowledge. Human being

classifies information on patterns of experiences and axioms; identifies reasoning and assesses ways to find a solution acceptable to reject other candidate solutions.

If the action takes place, inferred pattern of human action can be checked by reality. It should be noted that human being acquired knowledge by followings:
1) if the proposed solution has proven to be true this piece of knowledge enrich available knowledge;
2) if the proposed solution has proven to be false the reasoning pattern will be cancelled and will be added to the experience in the knowledge base.

## IV. REQUIREMENTS IMPOSED BY BUSINESS DECISIONS

In our opinion, knowledge belongs to humans/ decision-maker/ organization. Knowledge application depends on people. Moreover, knowledge elicitation is achieved by asserting qualitative factors. Applying knowledge depends on free will, decision-making responsibility, time, situation, interest, etc. People want tools to discover knowledge, to stimulate knowledge application. They don't want knowledge automation. If in terms of knowledge discovery there are neural networks, knowledge elicitation supposes the existence of representation formalisms that cannot be control structures, as they deal with the implementation of control and not with knowledge acquisition.

Thus we can state the following hypothesis relevant to this article: modeling decisions involves formalizing IF-THEN-ELSE controls on concepts that belong to decision-making models. Specifying and customizing decision-making models by applying knowledge belong to decision-makers and may be formalized apriori as data+control structures or locally at the decision moment and place.

Management decisions modeling involves the management and optimization models. Management accounting means respecting the true and fair value principle and cost-benefit in providing relevant information.

Management models interrelate with economic and financial analysis models and with management accounting models. Information required in making decisions come from heterogeneous sources: from organization and beyond. More information reduces uncertainty, but also a good management reduces the uncertainty.

## V. DOMAIN ONTOLOGIES

Discussing about domain ontologies means putting in the main frame issues regarding conceptual structures, knowledge structures, and knowledge models in other words allots of terms imprecisely defined and controversial. These terms come from artificial intelligence field although semantic web technologies aren't necessary related to artificial intelligence.

In order to make some differentiations we discuss in the following about: a (computational) enterprise (data) model is "a computational representation of the structure, activities, processes, information, resources, people, behaviour, goals, and constraints of a business, government, or other enterprise".
At the heart of all Semantic web applications is the use of ontologies.

Ontologies are the structural frameworks for organizing information and are used in artificial intelligence, the Semantic Web, systems engineering, software engineering, biomedical informatics, library science, enterprise bookmarking, and information architecture as a form of knowledge representation about the world or some part of it. The creation of domain ontologies is also fundamental to the definition and use of an enterprise architecture framework (Wikipedia).

Contemporary ontologies share many structural similarities, regardless of the language in which they are expressed. As mentioned above, most ontologies describe individuals (instances), classes (concepts), attributes, and relations. In this section each of these components is discussed in turn.
Common components of ontologies include:
- Individuals: instances or objects (the basic or "ground level" objects)

- Classes: sets, collections, concepts, classes in programming, types of objects, or kinds of things.
- Attributes: aspects, properties, features, characteristics, or parameters that objects (and classes) can have
- Relations: ways in which classes and individuals can be related to one another
- Function terms: complex structures formed from certain relations that can be used in place of an individual term in a statement
- Restrictions: formally stated descriptions of what must be true in order for some assertion to be accepted as input
- Rules: statements in the form of an if-then (antecedent-consequent) sentence that describe the logical inferences that can be drawn from an assertion in a particular form
- Axioms: assertions (including rules) in a logical form that together comprise the overall theory that the ontology describes in its domain of application. This definition differs from that of "axioms" in generative grammar and formal logic. In those disciplines, axioms include only statements asserted as a priori knowledge. As used here, "axioms" also include the theory derived from axiomatic statements.
- Events: the changing of attributes or relations.

Ontologies are commonly encoded using ontology languages. A domain ontology (or domain-specific ontology) models a specific domain, or part of the world. It represents the particular meanings of terms as they apply to that domain.

Ontology engineering (or ontology building) is a subfield of knowledge engineering that studies the methods and methodologies for building ontologies. It studies the ontology development process, the ontology life cycle, the methods and methodologies for building ontologies, and the tool suites and languages that support them.

## VI. DECISION-MAKERS AND INFORMATION RETRIEVAL

Information retrieval is closely related to the first phase of decision making, namely documentation, information about decision-making problem. Sources of information are different and require aggregation, consolidation, classification and generalization on the basis of need information. Business process models allow integration of data and information on different levels.

Decision problems are information problems. Interest in modelling decisions concerns the expertise, the know-how to solve various decision problems. In reality, decision modelling is as important as information quality. Solving decision problems varies from person to person, from group to other groups. In this way, we can say that automation is not a concern. Sources of information are different in the case of decision problems. Data from applications such as: business investigation (BI), customer relationship management (CRM), supplier chain management (SCM), enterprise resource planning and business management (ERP) systems, collaborative, knowledge-based systems and various Web information sources. To have real time information, the decision maker would need a single interface for its search. It's what Google product OneBox Enterprise is trying to make by integrating information from different systems and provides simple search. Decision maker will need to perform queries in a logical sequence needed to solve the problem.

Still useful to consider the importance of web and ontologies. Web Ontologies are native, they are at a particular IP address. Data integration applications run in the web environment. Approaches using a global ontology in achieving communication of a common vocabulary and semantics prove difficult in terms of maintenance. Approach based on using software application local ontologies requires the merge of local ontologies. Hybrid approach involves defining local ontologies on a vocabulary of a global ontology. Modeling a specific sector of activity or organization is more difficult than modeling interconnected systems. Ontologies are an independent local context of action and a point of view of system users.

In research on information systems, the notion of context is treated by so-called views (views), issues and roles, workspaces. Local description of background information is known and is defined as a

vector of values. The role of ontology is to describe the structure of terms and concepts. Background information is used to label items matching different representations. Local representations capture local semantics, yet it is normal because it provides quick access to data. Thus, the current opportunity to ensure interoperability is reflected in the definition of coordination of inter-representation formalisms for semantic overlap of two concepts, which although are represented in different contexts (different ontologies) they have the same meaning. Ontologies have been represented through the use of formalisms such as language KL-ONE (descriptive logic). Of all languages, logic-based descriptive were the most common and have resulted in the basic formalism for building ontologies - Web Ontology Language OWL. The descriptive logic, expressed things are true or false.

The Semantic Web is the extension of the World Wide Web that enables people to share content beyond the boundaries of applications and websites. It has been described in rather different ways: as a utopic vision, as a web of data, or merely as a natural paradigm shift in our daily use of the Web. Most of all, the Semantic Web has inspired and engaged many people to create innovative semantic technologies and applications. The core technological building blocks are now in place and widely available: ontology languages, flexible storage and querying facilities, reasoning engines, etc. Standards and guidelines for best practice are being formulated and disseminated by the World Wide Web Consortium (W3C).

The field of economy and finance is a conceptually rich domain. In seeking to describe the basic categories and relationships of entities and concepts of any financial activity, one can think of creating a knowledgebase of the domain. By using an ontology, one can represent the financial information with all of its complexity and relationships.

## VII. CURRENT NEEDS

In our opinion, intelligent information needed in assisting decision-making process has the following characteristics:
- constraints or rules act on concepts that belongs to an a priori decision therefore they must be formalized to form specialized knowledge bases for decision models;
- queries must operate on concepts;
- “intelligent” information is provided by semantic contextual change, which means that ontology should allow inferring rules describing specialized knowledge.

Information reduces uncertainty. Assuming we reach information integration by using ontology and semantic overlapping we cannot consider the decision problem is fully solved due to different ways of solving problems (involving different decision rules); to different ways of organizing business (which involves organizing different concepts in the ontology), different perceptions on risk, profit, social or political implications of a decision (which means ontologies for different contexts). Currently we do not believe that the solution based on ontology is sufficient to unify the way of solving decision problems but perhaps we consider that this is the best suited to share the same semantics.

While semantic heterogeneity can be solved by making use of ontology, the context is highly dependent on local information purposes and is provided by decision-makers. Linking ontologies and reasoning will represent, in our view, the key to develop decision-support systems. These systems must have application and domain ontologies and mechanism to permit reasoning on big data sets.
At the higher level of information system should be used enterprise ontology. Integrating business rules in the model system can be achieved by specifying constraints on the concepts of ontology. The implemented model could be the so called business model.

The main benefits of using ontologies to organize concepts from organization are:
1) concepts integration
2) instances management by using reasoning;
3) sharing general.

In presenting our example for modelling business decisions we started from the necessity of knowledge elicitation, in real time, from decision-maker in order to adapt the model to the decision context. Model assumes:
- the existence of a domain ontology and an ontology developed for application;
- the possibility of specifying reasoning;
- the possibility of querying.

## VIII. CONCLUSIONS

We want to draw attention to the ideas presented in this article:
- People acquire knowledge and enrich their own knowledge base primarily through communication and interaction. They learn rules, laws, theories through social interaction and exchange of experiences;
- People learn from experience and, more importantly, learn to adapt so as to reach goals. We believe that adaptation through learning and leaning through adaptation are important features in emulating intelligent behavior;
- People are gifted by nature with cognitive processes, are able to express emotions and to propose goals.

Discussions on the development of decision systems using artificial intelligence techniques, development of knowledge-based systems or expert systems are centered on methodological issues of decision support: which approach is better in implementing algorithms for decision problems? Based on the model or one based on data?

The model approach is oriented to decision-maker. The decision maker defines the model using data structures allowed by the application. We focused in this paper on how to overcome the limitations imposed by the way in which the decision- making context is described by actual Decision Support Systems.

Our study has limitations derived from the fact that the domain of study is new, unstructured yet and with very few applications in practice. Therefore, any empirical analysis is limited. What we wanted to underlie is the fact that the decision-making context might be described by using ontology and semantic technologies.

Another important fact that our paper tries to transmit is its importance to business software developers. There is equivalence between the degree in which organizations realize their information needs, their needs in context representations and the degree in which business software developers realize what the niche for semantic web technologies is.

Our study addresses all information systems within an organization and is not limited only to Decision Support Systems. Under the umbrella of Decision Support Systems we treated any business information system that helps in making business decisions.

The main aspect presented by our solution is that the internal logic of one computer-based application might be used by another computer-based application. Information used by a decision-support system must be organized in domain ontology and application ontology.

In a client / server architecture with a database server, server domain ontology, ontology applications and an inference engine, editing the meta-model (specialized knowledge extraction) is performed by the user, the inference engine executes the rules and “enriches” semantically the existing ontology.

The user must have a custom application with ontology of concepts which will overlap with the domain ontology. In this way there is a possibility to retrieve information coming from different sources.

The problem of obtaining information in the context of using ontologies doesn't solve entirely the decision-making problem. Every decision-maker has its own way of solving decision-problems, its own perception of risk, and works in its own business environment.

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