Creating Order from Chaos: Application of the Intelligence Continuum for Emergency and Disaster Scenarios

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INTRODUCTION

Recently, the world has witnessed several large scale natural disasters: the Tsunami that devastated many of the countries around the rim of the Indian Ocean in December 2004, extensive flooding in many parts of Europe in August 2005, hurricane Katrina in September 2005, the outbreak of Severe Acute Respiratory Syndrome (SARS) in many regions of Asia and Canada in 2003, and the earthquake disaster in Pakistan towards the end of 2005 . These emergency and disaster situations (E&DS) serve to underscore the utter chaos that ensues in the aftermath of such events, the many casualties and loss of life, not to mention the devastation and destruction that is left behind. One recurring theme that is apparent in all these situations is that irrespective of the warnings of the imminent threats, countries have not been prepared and ready to exhibit effective and efficient crisis management. This paper examines the application of the tools, techniques, and processes of the knowledge economy to develop a prescriptive model that will support superior decision making in E&DS and thereby enable effective and efficient crisis management.

BACKGROUND

Changing weather patterns, rapid urbanization, expansion of industry, not to mention development of air and ground transportation networks, population growth and migration, and recently – acts of terrorism , are associated with ever increasing frequency of major disasters involving multiple casualties (von Lubitz, Carrasco, Fausone, Gabbrielli, Kirk, Lary, and Levine, 2005). Emergency Healthcare management is a complex process which has to be tackled on various fronts (Beltrame, Maryni and Orsi, 1998; Kun and Bray, 2002). Such situations require effective crisis management capability, that is, pre-hospital and emergency/trauma, in-hospital medical services, firefighting, disaster-related law enforcement operations, and so forth, and superior decision making capabilities (von Lubitz, et al., 2005; von Lubitz and Wickramasinghe, 2005a; 2005b). Most of these services are governed by different local or national agencies, are subject to different rules and regulations, and develop independent operational plans. This in turn leads to the gathering and storing of data in disparate databases. However, given the interdependent nature of these elements, any decision making based on only one or a few of these data elements will logically provide only a partial picture and, thus, an inferior decision. Hence, it is necessary to collect multi-spectral data, analyze this data in aggregate to develop a complete picture if we are to truly support superior decisions. To do this effectively and efficiently, it is imperative to embrace the tools, techniques and processes of the knowledge economy (Liebowittz, 1999; Maier and Lehner, 2000; Shapiro and Verian, 1999; von Lubitz and Wickramasinghe, 2005b; Wickramasinghe, 2005; Wilcox, 1997; Zack, 1999). Advances in IT, coupled with the advent of Knowledge Management (KM), can facilitate better processes for efficient and effective healthcare (Dwivedi, Bali, James, Naguib, and Johnston; 2002).

MAIN FOCUS

The Intelligence Continuum consists of a collection of key tools, techniques, and processes of the knowledge economy; that is, including data mining, business intelligence/analytics and knowledge management which are applied to a generic system of people, process and technology in a systematic and ordered fashion (Wickramasinghe and Schaffer, 2005). Taken together, they represent a very powerful instrument for refining the data raw material stored in data marts and/or data warehouses and thereby maximizing the value and utility of these data assets. As depicted in Figure 1, the intelligence continuum is applied to the output of the generic information system. Once applied, the results become part of the data set that are reintroduced into the system and combined with the other inputs of people, processes, and technology to develop an improvement continuum. Thus, the intelligence continuum includes the generation of data, the analysis of these data to provide a "diagnosis," and the reintroduction into the cycle as a "prescriptive" solution. In this way, continuous learning is invoked and the future state always builds on the lessons of the current state.

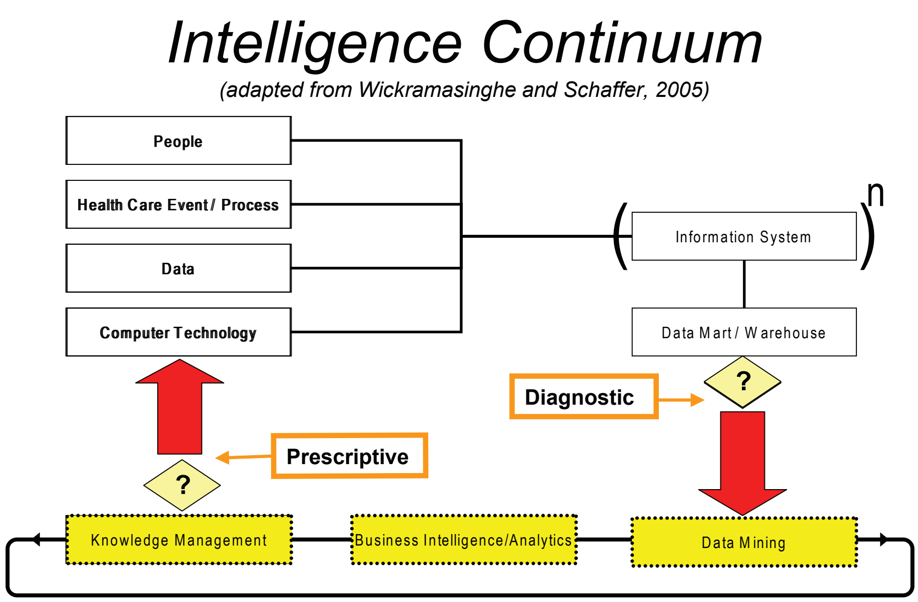
The key capabilities and power of the model are in analyzing large volumes of disparate, multi-spectral data so that superior decision making can ensue. This is achieved through the incorporation of the various intelligence tools and techniques which taken together make it possible to analyze all data elements in aggregate. Currently, most analysis of data is applied to single data sets and uses at most two of these techniques (Newell, Robertson, Scarbrough, and Swan, 2002; Nonaka, 1994; Nonaka and Nishiguchi, 2001; Schultze and Leidner, 2002; von Lubitz and Wickramasinghe, 2005b; Wickramasinghe, 2005; Wickramasinghe and Schaffer, 2005). Thus, there is neither the power nor the capabilities to analyze large volumes of multi-spectral data (ibid.). Moreover, the interaction with domain experts is typically non-existent in current methods. The benefits of applying the capabilities of the intelligence continuum to E&DS scenarios are profound indeed. E&DS scenarios are concomitant with complex, unstable, and unpredictable environments where the unknown or position of information inferiority prevails. Hence, these scenarios are chaotic and sub-optimal decision making typical results. In contrast, the tools and techniques of the intelligence continuum can serve to transform the situation of information inferiority to one of information superiority in real time through the effective and efficient processing of disparate, diverse, and seemingly unrelated data. This enables decision makers to make superior decisions which in turn lessen the chaos and facilitates the restoring of order. In order to appreciate the power of the intelligence continuum in such scenarios, it is necessary to briefly describe its key elements.

Data Mining

Due to the immense size of the data sets, computerized techniques are essential to help decision makers understand relationships and associations between data elements. Data mining is closely associated with databases and shares some common ground with statistics since both strive toward discovering structure in data. However, while statistical analysis starts with some kind of hypothesis about the data, data mining does not. Furthermore, data mining is much more suited to deal with heterogeneous databases, data sets, and data fields, which are typical of data in E&DS that contain numerous types of text and graphical data sets. Data mining also draws heavily from many other disciplines, most notably, machine learning, artificial intelligence, and database technology.

From a micro perspective, data mining is a vital step in the broader context of the knowledge discovery in databases (KDD) that transforms data into knowledge by identifying valid, novel, potentially useful, and ultimately understand-

Figure 1



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