THE USE OF DECISION SUPPORT SYSTEMS (DSS) IN SMART CITY PLANNING AND MANAGEMENT

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ABSTRACT

The components of a Decision Support System (DSS) offer the strategic, tactical and operational decision makers the required tools to plan and complete the set of projects necessary for the development of a Smart City and/or Smart Home. The rapid evolution of Information and Communication Technologies (ICT), Cloud Computing Services, the Internet-of-Things, Everything-as-a-Service (XaaS), as well as the development of new mathematical models, artificial intelligence and data storage capabilities, position DSS at a unique advantage as a continuously improving tool in the process of planning and completing complex projects. This paper presents the concepts of decisions, decision modeling and decision making, decision support systems, collaborative systems etc. and how these concepts can be useful in the context of a Smart City development project.

Keywords: Decision Support Systems, Information Society, ICT platform, Internet-of-Thing (IoT) , Everything-as-a Service (XaaS), Smart City, Web-based DSS.

1. INTRODUCTION

The transition from the traditional city to the smart city is made through supported efforts towards the achievement of a steadier, more efficient, and more responsible city. This is accomplished through convergent strategies that deal with Smart Transportation Systems, Energy and Utilities Management, Water Management, Smart Public Safety, Healthcare Systems, Environmental Management, Educational Systems, Information and Communications Technologies (ICT) Support, and Positive Thinking. The Smart City concept was developed during the past decade. Many business organizations, research and academic institutions, city councils, and governments have invested significantly in projects to study, design, and build solutions for urban cities using ICT and IoT (Information and Communication Technologies and easy access to Internet-of-Things). IBM Smart Planet, Oracle i-Government, Austin, Barcelona, Helsinki, Amsterdam Smart City, Dubai Smart City, European Smart Cities and Smart Cities Future are just some examples of the leading Smart City projects. The rapid expected growth of cloud computing and the Everything-as-a-Service (XaaS) market will provide both great pressure and support for the development of the traditional cities into a smart cities.

A city can be defined as 'smart' when investments in human and social capital, in traditional transport and modern communication infrastructure, all fuel efficient and sustainable economic development. In this 'Smart City' a wise management of natural resources and a high quality of life through participatory governance become consistencies

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and priorities. Smart Cities are the result of a dynamic process which develops along six dimensions: smart economy, smart people, smart mobility, smart environment, smart living and smart governance (http://www.ricercast/smartcities). These six dimensions identify urban growth and development, and are based on theories of regional competitiveness, human and social capital, participation of citizens in the governance of cities, transport and ICT economics, natural resources, quality of life and provide an image of how much a given community has achieved in the process of transforming itself into a smart city, and can be used to rank or describe the development towards 'Smart City' status.

Information technologies, and especially the Internet, mobile telecommunication and easy access to Internet of Things (IoT), have enabled the development of a new Information Society. Information and communication technologies (ICTs) are now used in many fields such as public health, road safety, e-commerce and energy. The Information Society currently plays a central role in the route transformation of the traditional city into a smart city. The European Union (EU) developed a lot of projects for using ICT facilities in various fields with the specific purpose of improving the quality of life for European citizens. Specifically, large-scale ITC projects have been developed in the following fields:

- Road safety: e-Call, i2010 Intelligent Car Initiative, In-vehicle emergency call system, e-Safety;
- Economic commerce: "Directive on electronic commerce";
- Payment systems: Community framework for electronic signatures, Electronic payment, Relationship between card-holders and card-issuers;
- Research: A strategy for research on future and emerging technologies in Europe ;
- The energy sector: ICTs to facilitate the transition to an energy-efficient, low-carbon economy ;
- Public health: Telemedicine systems and services.

The Smart City is a result of a long chain of Decisions and Decision Support Systems (DSS) used in various large-scale projects planning which develop the traditional city into a smart city. The Program Evaluation and Review Technique (PERT) is a widely used method for planning and coordinating these large-scale projects. It is generally accepted that time, money, people, equipment and other supplies are all needed for planning and executing such a project. In the period of research and design of a given project, it is very important to understand and follow a specific set of guidelines for that project, such as: (a) all tasks must have distinct beginning and end points; (b) all estimates must be realistic; (c) tasks must be able to be arranged in a defined sequence that produces a pre-defined result (a critical path must be recognizable); (d) resources may be shifted to meet need; and (e) cost and time share a direct relationship (i.e. the cost of each activity is evenly spread over time).

Today, Decision Support Systems (DSS) have become the usual tools for decisions and the decision making process. In the 1960s, Information Systems researchers and technologists began systematically studying the use of computerized quantitative models to assist in decision making and planning [Power, 2002]. The first model-driven DSS was built in the late 1960s, followed by several theory developments in the 1970s, and implementation of financial planning systems, spreadsheet-based DSS and Group DSS in the early 1980s. After that, data warehouses, Executive Information Systems, On-Line Analytical Processing (OLAP) and Business Intelligence evolved in the late 1980s and early

1990s, augmented by Knowledge-driven DSS and the implementation of the Web-based DSS beginning with the 2000s. The field of computerized decision support systems is expanding to use new technologies and to create new applications. Business and management applications of DSS started developing in the 1980s, including advances in Model-driven DSS, Data-driven DSS, Communications-driven DSS, Document-driven DSS, and Knowledge-driven DSS. By 1995, the World-Wide Web was recognized by a number of software developers and academics as a serious platform for implementing all types of Decision Support Systems. New approach of DSS Architecture based on Data Warehouse, several forms of integration Expert Systems into DSS, Spreadsheet packages as DSS generators, including IoT component in DSS are new development directions, in our days, of Decision Support Systems. The current research directions in the ICT field are focused on the elaboration and implementation of powerful hardware and software platforms which can use the capabilities offered by the Systems / Collaborative Software (CS) products and the DSS, and thus offer data and information in due time to the decision bodies and the population of the smart city, ensuring that they have permanent and up to speed access to this information and decisions.

The day-to-day management of the Smart City activities involves a lot of decisions at the strategic, tactical and operational level. Strategic and tactic decisions are often planned simultaneously across multiple projects, and useful-time decisions are the main objective of the city government. We can identify main collaboration opportunities when companies collaborate in their transportation planning, business and educational projects, environment activities and so on. The managers use the facilities of DSS and CS for complex decision making. Usually this technical support is integrated in the dynamic development process from the perspective of city planning and management, which requires that developers of DSS continuously improve and provide new capabilities for specific time-perspectives or specific horizon project.

This chapter presents several concepts related to the development of the smart city – specifically this chapter discusses the contents, structure and relationships among the smart city, Information Society, ICT – Hardware and Software Platform, DSS, Cloud Computing, Internet-of Things (IoT), Everything-as-a-Service (XaaS), Web-based DSS, as well as some examples of DSS and Collaborative Systems concepts based on software packages such as ERP, CRM, CIM, MS-Project Manager (which focus on operational and strategic/tactical planning decisions).

2. DECISIONS AND DECISION MODELING

Any human activity/task is influenced by three basic factors: matter, energy and information. The information flow associated with different activities/tasks within the smart city (and any information flow for that matter) has two main components: a prospective component (related to prognoses, programming and planning of the activities) and a retrospective component (related to supervising and controlling the activities/tasks). Projects and their related activities/tasks are encountered in all aspects of everyday life, from simple personal projects to complex business, enterprise, school, city, or smart city projects. All projects contain multiple tasks and performing each task involves making decisions (e.g. list of project tasks, time, resources, costs, earliest start time, latest finish

time etc.). These decisions need to be made for every project activity in a timely manner, without delaying the project completion. The main objective of any information flow is to supply "raw materials" for the decision process, given that any decision – at all stages, from start to the final feedback – needs accurate and in time data and information. In fig. no. 1 there is a imagine of a conceptual scheme of a smart city, where we can identify many, many projects for each level smart city components (water, energy, transport, security, waste, CO2 emissions, ICT) and the level of smart city government [Chichernea, 2011].

A decision is a choice made, sometime under uncertainly, between two or more available alternatives. Decision making is a long dispute between Mr. Yes and Mr. No, which defines the process of choosing the best alternative for the stated objectives. Managers make daily decisions affecting the organization and communicate those decisions to other organizational members. Most of decision theory is normative or prescriptive, assuming an ideal decision maker who is fully informed, able to compute with perfect accuracy, and fully rational. The practical application of how people ought to make decisions is called decision analysis, and is aimed at finding tools, methodologies and software to help people make better decisions. The most systematic and comprehensive software tools developed in this way are called decision support systems (http://www.wikipidia.org/wiki/). The imperative to make faster, better decisions has increased the pressure on organizations and their employees and the result is a fast development of a data-driven culture, typically based on the use of analytics and business intelligence.

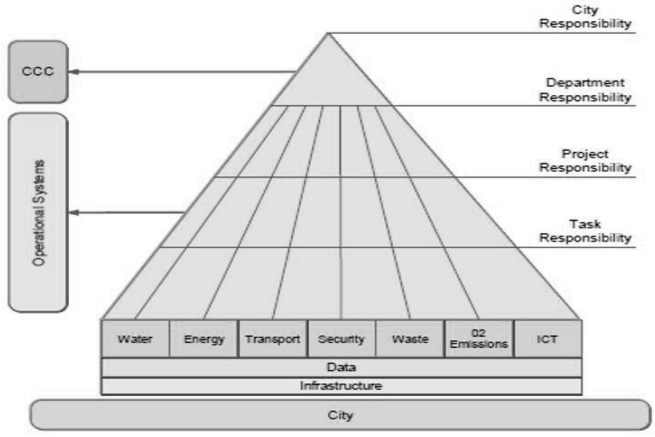

Fig No. 1 Conceptual scheme of a Smart City

- **Types of Decisions** In any organizations (small, medium or large size), Smart Cities included, there are three management levels: strategic level, tactical level and operational level (see fig. no.1). Making the correct decisions (most likely in useful time) at every level is a necessary condition for the organization's success. Decisions can be classified either based on the nature of the decision itself (programmed or non-programmed) or based on the organizational management level dealing with the decision (strategic, tactical and operational):
- - Programmed decisions are routine and repetitive, and the organization typically develops specific ways to handle them. A programmed decision might involve determining how products will be arranged on the shelves of a supermarket. For

this kind of routine, repetitive problem, standard arrangement decisions are typically made according to established management guidelines;

- - Non-programmed decisions are typically one-time decisions that are usually less structured than programmed decision.
- - Strategic decisions– relate to the identification of long-term or overall aims and interests and the means of achieving them;
- - Tactical / Organizational decisions – relate to the way different aspects and parts of a group are arranged with the aim of being more orderly and efficient;
- - Operational decisions– relate to the way a group or organization works on a daily basis.

Decision Modeling and Decision-Making Processes Decision Modeling makes the business logic visible and understandable and helps each management level of organizations to clarify and better analyze the relationships between business logic, processes and information. The level of improvement decision modeling makes for decision making depends of quality of data, information, facts and knowledge. Data is known to be crude information and not knowledge by itself. The sequence from data to knowledge is: from Data to Information, from Information to Facts, and from Facts to Knowledge. Data becomes information, when it becomes relevant to a decision problem. Information becomes fact, when the data can support it. Facts are what the data reveals. Fact becomes knowledge, when it is used in the successful completion of a decision process. The image of these processes can be seen in fig. no.2.

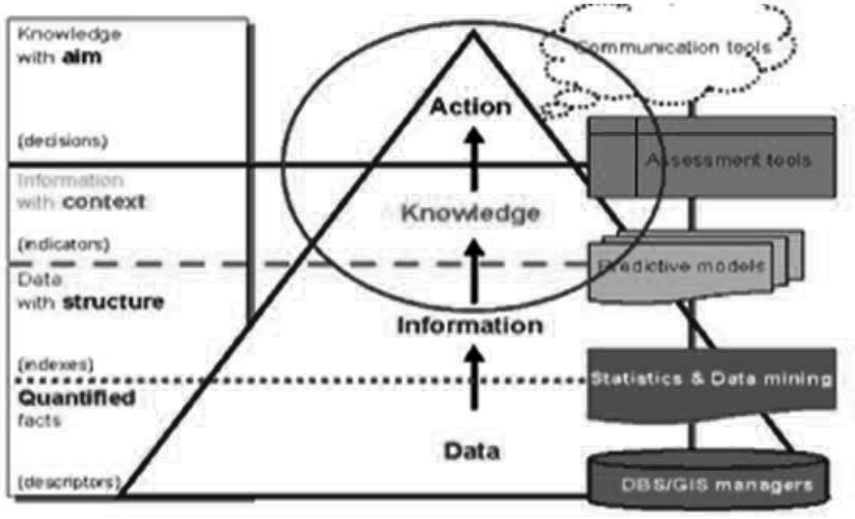

Fig. No. 2 Conceptual scheme of a Decision Support System

In general, decision modeling refers to the use of mathematical or scientific methods to determine an allocation of scarce resources which improves or optimizes the performance of a system. The terms operations research and management science are also sometimes used to refer to decision modeling. Examples of software applications developed in support of decision modeling for production, distribution, marketing, financial include packages like ERP, CRM or CIM [Hamilton, 2003].

Decision making is a daily activity for any human being. When it comes to businesses and organizations, decision making becomes a very important process for management - effective and successful decisions result in large profits for the company, while unsuccessful ones generate losses. Therefore, the decision making process is the most critical process in any organization. During the decision making process, we choose one course of action from several possible alternatives. We may use many tools, techniques and perceptions in order to reach our own private decisions or may prefer a collective decision instead. The technical literature has developed the following steps for the Decision Making Process, under different decision criteria, type and quality of available information (each step may be supported by different tools and techniques): identification of the purpose of the decision; information gathering; develop principles for judging the alternatives; brainstorm and analyze the different choices; evaluate the alternatives; select the best alternative; execute the decision; and, finally, evaluate the results. During the life of an organization, decision making is hard, and usually involves taking risks, but decision makers have to keep in mind that the greatest danger in a business setting (and life in general) is to do nothing. Usually, making the decisions and accepting their consequences is the only way to stay in control of your organization's life and time.

Because economical process are very complex, a complex study of problems that require making decisions that rely on multiple criteria at the same time is needed. The thorough studies in this field and the complexity of computations that need to be made in useful-time had great impact over what we nowadays call Decision Support Systems. Decision theory says that a decision process is characterized by the following elements:

- Decision criteria (the different points of view the problem is analyzed from);
- Objective (or objectives that are being pursued);
- Decision maker (the person or group of persons that look to make decision in order to accomplish the objective in the best possible conditions);
- The set of alternatives (is contains all of the possible actions that can be taken in order to achieve the objective);
- The set of possible states (each state represents the multitude of conditions that determines the apparition of a certain consequence for a certain alternative on a given objective);
- The set of consequences for alternatives (it comprises either exactly the same number of consequences as there are alternatives – one state means one certainty condition – or multiple possible consequences for each alternative – more possible states means conditions of risk or uncertainty);
- The utility that the decision maker looks for following the realization of a certain consequence.

The multidimensionality, which signifies taking multiple criteria into consideration at once, represents the main obstacle that can be overcome by using the mathematical apparatus provided by the theory of mathematical programming using multiple optimum criteria. For this kind of approach, we first need to outline the mathematical model for this complex decision process.

A web-based decision support system offers access to decision makers, via Internet, to planning systems for many, many projects using a web browser. For designing and developing the web-based DSS the Object Oriented Design methodology is used (OOM).

This methodology uses objects to represent data structure models and software assembled into the final product following certain rules. Using this model, each object has a number of attributes, methods and links to other objects in the system. A web-based DSS stands out from a classical desktop DSS because it is accessible through the Internet, typically via a web browser. Another quality of a web-based DSS is that the system can be maintained by a provider and access to support can be offered via Internet or other type of wide area network on a subscription basis (per user, per session, monthly or yearly fee). The benefits for the users of the system are that there is no hardware cost for maintenance, instant access to software updates, small initial investment and reduced risk.

Decision Tree and Influence Diagram The most common Visual (graphical) Modeling Tools for decision modeling are decision trees and influence diagrams, each of which may be supported by different software packages. A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. Decision trees are one way to display an algorithm, and are commonly used in operations research, specifically in decision analysis, to help identify a strategy most likely to reach a goal. Informally, decision trees are useful for focusing the discussion when a group must make a decision. Another use of decision trees is as a descriptive means for calculating conditional probabilities. Decision trees can be drawn by hand or created with a graphics program or specialized software. There are many specialized software packages which focus on decision trees and visual modeling tools (e.g. Smart Draw, TreeAge Pro Excel), thus allowing one to easily build decision trees to analyze a business, research, financial or legal problem [Hanna & Ahuja & Winston, 2013].

An Influence Diagram (ID) is a compact mathematical and graphical representation of a decision situation and a simple visual representation of a decision problem. ID offer an intuitive way to identify and display the essential elements, including decisions, uncertainties and objectives, and how they influence each other. ID were first developed in mid-1970s within the decision analysis community with an intuitive semantic that is easy to understand. They are now considered a viable alternative to decision trees, which typically suffer from exponential growth in number of branches with each variable modeled. The diagrams can be used for creating computer-based models that describe a system or as descriptions of mental models managers use to assess the impact of their actions. An influence diagram is intended to document an overview of the business and gives decision makers an understanding of the results of actions they may choose to take.

Decision trees and influence diagrams are complementary views of a decision problem. Decision trees display the set of alternative values for each decision and chance variable as branches coming out of each node. The influence diagram shows the dependencies among the variables more clearly than the decision tree. The decision tree shows more details of possible paths or scenarios as sequences of branches from left to right, in time that the influence diagram is a much more compact representation.

Executive Information System Decision making and decision modeling requires large amounts of quality data and information in useful time. The Management Information System is a very good solution for controlling the information flow from any business, enterprises (small, medium, large enterprises) and smart city. The Executive Information System (EIS) is a set of management tools supporting the information and decision-making needs of management by combining information available within the organisation with external information in an analytical framework. An EIS is a type of management information system intended to facilitate and support the information and decision-making needs of senior executives by providing easy access to both internal and external information relevant to meeting the strategic goals of the organization. EIS is commonly considered a specialized form of a Decision Support System (DSS). The components of an EIS can typically be classified as:

- Hardware (input data-entry devices, the central processing unit (CPU), data storage files, and output devices);
- Software (text base software, database, graphic base, model base, DSS);
- User Interface (scheduled reports, questions/answers, menu driven, command language, natural language, and input/output);
- Telecommunications (Transmitting data from one place to another has become crucial for establishing a reliable network);
- Applications (people have applied EIS in many areas, especially, in manufacturing, marketing, sales and finance areas).

EIS is a computer-based system that serves the information needs of the executives and provides rapid access to timely information and access to management reports. They provide holistic information from a corporate (ERP systems), Business Intelligence (B2B, B2C), Enterprise Information Portals and Knowledge Management System. EIS have user-friendly, supported graphics, provide exceptional reporting and "drill-down" capabilities and are easily connected to the internet. Organizational Decision Support Systems (ODSS) are a combination of computer and communication technology designed to coordinate and disseminate decision-making across functional areas and hierarchical layers in order that decisions are congruent with organizational objectives and management's shared interpretation of competitive environment. The great producers of software (IBM, Microsoft etc.) develop technologies that could allow creating applications able to function in the context of cloud computing (using web solution, Internet/ Intranet, etc.). ERP Systems (Enterprise Requirements Planning) and CRM (Customer Relationship Management) have a positive impact both on the company's performance and upon its collaboration with its partners [S. Hamilton, 2003].

In this respect the informational systems of a company comprises of the following modules:

- The planning of the company's resources (ERP) which is a system that integrates the main economic processes that take place inside the company (Finances, Human Resources Management, Purchase, Planning and monitoring of the production, Sales). ERP integrates all departments and functions across an organization into a single computer system that addresses the needs of the entire enterprise.
- Customer Relationship Management (CRM) is designed to solve the complex nexus of interactions between the company and its clients. CRM offer the facilities of services through Internet, telephone, ATM/Kiosk etc.

- E-business (online business) assures the access on the web of ERP systems (Business to Business (B2B), Business to Consumer (B2C), Supply Chain Management (SMC));
- Business Intelligence (BI) applications – software support for collect stock and adjust data in order to take decisions. BI includes activities such as: Decision Support Systems (SSD); Online Analytical Processing (OLAP), Data warehouse, Data Mining.

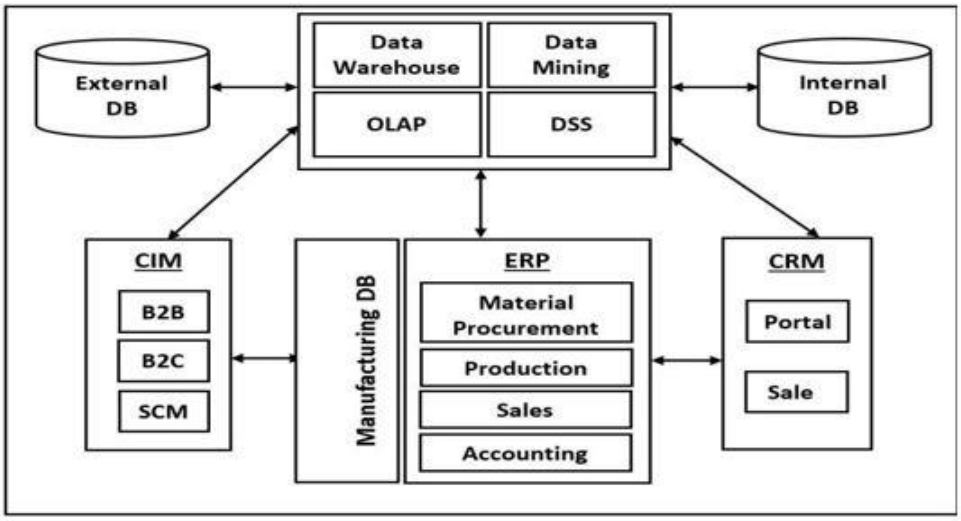

Fig No. 3 ERP – CRM – CIM Information flows

In fig. no.3 we can see a schematic image of information flows for ERP and an overview of information flows of ERP – CRM – CIM (Common Information Model).

3. DECISION SUPPORT SYSTEMS (DSS)

A Decision Support System is an interactive information system which is intended to assist users in making an informed decision based on a set of specific criteria which has been set by the user. The Decision Support System (DSS) is a class of information systems that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system, intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, or business models in order to identify and solve problems and make decisions (http://www.wikipidia.org/wiki/).

Collaborative software is computer software designed to help people involved in a common task achieve their goals. It is usually associated with individuals not physically co-located, but instead working together across an internet connection. It can also include

remote access storage systems for archiving common use data files that can be accessed, modified and retrieved by the distributed workgroup members.

Decision support systems are interactive, computer-based systems that aid users in judgment and choice activities. They provide data storage and retrieval but enhance the traditional information access and retrieval functions with support for model building and model-based reasoning. These systems support framing, modeling, and problem solving. Typical application areas of DSS are management and planning in business (transport, energy, CO2 Emission, ICT etc.), health care, the military, and any area in which management will encounter complex decision situations. DSS are powerful tools integrating scientific methods for supporting complex decisions with techniques developed in information science, and are gaining an increased popularity in many domains. They are especially valuable in situations in which the amount of available information is prohibitive for the intuition of an unaided human decision maker and in which precision and optimality are of importance. DSS aid managers by integrating various sources of information, providing intelligent access to relevant knowledge, aiding the process of structuring, and optimizing decisions. The graphical schematic of the relationship among the Smart City, the Information Society, Decision Support Systems, ICT platforms and Cloud Computing is presented in fig. no. 4.

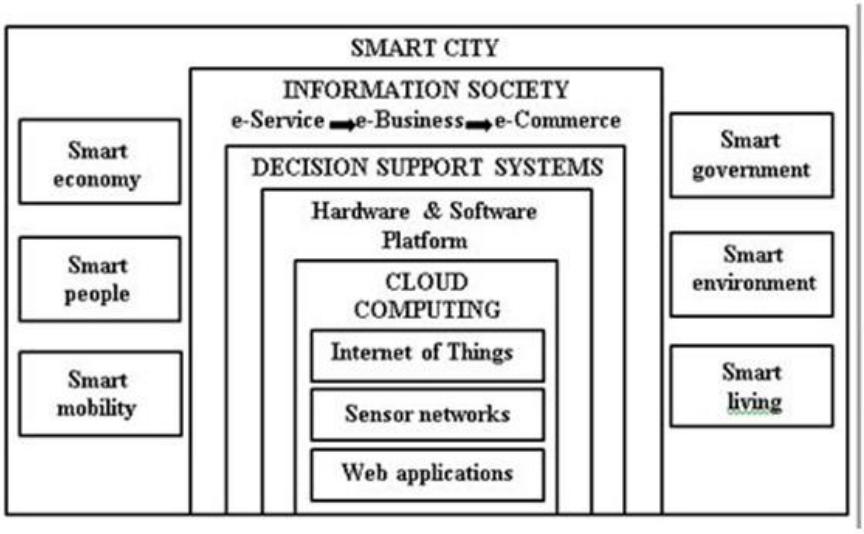

Fig No. 4 Relationship among Smart City, Information Society, Decision Support Systems, Hardware & Software Platform and Cloud Computing

Main Components of a Decision Support System Decision Support System can be composed of different sub-systems such as: Data Management, Model Management, Knowledgebase Management, Dialog Generation and Management System, and the User Interface [Druzdzel & Flynn, 2002]. The architecture and structure of DSS are presented in Fig. no.5.

The Data Management (DM) sub-system collects and organizes the data. Data Management requires the use of a Data Base and a Data Base Management System (DBMS). It also needs storage which holds the data until is it required to be used and

manipulated. DM assists the decision-making processing of the data and serves as a data bank for the DSS and stores large quantities of data that are relevant to the class of problems for which the DSS has been designed. A DBMS separates the users from the physical aspects of the database structure and processing.

The Model Management subsystem utilizes software such as a spreadsheet to develop the statistical or quantitative models used to analyze the data. The software used for this is usually called a Model Base Management System (MBMS). Model Management allows the user to create a model to represent a problem, and enables data to be processed into information. The model allows for input variables that will change the output depending on the model, prototype or simulation utilized. The role of MBMS is analogous to that of a DBMS. The purpose of an MBMS is to transform data from the DBMS into information that is useful in decision making. Since many problems that the user of a DSS will cope with may be unstructured, the MBMS should also be capable of assisting the user in model building.

The Knowledge-Based Management (KBM) subsystem supports the other systems as it acts as an independent component to provide the intelligence to augment the solution for a decision to be made. This sub-system can also be known as organizational knowledge base.

The Dialog Generation and Management System (DGMS) is the main product of the interaction with a DSS and it helps the user get insight from this interaction. As their users are often managers who are not computer-trained, DSSs need to be equipped with intuitive and easy-to-use interfaces. These interfaces aid in model building, but also in interaction with the model, such as gaining insight and recommendations from it. The primary responsibility of a DGMS is to enhance the ability of the system user to utilize and benefit from the DSS.

The User Interface (UI) enables the user to communicate with the Decision Support System and to extract the information that is derived from the modelling of the given situation. UI enables the users to be informed throughout the process helps them make a decision. The interface can report the functioning of the model and what is happening at any time during the operation of the model and finally give the user an informed response or responses to the stimulus given. The user can then make a decision based on the response from the DSS.

The function of the Decision Support System is to enable the user to build a model of the problem, and input the data so that the DSS can organize, process, and analyze it, and then to enable the user to retrieve the information output and determine possible solution(s). The main role of the DSS software is to create a model for the user, by using the appropriate software package (such as, for example, databases, spreadsheets, expert systems or neural networks). For the user and developers of DSS the internet provides a wealth of information regarding training (see for example MS Project Manager, ERP, CRM, etc.). The training process for using a DSS must contain the following steps: Remembering; Understanding; Applying; Analyzing; Evaluation and Creating.

A DSS may present information graphically and may include an expert system or artificial intelligence. Typical information that a decision support application might gather and present to the user would be: (a) Accessing all information assets, including legacy and

relational data sources; (b) Comparative data figures; (c) Projected figures based on new data or assumptions; (d) Consequences of different decision alternatives, given past experience in a specific context.

Examples of Decision Support Systems As mentioned in the introduction, planning and executing a project requires time, money, people, equipment and other supplies, and most importantly a whole lot of information. The Program Evaluation and Review Technique (PERT) is a widely used method for planning and coordinating large-scale projects. Project Management (PM) Software Package seeks to answer two key questions in order to craft effective project plans: (1) what tasks are necessary to do this project? (2) how long will it take to do those tasks? Based on the answer to these two questions, PM provides responses to the four basic issues raised in most cases: How long will this project take? What will it take to do this project? Can it be completed sooner? How likely is it that it will be done on time?

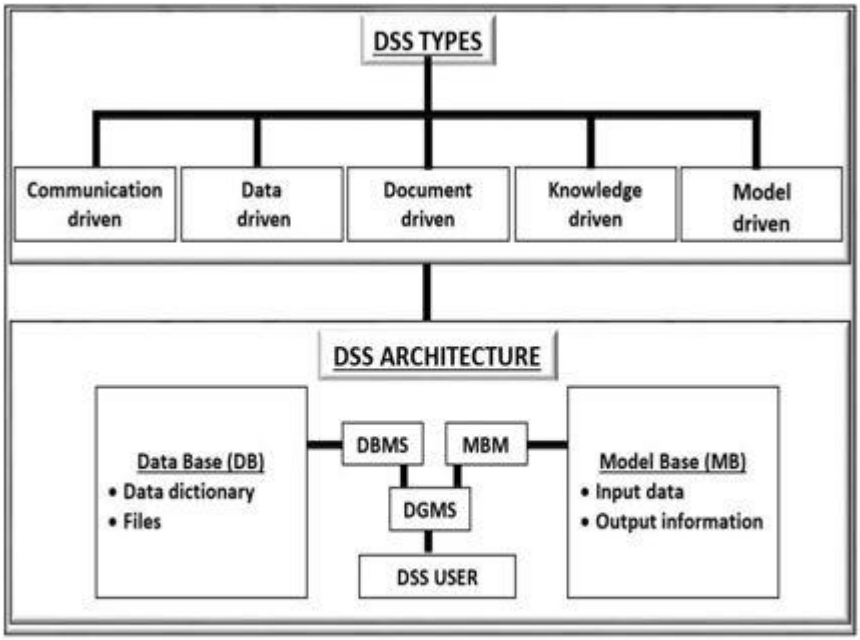

Fig. No. 5. The architecture and structure of a DSS

For complex problems involving hundreds of activities, computers are used to create and analyze the project networks. The basic project information input for the computer includes the earliest start and finish time for each activity, as well as the latest start and finish time for each activity (without delaying the project completion). From these values, a computer algorithm can determine the expected project duration and the activities located on the critical path. Software packages (e.g. MS Project Manager) produce time analyses, resources analyses and cost analyses and issue several reports which can be grouped in categories like overview (project summary), top-level tasks, critical tasks, milestones, working days etc., in each stage of the project (design or execution stage) and enable of the project managers the following type of the reports:

- Current activities: Unstarting Tasks, Tasks Starting Soon, Task in Progress, Completed Tasks, Should Have Started Tasks, Slipping Tasks;

- Costs: Weekly Cash Flow, Budget, Over-budget Tasks, Over-budget Resources, Earned Value;
- Assignments: Who Does What, Who Does What When, Weekly To-Do–List, Over-allocated Resources;
- Workload: Task Usage, Resources Usage;
- Custom: Base Calendar, Budget Report, Completed Tasks, Crosstab, Earn Value, Milestones, Over-allocated Resources, Over-budget Tasks, Project Summary, Resources, Resource usage, Should Have Started Tasks, Slipping Tasks, Task in Progress, Task Starting Soon, Top Level Tasks, Un-started Tasks, Weekly Cash Flow, Weekly To Do List, Who Does What, Who Does What When.

4. THE ADVANTAGES AND DISADVANTAGES FOR USING A DSS.

Some of the advantages of using DSS in decision making process include:

- Time savings - reduced decision cycle time, increased employee productivity and more timely information for decision making.
- Enhance effectiveness - improved decision making effectiveness and better decisions;
- Improve interpersonal communication - can improve communication and collaboration among decision makers;
- Competitive advantage for business intelligence systems, performance management systems, and web-based DSS;
- Promote learning - learning of new concepts and the development of a better factual understanding of the business and decision making environment;
- Increase organizational control - Data-driven DSS often make business transaction data available for performance monitoring and ad hoc querying.

Although DSS can provide undeniable advantages for organizations and can have positive benefits, building and using DSS can also create negative outcomes in some situations. The following are some of the disadvantages that can come with DSS:

- Overemphasized decision making. We must continue to ask if the decision situation is appropriate for using any type of DSS and if a specific DSS remains appropriate to use;
- Assumption of relevance. The danger is that managers will use DSS inappropriately;
- Unanticipated effects. Implementing decision support technologies may have unanticipated consequences. Some DSS reduce the skill needed to perform a decision task;
- False belief in objectivity. Managers who use DSS may or may not be more objective in their decision making.

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