

DSS FOR ENHANCED EMERGENCY CALL SERVICES: A DALMATIA CASE STUDY

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Abstract

Because of international agreements and protocols as well as hosting numerous tourists during summer, Croatia needs to establish of Enhanced Emergency Telephone Call Services. For Split-Dalmatia County a pilot project called "Enhanced Emergency Call Service 112" was evaluated. The approach is based on available infrastructure, resources, knowledge and potentials, aiming to conceptualise "Centre 112", mainly from telecommunication and decision support model aspects, in organisational and functional manner.

Starting from the telecommunication infrastructure base, we analysed the digital records for "Centre 112" infrastructure efficiency (areas covered, covering of special risk areas, capacities, reliability, technical and technological functionality, interoperability, etc.). Moreover, analysis of available resources for rescue and help was performed regarding telecommunication equipment and possibility to fit into unique emergency management systems (police, fire brigades, hospitals and ambulances, marine and river rescue teams, mountain rescue teams and other SAR brigades, various anti-accident biological, chemical-technological and other brigades, special mobile mechanisation, experts in certain fields, etc.). To make "Centre 112" more efficient, based on the analysis of collected data, a DSS for Enhanced Emergency Call Services is conceptualised. It consists of several modules containing model and software support for "Centre 112" functioning. The most important modules are: GIS (geographic information system), locating critical infrastructure network using GIS, locating the calls in the fixed phone network, locating calls in the mobile telecommunication network, determining the nearest station for intervention and the fastest route for intervention by using GIS "network analyst" software, establishing alerting and warning functions via fixed and mobile telecommunication networks, location the user of mobile phone within SAR activities, offering services to the tourists that calls "Centre 112" (identification of communication language and establishment of some automatic dialogs), etc.

Introduction

Noticeable increase of amount and frequency of natural and technologically based accidents, as well as danger from terrorist attacks, clearly indicates the need for an improved organisation of efficient urgent help services. Furthermore, telecommunication support to both civil services and services for crises situations, profoundly contributes for lowering threats to human life, as well as materials, goods and environment protection, while at the same time covering the basic needs for private and public information.

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Important activities connected with public security oriented to civil protection support and relief of emergency situations, are currently being undertaken in various national, regional and international bodies (1). It is believed that the establishment of the "Law of protection and rescue" in Croatia was came about from integration in the European system for search and rescue during emergencies, as well as by signing protocols and obligations. This new law, beside other things, prepossess introduction of regional Centres "Centres 112" as PSAP (Public Safety Answering Points) services, making Croatia consistent with the European system of unique "112" telephone aid numbers. Implementing "Centres 112" demands very complex intervention within the information and telecommunication systems in order to achieve a high technological services level, increase efficiency of first aid and, generally, interventions in diverse emergencies and catastrophes. Experiences of the United States and European countries definitely help the process of system conceptualisation in Croatia. Even though the progress in information and telecommunication technology is very fast, all countries share the same challenge: how to utilise all possibilities of technological progress. Furthermore, almost all countries face the problem that the part or even all of the telecommunication system belongs to the private sector, therefore the jurisdictional and other frameworks and principles of telecommunication services costs has to be worked out with the private sector for the general public interest.

This paper presents a concept of case study, evaluated in order to analyse available infrastructure basis, resources, knowledge and potentials of Split-Dalmatia County. Further objective is to conceptually co-ordinate them to develop a "Centre 112" structure in organisational and functional sense, primary for the telecommunication and model aspect.

Main milestones in the first phase of Case study realisation are:

- analysis of telecommunication infrastructure basis and forming of digital records for efficiency analysis in function of "Centre 112" (coverage of areas in a whole and coverage of exceptional risk areas, capacities, reliability, technical and technological functionality, interoperability, etc.)
- analysis of available resources for aid and rescue from the aspect of telecommunication equipment and possibility to fit into unique emergency management system (police, fire brigades, hospitals and ambulances, marine and river rescue brigades, mountain rescue teams, and other SAR brigades, various anti-accident biological, chemical-technological and other brigades, mobile special mechanisation, experts in particular fields, etc.)
- analysis of possible model and software support to "Centre 112" functioning (geographic information systems - GIS, location of key "critical" infrastructure network within GIS, location of calls in fixed phone network, location of calls in mobile phone network, identifying the closest intervention station within GIS and the fastest intervention route by software "Network Analyst", establishment of alert and warning functions via both fixed and mobile phone networks, Internet, location of mobile phone network users in the SAR activities, etc.)
- analysis of established European standards and regulations for "Centre 112", and analysis of the possibilities of application for European projects LOCUS, ROSETTA i CGALIES, as well as participation in other actual projects in this fields.
- analysis of the Croatia law's regulations and presumptions for "Centre 112" functioning, accepting standards for privacy protection, as well as ownership of telecommunication equipment and costs coverage of "Centre 112" services.
- conceptualisation of telecommunication support for "Centre 112" within Case Study of Split-Dalmatia County
- conceptualisation of operational procedures and software for different functions during crisis, based on usage of present telecommunication infrastructure system
- conceptualisation of possible technological solutions for locating help calls in the both the fixed and mobile phone systems taking into account existence of several operators on the particular area



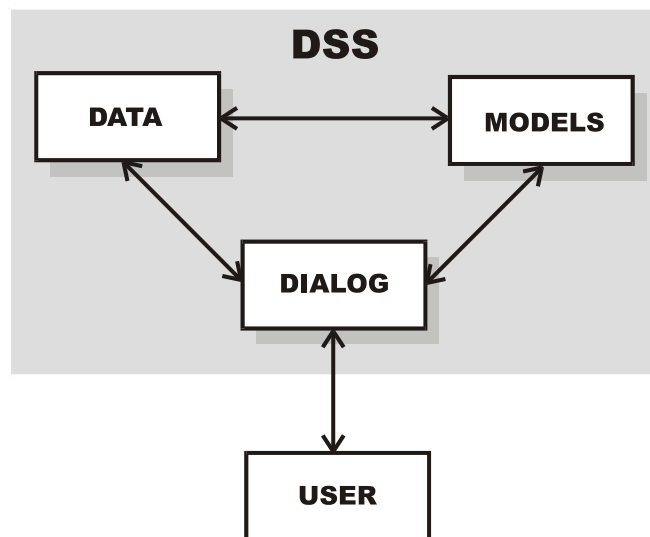
- conceptualisation of possible technological services solutions for tourists calling "Centre 112" (identification of communication language and establishment of some automated dialogs, etc.)

Theoretical background

The decision process is a generic process that can be applied on any kind of organised set of activities in order to meet objectives. Generally, there is no unique model of decision process, because it includes numerous variables, different kinds of decisions (strategic, tactical, and operational), as well as different decision makers.

There are lots of definitions of decision support system (DSS) but for this purpose it can be said that it is a system that consists of users/managers that use the system and its resources in order to solve tasks (problems) in organisational environment (Sprague, Carlson 1982). DSS philosophy is based on paradigm "Data - Dialog - Models", meaning "user" communicates with the computer on the natural language (mainly through menus), and special interfaces enable data base management and model management, that are able to communicate mutually, as well (Figure 1). From the point of view of the user (manager), a decision support system must support users at all levels and help the integration between levels whenever possible. Furthermore, decision makers express the need for integration and co-ordination of the decision making process that includes several persons who participate in the process of solving a larger problem.

Figure 1: Basic DSS concept



Use of that knowledge and experience in the development of a decision support system for enhanced emergency call services logically leads to the implementation of a system that will support all decision levels. The organisation of that system is generally hierarchic; at each level decisions are made in accordance with the authority. The decision character is different at some levels and depends on the system organisation; the decision range at lower levels is in accordance with previously made strategic decisions. All decision makers have different authorisations and operational possibilities and their communication is often very complex. Therefore an operational understanding is essential for the development of a decision support system. Such a system is complex and comprises many details. Therefore, at elaboration and system analyses, it is necessary to concentrate on a higher level of abstraction and look at the system through decision character that is correlated to the hierarchic structure of the emergency management system.

The decision support system helps to structure and organise such a large quantity of information related to the emergency management system, especially spatial data, in order to make it available to decision makers in a comprehensible and user-friendly way. A system approach throughout the decision support system provides very simple and comprehensible integrated information regarding the technological changes and in accordance with different emergency policies and management methods.

Besides the organisational aspect, changes of the technological subsystem influence the organisation of the decision support system. It is evident that there is no permanent solution in terms of decision uniqueness, since the decision making process must be able to continuously accept all changes and to support problem solving in accordance with them. Hence, for modelling of such a system in the area of emergency management it is necessary to find the best solution not only in terms of organisational and technological but even in economic and sociological aspects in accordance with the concept and idea of enhanced emergency call services (Centres 112).

The DSS model relies on basic decision making levels:

- strategic level – decisions with long-term consequences related to the system development and criterion for valuation of these decisions is efficiency of whole system;
- tactical level – decisions that ensures realisation of strategic levels, and criterion for their valuation is successfulness of the system;
- operational level – realisation of the upper level decisions.

Building DSS for Enhanced Emergency Call Services

Concerning all functions of the various services and units included in activities of preparedness, prevention, response and relief in catastrophes and other emergencies, the DSS based on an effective system of distributed data bases and GIS applications to achieve and guaranty a high level of effectiveness. Generally, the DSS has to be built on several levels, namely a DSS that covers operation of Regional Centre for Assistance and Disaster Relief⁷ (RCADER) situated in Divulje (Figure 2) as a top level in County (strategic level), and several DSS at lower levels that serve “Enhanced Emergency Call Services (Centre 112)” on the Split-Dalmatia County area (tactical level). The DSS’ conceptual design is divided into a number of segments (modules) that will be built in the further phases. The basic module is a GIS for all levels of DSS that comprise information sub-systems about spatial and other data and serves the other modules with data and information.

The GIS module is divided in several thematic layers with basic information about settlements, road network, topographic data, location about police and fire departments, emergency services and hospitals, etc.



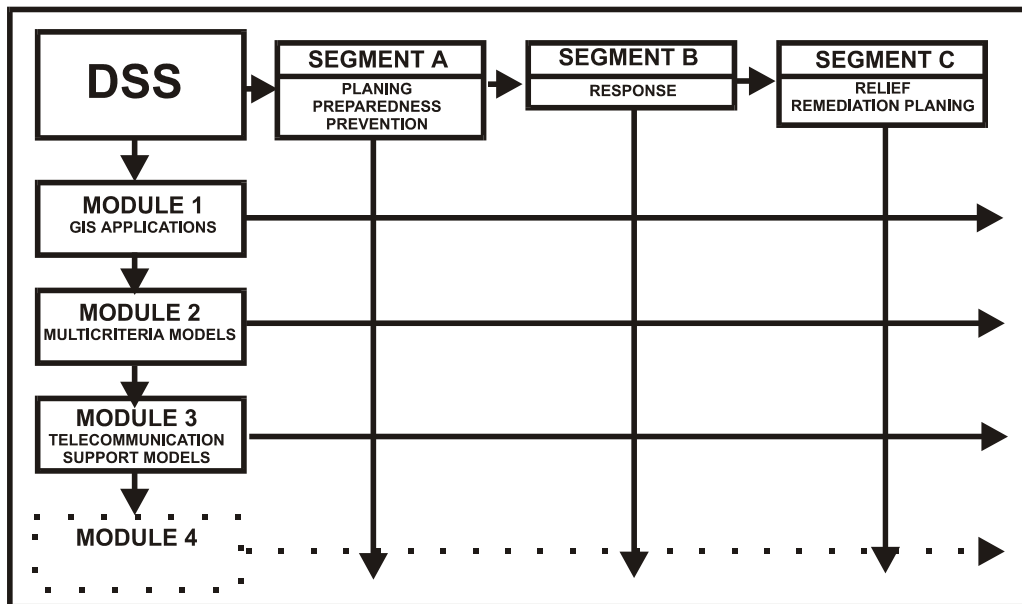
Figure 2: Location of «Regional Centre for Assistance and Disaster Relief – Divulje» in Southeast Europe



Figure 3 shows conceptual scheme of DSS for County level, namely DSS that support functions of “Regional Centre for Assistance and Disaster Relief”, that are focused on support to the activities connected to:

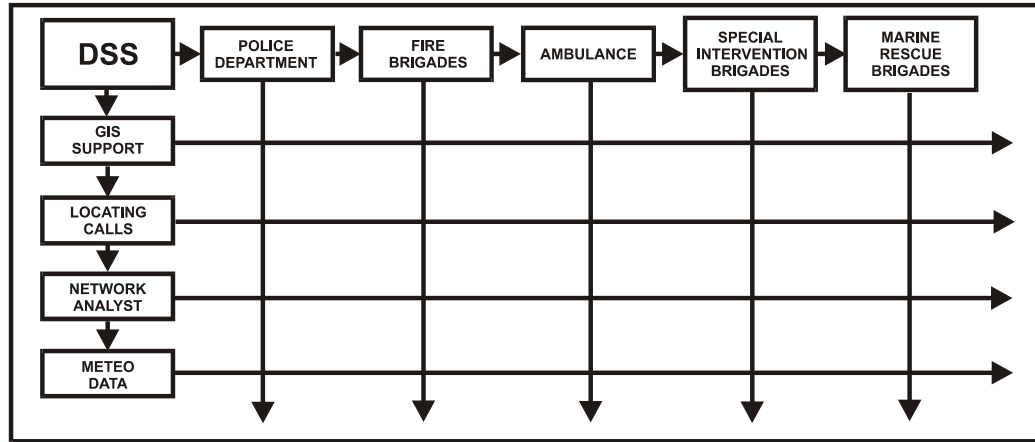
- Segment A: planning, preparedness and prevention;
- Segment B: response;
- Segment C: relief and remediation planing.

Figure 3: Conceptual framework for DSS development for County level (strategic level)



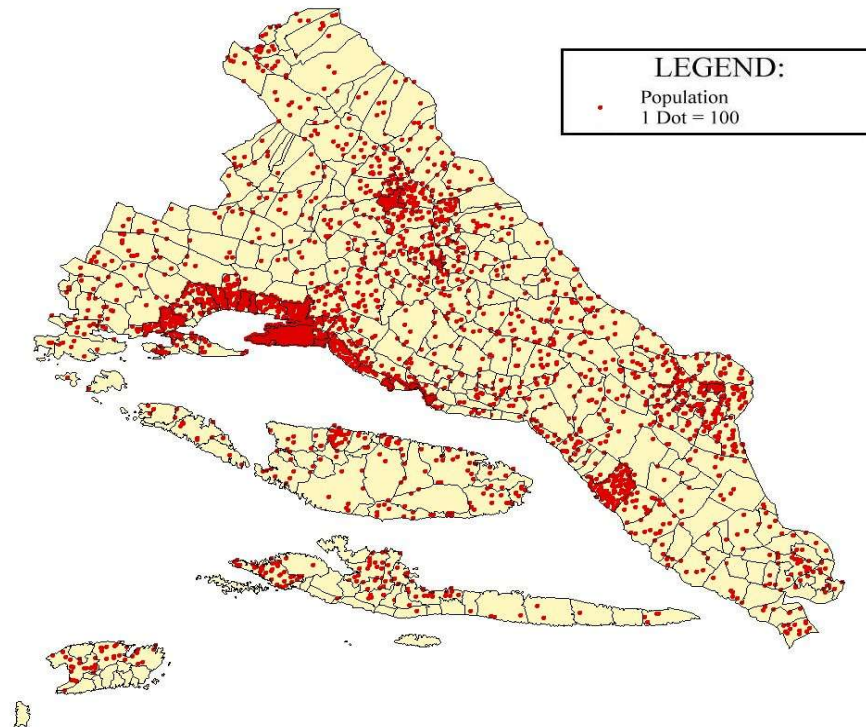
For "Centre 112" level conceptual scheme of DSS is different, because this level supports activities of particular services (police, fire brigades, ambulance, etc.) as can be seen on Figure 4.

Figure 4: Conceptual framework for DSS development for "Enhanced Emergency Call Services (Centre 112)" level



In order to determine the number and exact locations of Centres 112 within the county, data about population density (Figure 5), as well as statistical data about average number of tourists situated in the certain locations during the summer were used. Data were provided by the GIS module.

Figure 5: Layout of residence density



Furthermore, the GIS module provides data about route networks, and in the combination with "Network analyst" module determines the fastest approach route to the emergency location from the nearest fire and ambulance stations (Figure 6).



Figure 6: GIS support for locating emergency call and definition of intervention routes



If a call comes from fixed landline network the Centre 112 locates emergency place (yellow point) on the existing digitalised map of the town (scale 1:5000) using MSAGA (Master Street Address Guide). Dispatcher in the Centre chooses nearest police station (policeman symbol) and by “Network” software and option «Find best route» defines fastest and the most convenient route to the emergency point. The same procedure is being performed for the fire brigades and ambulance cars (H symbol). GIS contains thematic layers with positions of hydrant valves, so the fire brigade can be supported with information about the best valves regarding the water pressure.

If the call comes from the mobile network, namely a cell phone, "Locating calls" module estimate the location of the call using procedures that are implemented within GSM stations. Higher density of GSM base stations enables more precise call location. Report of CGALIES (Co-ordination Group on Access to Location for Emergency Services) (3) project states that possible precision that in urban areas is 25 – 150 meters, and in sub-urban areas is 100 – 500 meters, and on the highways and waterways is 100 – 500 meters.

The DSS module named "Meteo-data" ensures data that describe weather conditions, as well as weather forecast for further 12 or 24 hours. These data are very important for SAR brigades both on the land and sea, and for fire brigades because technique and tactics for intervention are closely connected with meteorological data. The conceptualised framework for DSS development of “Enhanced Emergency Call Services (Centre 112)” level can be enlarged with other modules that support Emergency Services functions. On-line communication of DSS at operational level with the DSS at county level, namely “Regional Centre for Assistance and Disaster Relief” is very important, because in the case of big emergencies DSS at county level has to co-ordinate activities of all Emergency Call Services in the County.

Conclusion

The affiliation of Croatia in the European system PSABA and establishment of Emergency call Centres 112 initiated conceptualisation of DSS for Enhanced Emergency Call Services at the operative level. Furthermore, at the county level (strategic level) DSS that integrates work of all Emergency Call Services in the County is conceptualised, as well. Achieving synergetic effect from hierarchic structure of proposed DSS is possible by intensive application of GIS support, telecommunication support and, generally, information technology.

An ever increasing frequency of catastrophes and natural disasters with ever more serious consequences demands ever more serious preparations and joining of knowledge, information and available resources for an adequate response. This was the reason for establishing the "Regional Centre for Assistance and Disaster Relief" in Divulje near Split (Croatia) in Southeast Europe, on the coast of the Adriatic Sea. One of the main objective of Regional Centre is to improve application of system approach, especially the DSS, as well as co-operation in the field of planning, preparation, prevention, fast acting and mitigation of catastrophes, natural disasters and various kinds of accident situations on the regional level.

Author Biographies

Nenad Mladineo is Senior Lecturer at the Faculty of Civil Engineering, University of Split. He received his Ms.Sc. in application of Decision Making from University of Zagreb. His current research interests are in application of decision making process, GIS tools, organisational science and, especially, decision support systems in various engineering fields.

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Ranko Britvic finished Faculty of Law and was Deputy Head of Police Administration of Spit-Dalmatia County. Now he is Head of "Regional Centre for Assistance and Disaster Relief" in Divulje near Split (Croatia).

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