Chapter IX
Context-Based Intelligent Service for Healthcare Applications

Alexander Smirnov
St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, Russia

Tatiana Levashova
St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, Russia

Nikolai Shilov
St.Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, Russia

ABSTRACT

The chapter presents an approach to implementation of an intelligent service for decision support in healthcare logistics taking an advantage of the knowledge logistics idea. The approach is based on synergistic integration of knowledge acquired from distributed sources in order to obtain new or complement insufficient knowledge. The approach is based on the methodology that assumes three levels of information integration. The application domain is described via an application ontology using the formalism of object-oriented constraint networks. The problem is represented by an abstract context that is obtained as a result of the slicing operation on the application ontology. Finally, filling the abstract context with up-to-date information about the current situation produces an operational context. Contexts of both types share the same knowledge representation formalism that is used by the application ontology. As a result the operational context can be considered as a constraint satisfaction problem. Solving this task produces feasible decisions in the current situation.

INTRODUCTION

The practice shows that one of the most difficult steps is getting the right relief supplies to the people in need at the right time. At the same time delivering too much supplies or wrong supplies means losing time and money. Therefore, humanitarian logistics standing for *processes and systems involved in mobilizing people, resources, skills and knowledge to help vulnerable people affected by natural disasters and complex emergencies*, is central for disaster response (Scott and Rogova, 2004). This fact motivated the choice of the case study for implementation of the presented here approach. In this chapter the healthcare logistics related tasks are considered as a part of humanitarian logistics.

Very often, local organizations involved in disaster response where healthcare logistics plays one of the most important roles do not have resources to respond effectively to a disaster. It is therefore important to determine what resources an organization has (or is lacking), and what is required for response operations to be carried out effectively. Given actualized information available for logistical planning and preparations, this will make it easier to determine which resources are available – and which are lacking and must be produced elsewhere. Such operations take place in rapidly changing content of network-centric environment. Due to increasing complexity of decision making and wide acceptance of information technologies, the computational intelligence is currently highly demanded in the area of disaster response operations.

Disaster response operations include but not limited to: emergency preparedness and response (to terrorism attacks / incidents, catastrophic events, natural disasters, emergency situations, etc.), etc. The operations exploit information and network technologies to integrate widely dispersed human *decision-makers*, networking *sensors*, and *resources* into a highly adaptive, comprehensive *network-centric environment* to achieve shared *situation* awareness and *unprecedented mission* effectiveness by efficient linking *knowledgeable components* in the environment.

Research efforts focusing on decision support in emergency situations try to analyze possible successions of events or consequences of undertaken actions. For that, methods for situation assessment and prediction are applied (e.g., Intille and Bobick, 1999; Glinton et al., 2005; Rogova et al., 2005). So far, the scope of situation assessment and prediction has gone beyond the research considered in the chapter.

To manage any coalition operation an efficient intelligent support of knowledge sharing between multiple participating parties is required (Pechoucek et al., 2004). This knowledge must be pertinent, clear, and correct, and it must be timely processed and delivered to appropriate locations, so that it could provide for situation awareness. This is even more important when disaster response operation involves coalitions uniting resources of both government (military, security service, community service, etc) and non-government organizations.

Growing importance of intelligent support causes a need for acquisition, integration, and transfer of the right knowledge from distributed sources located in information environment. This knowledge is to be delivered in the right context to the right person, in the right time for the right purpose. These activities called knowledge logistics (KL) are required for global awareness, dynamic planning and global information exchange in the network centric environment.

Here described approach considers the KL problem as a problem of a knowledge source network configuration. Since KL assumes dealing with knowledge contained in distributed and heterogeneous knowledge sources, the approach is oriented to ontological model as a common way of knowledge representation (e.g. Ko et al., 2007). It proposes ontology-driven methodology for knowledge source network configuration. The developed approach proposes usage of (i) ontolo-